ACOUSTICS 2012 FREMANTLE

ACOUSTICS, DEVELOPMENT, AND THE ENVIRONMENT

NOVEMBER 21 - 23, 2012

The 2012 Conference of the Australian Acoustical Society

Program and Book of Abstracts

Esplanade Hotel
Fremantle
Western Australia

Australian Acoustical Society
Western Australian Division

A.B.N. 28 000 712 658

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Summary program

Thursday 22nd November 2012, Esplanade Hotel, Fremantle

Time	Room A: Sirius Ballroom	Room B: King Sound / Admiralty Gulf	Room C: Garden / Carnac	Room D: Rottnest
0800-0830	Conference Registration (Foyer)			
0830-0850	**Conference opening:** ***Minister for the Environment, Hon Bill Marmion, MLA***			
0850-0930	S01: **Plenary 1 – Noise and Health** ***Irene Van Kamp***			
0935-1035	S02A: **Underwater acoustic modelling and measurement 1** *Katsnelson Keynote*	S02B: **Vibration 1**	S02C: **Architectural acoustics 1**	S02D: **Occupational noise and vibration 1**
1035-1100	**Morning Tea** (Exhibition area)			
1100-1240	S03A: **Underwater acoustic modelling and measurement 2**	S03B: **Noise control 1** *Fuller Keynote*	S03C: **Signal processing & measurement**	S03D (1120-1240**): Occupational noise and vibration 2**
1240-1340	**Lunch** (Exhibition area)			
1340-1520	S04A: **Array processing**	S04B: **Road and rail traffic noise**	S04C: **Architectural acoustics 2** *Charlton Keynote*	S04D: **Marine environmental and bioacoustics 1** *Cato Keynote*
1520-1550	**Afternoon Tea** (Exhibition area)			
1550-1730	S05A: 1550-1640: *Discussion forum:* **Underwater Hearing Impacts** Chair: Darlene Ketten 1640 - 1730: *Discussion forum:* **Australian Standards and the Australian Acoustical Society** Chair: Marion Burgess	S05B: **Sonar performance and propagation effects**	S05C: **Physiological, psychological and musical acoustics**	S05D: **Vibration 2**

1730-1800	**Australian Acoustical Society AGM**			
1900-2300	**Conference Banquet** (Fremantle Sailing Club)			

Friday 23rd November 2012, Esplanade Hotel, Fremantle

Time	**Room A: Sirius Ballroom**	**Room B: King Sound / Admiralty Gulf**	**Room C: Garden / Carnac**	**Room D: Rottnest**
0845-1025	S06A: **Underwater communications**	S06B: **Industrial noise and modelling**	S06C: **Marine environmental and bioacoustics 2**	S06D: **Vibration 3**
1025-1055	**Morning Tea** (Exhibition area)			
1055-1155	S07A: **Sonar signal processing**	S07B: **Urban noise**	S07C: **Marine environmental and bioacoustics 3**	S07D: *Discussion forum:* **Aircraft noise** Chair: Colin Tickell
1200-1240	S08: **Plenary 2 – Geoacoustic perspectives,** ***Ross Chapman***			
1240-1340	**Lunch** (Exhibition area)			
1340-1520	S09A: **Underwater acoustic modelling and measurement 3**	S09B: **Wind farm noise 1**	S09C: **Acoustic characterisation of marine habitat**	S09D: **Vibration 4**
1520-1550	**Afternoon Tea** (Exhibition area)			
1550-1650	S10A: **Underwater acoustic modelling and measurement 4**	S10B: *Discussion forum :* **Wind farm noise** Chair: John Macpherson	S10C: **Marine environmental and bioacoustics 4**	S10D: **Noise control 2**
1650-1700	**Conference close**			

Full Program

S01 Plenary 1, Noise and health, Irene Van Kamp

Thursday 0850-0930, Room A

Chair: John Macpherson

08:50 Noise and health, cardiovascular risk and susceptible groups
Van Kamp, Irene; Davies, Hugh

S02A Underwater acoustic modelling and measurement 1

Thursday 0935-1035, Room A

Chair: Alexander Gavrilov

09:35 Spatial and temporal variability of sound signals in shallow water with parameters varying in the horizontal plane
Katsnelson, Boris

09:55 Toward a simple model for peak pressure of underwater signals from offshore impact pile driving
Hall, Marshall

10:15 Assessing the environmental impact of underwater noise during offshore windfarm construction and operation
Nedwell, J; Mason, T; Barham, R; Cheesman, S

S02B Vibration 1

Thursday 0935-1035, Room B

Chair: Nicole Kessissoglou

09:35 Assessment of masonry bell tower response to bell ringing using operational modal analysis and numerical modelling
Brown, Steve; Hwang, Joon-Pil; Parker, Andrew

09:55 Voltage and vibration fluctuations in power transformers
Wang, Yuxing; Pan, Jie

10:15 Control of variable frequency vibration in large span composite construction floor in a high rise building
Marks, Tim; Koss, Len; Plum, Michael

S02C Architectural acoustics 1

Thursday 0935-1035, Room C

Chair: Kingsley Hearne

09:35 Aural Representations of Room Tones in Architectural Space
Tout, Errol Harold

09:55 Variations in acoustical parameters in oral-binaural room impulse responses of a real and a computer-modelled room
Yadav, Manuj; Miranda, Luis; Cabrera, Densil; Martens, William

10:15 Spatial analysis of acoustic support on auditorium stages: modelling and measurement using high-order transducers
Cabrera, Densil; Miranda, Luis; Jin, Craig; Epain, Nicholas

S02D Occupational noise and vibration 1

Thursday 0935-1035, Room D

Chair: Pam Gunn

09:35 Occupational Noise Surveys – Making a Difference
McLoughlin, Jim

09:55 20 years of using the Noise Exposure Indicator and new strategies in effective occupational noise management
Tickell, Colin

10:15 Assessing the most effective and efficient solutions for noise control in a complex workplace
Pamley, Richard John

S03A Underwater acoustic modelling and measurement 2

Thursday 1100-1240, Room A

Chair: Alexander Gavrilov

11:00 Comparison of a Small Slope Approximation Model of Reflection Loss at the Rough Ocean Surface with Stochastic Modelling using PE
Jones, Adrian; Maggi, Amos; Bartel, David; Duncan, Alec; Zinoviev, Alex

11:20 Modelling sound propagation under ice using the Ocean Acoustics Library's Acoustic Toolbox
Alexander, Polly; Duncan, Alec; Bose, Neil

11:40 The loss mechanisms of plane-wave reflection from the seafloor with elastic characteristics
Li, Binghui; Hall, Marshall

12:00 An Investigation of Plane Wave Propagation through a Layer with High Sound Speed Gradient
Zinoviev, Alex; Bartel, David; Jones, Adrian

12:20 Low frequency acoustic propagation over calcarenite seabeds with thin, hard caps
Duncan, Alec; Gavrilov, Alexander

S03B Noise control 1

Thursday 1100-1240, Room B

Chair: Jie Pan

11:00 Active-passive control of portable generator set radiated noise
Fuller, Chris; Papenfuss, Cory; Saux, Tom

11:20 Development of an Adaptive Quarter-Wave Tube Attached to a Large Diesel Engine
Craig, Richard; Howard, Carl

11:40 Variation in Acoustic Performance of an Adaptive Quarter Wave Tube with Orifice Geometries of Side-Branches in a Duct with Flowing Gas
Howard, Carl; Craig, Richard

12:00 Leading Element Dichotomous Coordinate Descent Exponential Recursive Least Squares Algorithm for Multichannel Active Noise Control
Felix Albu,

12:20 Active control of propagated noise in a duct by using Matlab simulation and adaptive filtering
Forouharmajd, Farhad; Masoumeh, Ahmadvand; Hadian, Mohammad

S03C Signal processing and measurement 1

Thursday 1100-1240, Room C

Chair: Jim MacLoughlin

11:00 Sound Intensity Measurements for Ranking Noise Transmission Through Building Envelope Elements
Taylor, Jeremy

11:20 Sound absorption coefficient measurement: Re-examining the relationship between impedance tube and reverberant room methods
McGrory, Mathew; Castro Cirac, Daniel; Gaussen, Olivier; Cabrera, Densil

11:40 Frequency Shifting Listening Device
Wong, Wei Shern; Cheng, Nicholad Peng-Hao; Cazzolato, Benjamin; Prime, Zebb; Hewett, Keith

12:00 A system for providing audible separation of mixed sound sources
Bullen, Robert; Erlach, Bjoern; Abel, Jonathan

12:20 Unattended noise monitoring: how to to fulfill IEC 61672 sound level meter standard for 0 degree and 90 degree reference directions with the same device
Pischedda, Patrice; Aflalo, Erik

S03D Occupational noise and vibration 2

Thursday 1120-1240, Room D

Chair: Marion Burgess

11:20 Which is Safer – Tonal or Broadband Reversing Alarms?
Popoff-Asotoff, Peter; Holgate, Jonathan; Macpherson, John

11:40 The effects of the mechanical properties on the attenuation of earmuffs
Williams, Warwick

12:00 Noise and vibration training and its practical connection with real life practice in today's world
Groothoff, Beno

12:20 Overview of the occupational exposure limits for hand-arm and whole-body vibration
Burgess, Marion; Foster, Gary

S04A Array processing

Thursday 1340-1520, Room A

Chair: Alec Duncan

13:40 Estimation of steering vector errors for adaptive beamforming
Bao, Chaoying; Bertilone, Derek

14:00 On Robustness of Constrained Least Mean Square Beamformer
Meegan, Isaac; Bao, Chaoying; Pan, Jie

14:20 Source localization with orthogonal horizontal arrays in shallow water
Su, Lin; Guo, Shengming; Lu, Licheng; Ma, Li; Zhang, Chunhua

14:40 Performance analysis of virtual array processing for source ranging using different frequency bands
Yao, Meijuan; Lu, Licheng; Guo, Shengming; Ma, Li

15:00 Passive Measurement of Vertical Transfer Function in Ocean Waveguide using Ambient Noise
Xinyi, Guo; Fan, Li; Li, Ma; Geng, Chen

S04B Road and rail traffic noise

Thursday 1340-1520, Room B

Chair: Rob Bullen

13:40 Wayside horn noise investigation
Moore, Simon

14:00 Further Investigations of Low-frequency Noise Problem Generated by Freight Trains
Guo, Jingnan; Macpherson, John; Popoff-Asotoff, Peter

14:20 Is the 2.5 dB(A) Façade Correction for Road Traffic Noise Correct?
Mortimer, J; Kean, S; White, T

14:40 Inland tsunami destroys Grantham
Hall, Arthur; Grant, Robert

15:00 Transport Infrastructure Noise: Beyond 2050
Burgemeister, Kym; Johnson, Bruce

S04C Architectural acoustics 2

Thursday 1340-1520, Room C

Chair: Rebecca Ireland

13:40 Acoustics and the Engineering Team
Charlton, Emma

14:00 Notes on the acoustical design of animal holding rooms within medical research facilities
Zoontjens, Luke

14:20 A cost benefit analysis of providing a 'sound' environment in educational facilities
James, Deb; Stead, Matthew; Clifton-Brown, David; Scott, David

14:40 Room acoustic design to improve speech privacy in passenger cars of high-speed trains
Jeon, Jin Yong; Jang, Hyung Suk

15:00 Investigation into the airborne flanking sound transmission paths of wastewater pipes and acoustic lagging
Tommasini, Paolo; Tardio, Darren

S04D Marine environmental and bioacoustics 1

Thursday 1340-1520, Room D

Chair: Chandra Salgado-Kent

13:40 Project BRAHSS: Behavioural Response of Australian Humpback whales to Seismic Surveys
Cato, Douglas; Noad, Michael; Dunlop, Rebecca; McCauley, Robert; Gales, Nicholas

14:00 Investigation of the noise exposure on marine organisms from fisheries acoustic instruments
Kloser, Rudy

14:20 Measurement of long-term ambient noise and tidal turbine levels in the Bay of Fundy
Martin, Bruce; Whitt, Christopher; McPherson, Craig; Gerber, Andrea; Scotney, Murray

14:40 Model based sound level estimation and in-field adjustment for real-time mitigation of behavioural impacts from a seismic survey and post-event evaluation of sound exposure for individual whales
Racca, Roberto; Rutenko, Alexander; Bröker, Koen; Gailey, Glenn

15:00 A case study on the effects of underwater noise during the construction of large offshore wind farms
Mason, Tim; Barham, Richard; Nedwell, Jeremy

S05A Discussion forums

Thursday 1550-1730, Room A

Chair: Darlene Ketten - Marion Burgess

15:50 Underwater Hearing Impacts: What do we know? What do we need to know? How do we find out?
Ketten, Darlene

16:40 Australian Standards - Current situation and role for Australian Acoustical Society
Burgess, Marion

S05B Sonar performance and propagation effects

Thursday 1550-1730, Room B

Chair: Alec Duncan

15:50 Multi faceted advances in underwater operational sonar prediction systems
Sendt, Janice

16:10 Comparison of the physical acoustic channel response of a line array of thin rectangular bars to an equivalent model of thin vibrating rectangular pistons
Chambers, Shane; James, Ralph; Duncan, Alec

16:30 Acoustic Emission of Bubbly Flow and Its Size Distribution Spectrum
Chen, Li; Wood, Shane; Moore, Stephen; Nguyen, Binh

16:50 Acoustic travel-time perturbations due to shallow-water internal waves in the Yellow Sea
Fan, Li; Xinyi, Guo; Tao, Hu; Li, Ma; Yaoming, Chen

17:10 Acoustic Model of the Remnant Bubble Cloud from Underwater Explosion
Kouzoubov, Alexei; Castano, John; Godoy, Carlos; Hyman, Mark

S05C Physiological, psychological and musical acoustics

Thursday 1550-1730, Room C

Chair: Jie Pan

15:50 Hearing, the perception of sound and expert evidence in litigation
Woolford, Donald Henry; Alais, David; Best, Virginia; Semmler, Carolyn; Niall, Paul

16:10 Low frequency response of the vocal tract: acoustic and mechanical resonances and their losses
Hanna, Noel; Smith, John; Wolfe, Joe

16:30 Finite element modeling of brass musical instruments
Rose, Nicholas; Holloway, Damien

16:50 Stable, quantised pitch in singing and instrumental music: signals, acoustics and possible origins
Wolfe, Joe; Schubert, Emery

S05D Vibration 2

Thursday 1550-1730, Room D

Chair: Gareth Forbes

15:50 Boundary control of vibration in coupled nonlinear three dimensional marine risers
Nguyen, T.L.; Do, K.D.; Pan, Jie

16:10 An experimental study of flow induced vibration of a flexible model riser
Lu, Ji; Do, Duc; Pan, Jie

16:30 Investigation into the Dynamic Effects of Lateral Buckling of High Temperature / High Pressure Offshore Pipelines
Reda, Ahmed; Forbes, Gareth

16:50 Transmission of vibration of a power transformer from the internal structures to the tank
Jin, Ming; Pan, Jie; Huang, Hai; Zhou, Jianping

17:10 Vibration control of pedestrian bridges
Marks, Tim

S06A Underwater communications

Friday 0845-1025, Room A

Chair: Alessandro Ghiotto

08:45 Measurements of Doppler and delay spreading of communication signals in medium depth and shallow underwater acoustic channels
Caley, Michael; Duncan, Alec; Ghiotto, Alessandro

09:05 Experiments on Underwater Acoustic Communications Using Turbo-Encoded Sweep-Spread Signals
Kebkal, Veronika; Kebkal, Anzhelika; Kebkal, Konstantin; Kebkal, Oleksiy

09:25 Reliability in Underwater Acoustic Networks
Ghiotto, Alessandro; Andronis, Nick; Dragojevic, Michael

09:45 Voices from the deep – Acoustic communication with a submarine at the bottom of the Mariana Trench
Roberts, Paul; Andronis, Nick; Ghiotto, Alessandro

10:05 Practical issues of combined underwater acoustic communication and long-baseline positioning
Kebkal, Oleksiy; Kebkal, Konstantin

S06B Industrial noise and modelling

Friday 0845-1025, Room B

Chair: Larry Clark

08:45 Understanding variability in an ambient noise enviroment: implications for planning and mine noise management
Sparke, Clayton

09:05 The Harmonoise noise prediction algorithm: Validation and use under Australian conditions
Bullen, Robert

09:25 Environmental management of two industrial sites in NSW using Pollution Reduction Programs
Tickell, Colin; Zammit, Lawrence; Schianetz, Karin; Collings, Stephen

09:45 Assessment of Noise from CSG Pipeline Construction
Matthew Terlich,

10:05 Helicopter Noise Impacts on Hospital Development Design
James, Aaron; Zoontjens, Luke

S06C Marine environmental and bioacoustics 2

Friday 0845-1025, Room C

Chair: Chandra Salgado-Kent

08:45 Dhu they or don't they? A study of sound production by three fish species of commercial and recreational importance in Western Australia
Parsons, Miles; Lewis, Paul; Longbottom, Simon; McCauley, Robert; Fairclough, David

09:05 Passive acoustic detection of Shark Bay dugongs (Dugong dugon)
Parsons, Miles; Holley, David; McCauley, Robert

09:25 Acoustic modification of tilapia behaviour
McPherson, Geoff

09:45 Monitoring Ambient Noise from a European Perspective
Thomsen, Frank

10:05 Fish choruses from the Kimberley, seasonal and lunar links as determined by long term sea noise monitoring
McCauley, Robert

S06D Vibration 3

Friday 0845-1025, Room D

Chair: Bob Randall

08:45 Order-Tracking with and without a tacho signal for gear fault diagnostics
Coats, Michael; Randall, Robert

09:05 Correlation of pump efficiency and shaft torsional vibration using torsional laser vibrometry
Guzzomi, Andrew; Pan, Jie

09:25 A Study of Transformer Winding Vibration using a Laser Doppler Vibrometer
Zheng, Jing; Pan, Jie; Hai, Huang

09:45 Automated diagnosis of piston slap faults in internal combustion engines: based on a simulation model
Chen, Jian; Randall, Robert; Peeters, Bart; Van der Auweraer, Herma

10:05 Periodic stiffness of a cracked shaft
Wu, Helen

S07A Sonar signal processing

Friday 1055-1155, Room A

Chair: Darryl McMahon

10:55 Method for the Generation of Broadband Acoustic Signals
Swincer, Paul; Nguyen, Binh; Wood, Shane

11:15 Diver Detection and Localization Using Passive Sonar
Lo, Kam; Ferguson, Brian

11:35 Passive acoustic detection and tracking of targets in harbour environments using hydrophone arrays
Pusey, Grant Mark; Allen, John; Siderius, Martin

S07B Urban noise

Friday 1055-1155, Room B

Chair: Arthur Hall

10:55 Evaluating aural comfort in tropical high-rise environment
Alam, Sheikh Mahbub; Lee, Siew Eang

11:15 Evaluation of noise emissions from an evaporative air conditioning unit and their environmental impact
Hongmei, Sun; Fenton, Rhys; Popoff-Asotoff, Peter; Jingnan, Guo; Macpherson, John

11:35 Influence of upwind turbines on wind turbine sound power output
Cooper, Jon; Evans, Tom

S07C Marine environmental and bioacoustics 3

Friday 1055-1155, Room C

Chair: Miles Parsons

10:55 Real-time tracking of blue whales using DIFAR sonobuoys
Miller, Brian Seth

11:15 Clumped distribution of vocalising dugongs (Dugong dugon) monitored by passive acoustic and visual observations in Thai waters
Ichikawa, Kotaro; Akamatsu, Tomonari; Shinke, Tomio; Arai, Nobuaki; Adulyanukosol, Kanjana

11:35 Passive acoustic monitoring of baleen whales in Geographe Bay, Western Australia
Salgado Kent, Chandra; Gavrilov, Alexander; Recalde-Salas, A; Burton, C; McCauley, Robert

S07D Discussion forum

Friday 1055-1155, Room D

Chair: Colin Tickell

10:55 Aircraft noise discussion forum – Scope for revision of AS2012:2000?
Tickell, Colin

S08 Plenary 2 - Geoacoustic perspectives, Ross Chapman

Friday 1200-1240, Room A

Chair: Alexander Gavrilov

12:00 Geoacoustic perspectives: what have we learned about modelling sound propagation in the ocean bottom
Chapman, Ross

S09A Underwater acoustic modelling and measurement 3

Friday 1340-1520, Room A

Chair: Alexander Gavrilov

13:40 FMBEM analysis of sound scattering from a damping plate in the near field of a hydrophone
Wilkes, Daniel; Alexander, Polly; Duncan, Alec

14:00 Sound radiation of a plate into a reverberant water tank
Pan, Jie

14:20 Recorded noise as a source for measurement of propagation loss
Tindle, Chris; Jeffs, Andrew; Ghazali, Shahriman; Radford, Craig

14:40 An Application of Range-Frequency Striations to Seafloor Inversion in Shallow Oceans
Jones, Adrian; Bartel, David; Clarke, Paul

15:00 Shallow Water Seafloor Inversion using Ship-generated Striation Patterns
Clarke, Paul; Jones, Adrian

S09B Wind farm noise 1

Friday 1340-1520, Room B

Chair: Peter Heinze

13:40 Influence of wind direction on noise emission and propagation from wind turbines
Evans, Tom; Cooper, Jon

14:00 Variations in sound pressure levels under random change of atmospheric conditions
Lenchine, Valeri

14:20 Wind farm noise – what is a reasonable limit in rural areas?
Hansen, Kristy Lee; Henrys, Nicholas; Hansen, Colin; Doolan, Con; Moreau, Danielle

14:40 A personal perspective on trends and changing emphasis in UK wind farm noise assessments
Simpson, Pete

15:00 Characterisation of noise in homes affected by wind turbine noise
Nobbs, Benjamin; Doolan, Con; Moreau, Danielle

S09C Acoustic characterisation of marine habitat

Friday 1340-1520, Room C

Chair: Iain Parnum

13:40 Can singing be used to predict critical habitats?
Rogers, Tracey; Ciaglia, Michaela; Klinck, Holger; Southwell, Colin

14:00 Seabed mapping of key ecological features of the Australian continental margin
Kloser, Rudy; Keith, Gordon

14:20 High-frequency seafloor acoustic backscatter from coastal marine habitats of Australia
Parnum, Iain; Gavrilov, Alexander

14:40 Topics In Acoustic Seabed Segmentation – Current Practice, Open Software, and Data Fusion
Hamilton, Les

15:00 Using multibeam echo-sounder backscatter to characterise the seafloor of Davis Harbour, Antarctica: preliminary results
Mair, Elizabeth; Parnum, Iain; Schut, Tom

S09D Vibration 4

Friday 1340-1520, Room D

Chair: Paul Dylejko

13:40 Optimisation of an Inertial Mechanism within a Uni-Axial Vibration Isolator to Suppress Internal Resonance
Dylejko, Paul

14:00 Structural responses of a fluid-loaded cylinder/plate structure using deterministic and statistical approaches
Wu, Hongjian; Nicole, Kessissoglou; Mace, Brian

14:20 Effect of Internal Mass Isolation on the Radiated Sound Power of a Submerged Hull
Peters, Herwig; Kinns, Roger; Kessissoglou, Nicole; Marburg, Steffen

14:40 Nonlinear Control of Propeller Induced Vibration
Liu, Wei; Pan, Jie

15:00 Effect of excitation loads on the low frequency structural responses of a submerged hull
Zhang, Cong; Kessissoglou, Nicole

S10A Underwater acoustic modelling and measurement 4

Friday 1550-1650, Room A

Chair: Rod Macleod

15:50 Suitability of PVDF films for use in pressure-gradient acoustic intensity vector probes
Killeen, Damien; Matthews, David; Munyard, Andrew

16:10 The effect of backing material on the sensitivity of PVDF hydrophones at high frequencies
Munyard, Andrew; Matthews, David; Killeen, Damien

16:30 Recent Advances in Fibre Optic Array Technologies
Foster, Scott; Tikhomirov, Alexei; Van Velzen, John; Harrison, Joanne

S10B Discussion forum

Friday 1550-1650, Room B

Chair: John Macpherson

15:50 Wind farms discussion forum – Where are we at?
Macpherson, John

S10C Marine environmental and bioacoustics 4

Friday 1550-1650, Room C

Chair: Miles Parsons

15:50 Clustering of snapping shrimp snaps on long time scales: a simulation study
Legg, Matthew; Chitre, Mandar

16:10 Underwater ambient noise of Fremantle inner harbour: dolphins, pile driving and traffic
Salgado Kent, Chandra; McCauley, Robert; Parnum, Iain; Gavrilov, Alexander

S10D Noise control 2

Friday 1550-1650, Room D

Chair: Andrew Guzzomi

15:50 On the sound produced by flow interaction with a wall mounted finite length cylinder
Moreau, Danielle; Doolan, Con

16:10 Prediction of noise from a wing-in-junction flow using computational fluid dynamics
Doolan, Con; Coombs, Jesse; Moreau, Danielle; Zander, Anthony; Brooks, Laura

16:30 Performance Analysis of the Wave Trapping Barrier
Yang, Cheng; Pan, Jie; Cheng, Li

Discussion forums

Underwater Hearing Impacts: What do we know? What do we need to know? How do we find out?
Thursday 3:50 pm – 4:20 pm within the Sirius Ballroom (Room A)
Chair: Darlene Ketten

While there are many lightless regions on Earth, none are soundless. From the deep ocean to fresh water rivers and estuaries, perception and analysis of sound are critical for survival. Our increasing use of the ocean raises concerns about anthropogenic noise corrupting oceanic soundscapes and physically impacting species within our "acoustic reach", but because species and individuals vary substantially in their ability to perceive and analyse sounds, each can have a different susceptibility to noise impacts. Thus, no single "sound byte" is universally safe or hazardous for all species. The key is to understand the critical interplay of how anthropogenic sounds interact with hearing in the real world, in a range of soundscapes, with mobile animals, and with the range of ear conditions present in wild populations. In a sense, we are faced with trying to determine how the industrial noise that we are contributing to the oceans through exploration, shipping, transport, recreation, defence, and construction must be mitigated or metered to avoid serious harm, just as we concern ourselves with workplace exposures. The first step is to determine what critical and representative species hear and how susceptible they are to hearing loss and related stress and disruption of significant behaviours. This special session will review what we know about "ear health", and what we still need to learn. Representatives from various stakeholders in the marine environment are invited to discuss their needs, their hopes, their concerns.

Australian Standards - Current situation and role for Australian Acoustical Society
Thursday 4:20 pm – 5:30 pm within the Sirius Ballroom (Room A)
Chair: Marion Burgess

Australian and International Standards provide the basis for measurement and assessment over the wide field of acoustics ranging from performance of building materials, environmental and occupational noise assessments, aircraft noise, noise in buildings and in the marine environment, instrumentation etc . Over the years the operating model for Standards Australia has changed - as has the capacity for those working in the subject areas to contribute to the work of the committees. To commence this workshop Marion Burgess will give an example of the application of the current operating model by outlining the process that was necessary to get to the point of raising a project within Standards Australia for a straightforward direct text adoption of an ISO on Hand Arm Vibration. For any substantive work on any Australian Standards, it is important for the AAS to develop a plan that optimises and priorities efforts into the future. Just for example should AAS efforts be directed to update 2107 on noise levels inside buildings or to update of 2021 on aircraft? This discussion session will seek guidance on the role and the way ahead for AAS in regard to Standards Australia.

Aircraft noise discussion forum – Scope for revision of AS2012:2000?
Friday 10:55 am – 11:00 am within the Rottnest Room (Room D)
Chair: Colin Tickell

Following from the National Airports Safeguarding Framework (NASAG) report earlier this year, there has been a call for revision of AS2021:2000 Acoustics-Aircraft noise intrusion-Building siting and construction. AS2021 has been widely used in land use planning and building design around major airports, and uses as its basis the ANEF (Australian Noise Exposure Forecast) metric. The NASAG report (Guideline A) envisaged reference to 'a broader suite of assessment metrics' than ANEF for land use planning purposes. Any review of AS2021 is likely to begin with a scoping process for the review, and Acoustics 2012 is an opportunity to bring to the table the thoughts of many interested persons with expertise in aircraft noise. The forum will focus on identifying and discussing issues relevant to a review of AS2021, with the objective of providing feedback to Standards Australia to assist with the scoping process. Some of the questions may be:

- Does ANEF need to be revisited?
- Are there other metrics, e.g. N60, that should be considered for land use planning purposes?
- What metrics are appropriate for general aviation, military and regional airports?
- In what ways does AS2021 need updating generally, e.g. the table of aircraft noise levels?

Wind farms discussion forum – Where are we at?
Friday 3:50 pm – 4:50 pm within the King Sound / Admiralty Gulf Room (Room B)
Chair: John Macpherson

The Acoustics 2012 conference program contains 6 papers on noise from wind farms, indicating that this issue continues to present many challenges to the acoustics community. Discussion about possible health issues associated with low frequency noise and infrasound has spilled over into the political arena, with a Senate Inquiry and some interventions into noise policy for wind farm developments. Meanwhile there has been growth in the understanding of wind turbine noise generation and propagation, and in the methodologies for assessing wind farm noise against background noise. The workshop will draw together current thinking on issues such as the health effects of wind farm noise, assessment methodologies and approaches to setting noise criteria.

Contents for abstracts

S01 Plenary 1, Noise and health, Irene Van Kamp
Thursday 0850-0930, Room A

166 **Noise and health, cardiovascular risk and susceptible groups**

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(2) School of Population and Public Health, University of British Columbia, Canada.

ABSTRACT
Chronic exposure to noise in residential, work and some recreational situations can lead to a range of health effects. These are usually subdivided into well-being effects, such as annoyance and sleep disturbance, and clinical effects, such as hearing damage and cardiovascular diseases (CVD). The association between noise and CVD has been studied for several decades now and the weight of evidence clearly supports a causal link between the two. Nevertheless, many questions remain, such as the magnitude and threshold level of the adverse effects of noise, how noise and other pollutants (such as particulate matter) interact in disease causation, identifying vulnerable populations, and how epidemiologic study methodology can be improved. After a general introduction and a short description of potential mechanisms, this paper reviews the state of the art as described in literature over the past years in the area of noise and CVD with a focus on susceptible groups, and noise and air pollutants interaction and some attention for threshold levels.

S02A Underwater acoustic modelling and measurement 1
Thursday 0935-1035, Room A

112 **Spatial and temporal variability of sound signals in shallow water with parameters varying in the horizontal plane**

Katsnelson, Boris
School of Marine Sciences, University of Haifa, Israel

ABSTRACT
In the oceanic waveguide with parameters varying in horizontal plane (for example bathymetry - in area of coastal wedge, slopes and canyons, or in area of varying water layer - in the presence of nonlinear internal waves or temperature fronts, or in presence of both these effects) there is significant horizontal refraction or redistribution of the sound field in horizontal plane. Due to waveguide dispersion (dependence of modal propagation constants on frequency) it is possible to observe different spatial and temporal variations of the sound signal. It can be manifested in non stationary interference pattern, arrival time variations, variations of spectra etc. These effects can be used to solve different inverse problems especially by using horizontal and vertical line arrays.

62 **Toward a simple model for peak pressure of underwater signals from offshore impact pile driving**

Hall, Marshall
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ABSTRACT
A simple model is derived for the peak pressure of the underwater sound radiated when an offshore pipe pile is struck by a hammer. A pipe pile is modelled as a semi-infinite cylindrical shell of an elastic solid. Neglecting coupling between the axial and radial particle velocities results in the former being a solution of the wave equation. The impact generates a pulse of vibration that travels down the pile at the longitudinal sound-speed. At a given time after impact, the axial particle velocity increases exponentially as a function of axial distance, until the peak at a distance proportional to the time is reached. At a given distance, the axial velocity after the peak has arrived decreases exponentially with time. The radial velocity is estimated from the axial velocity using the definition of the Poisson ratio. The radiated sound pressure (which is proportional to the radial acceleration) is found to be proportional to the Poisson ratio and Young's Modulus of the solid, hammer velocity, contact area between hammer and pile, and square of the pile radius; and inversely proportional to the hammer's mass and the sound-speed along the pile. This model is applied to a published scenario for which the radiated sound pressure had been computed using a Finite Element Model. The simple model yields a sound pressure only one-tenth of that produced by the Finite Element Model. Some assumptions used in the model are identified that may explain the disparity.

116 **Assessing the environmental impact of underwater noise during offshore windfarm construction and operation**

Nedwell, J (1); Mason, T (1); Barham, R (1); Cheesman, S (1)
(1) Subacoustech Ltd

ABSTRACT
Offshore wind farms offer an important source of renewable energy worldwide. The noise created during their construction and operation, however, has the capacity to adversely affect the underwater environment. Consequently, a reliable, robust and accurate means of predicting and assessing the environmental effects of noise at an early stage is of key importance in providing an iterative process in the engineering towards an optimum design for the construction, which reduces environmental effects to a minimum or acceptable level while not unreasonably constraining the project or influencing its cost-benefit. It has been found that a key part of this process is to use appropriate and objective criteria for the principal effects of noise (hearing damage and avoidance), to estimate the degree of effect using these and a suitable predictive model, and to consider the biological consequences of this prediction with a view to determining if it is acceptable, and changing the engineering design if not. This paper investigates state of knowledge for assessment of underwater noise impacts on marine fauna and the ways this is used by offshore wind developers to minimise the risk to the environment.

S02B Vibration 1
Thursday 0935-1035, Room B

149 **Assessment of masonry bell tower response to bell ringing using operational modal analysis and numerical modelling**

Brown, Steve (1); Hwang, Joon-Pil (1); Parker, Andrew (1)
(1) Acoustics and Vibration, SLR Consulting Australia Pty Ltd, Sydney, Australia

ABSTRACT
The authors carried out an investigation into the dynamic response of a bell tower. The main focus of this study was to investigate the mechanism behind the perceived high vibration response during bell ringing as well as to provide an assessment of the severity of vibration response with respect to risk of

damage to the structure. A combination of operational modal analysis techniques (including a non-contact measurement option) and finite element modelling was used to analyse the dynamic response of the structure. This paper discusses the measurement and modelling techniques implemented in order to assess the effect of bell ringing to the tower structure as well as retrofit and monitoring strategies proposed in order to manage and monitor the motion of the tower for improved safety.

131 **Voltage and vibration fluctuations in power transformers**

Wang, Yuxing (1); Pan, Jie (1)
(1) School of Mechanical and Chemical Engineering, University of Western Australia, Crawley, WA 6009, Australia

ABSTRACT
A power transformer is designed to work within a range of steady-state voltages and to be capable of withstanding emergency voltages according to its design requirements. However, both voltage variations and changes in the transformer's structural properties are responsible for changes in transformer vibration. A separation of the sources of the changes in transformer vibration is necessary for extracting possible changes in the transformer's structure for condition monitoring purposes. Common sources of voltage variation, e.g., power source fluctuations and secondary loading operations, are investigated with a focus on their effects on transformer vibration. The effects of changes in the winding and core clamping pressures on transformer vibration are also investigated. Experimental results show a high correlation between voltage fluctuation and vibration changes without transformer structure anomalies. When the system's clamping force changed, the vibration difference becomes much larger than that induced by background voltage variations.

90 **Control of variable frequency vibration in large span composite construction floor in a high rise building**

Marks, Tim (1); Koss, Len (1); Plum, Michael (2)
(1) Marshall Day Acoustics, Melbourne, Australia
(2) Embelton, Melbourne, Australia

ABSTRACT
A new 31 storey commercial building was the subject of complaints regarding excessive floor vibration. There were some concerns regarding footfall induced floor vibration, but the majority of complaints came from the 19th floor, above the 18th floor plant room where a number of large, slow speed, vibration isolated, centrifugal fans were operated by variable speed drives (VSDs).
It was a simple matter to identify that the fans, when operating at 360rpm, generated significant energy that excited the floor directly above the plant room, whose first natural frequency was also identified at being around 6Hz.

Controlling and reducing the vibration was less straightforward. Due to their size, the fans could not be replaced. The greatest vibration occurred at the floor mid span and tuned mass vibration dampers (TMD's) were specified to reduce the floor response at 6Hz. Following the TMD design and installation, occupant complaints continued and it was established that the variable speed operation and the extreme occupant sensitivity at 6Hz resulted in annoyance even when the AS2670 threshold for offices was met by a factor of 10dB or more. The problem was eventually solved with a unique design of variable frequency tuned dampers conceptualized and specified by Marshall Day Acoustics (MDA) and designed and supplied by G.P. Embelton & Co. A total of 4 such dampers were successfully installed at strategic locations under the L-19 floor with very significant vibration reduction results.

S02C Architectural acoustics 1
Thursday 0935-1035, Room C

17 **Aural Representations of Room Tones in Architectural Space**

Tout, Errol Harold
Curtin University

ABSTRACT
Architecture is not only a visual and physical phenomenon but also an instrument that tempers and constructs our sound perceptions of the world. My recently completed PhD contains a number of projects drawing attention to the significance of what I have termed 'aural representation' as being a contribution in forming an understanding of a work of architecture and how architectural space conditions not only how we see the world but also how we hear it.

My PhD asked the question 'Can sound be used to tell audience things about space that, perhaps, images cannot?' The findings from this question interact with, and extend, an internationally recognised body of scholarly work. The PhD projects led to a final project involving a substantive body of creative work to help to make the knowledge gained in the PhD more explicit.

This paper will present composed music, 'aural representations' for selected spaces based on my perceptions of their spatial sound characteristics. Each individual piece of music is based on the aural characteristics of the spaces it is created for, and in some cases, within. The pieces wrap themselves around the 'room tone' of the space. This process demands that the space is 'listened' to and this paper describes different modes of listening and how this was approached in the creation of the 'aural representations'.

53 **Variations in acoustical parameters in oral-binaural room impulse responses of a real and a computer-modelled room**

Yadav, Manuj (1); Miranda, Luis (1); Cabrera, Densil (1); Martens, William (1)
(1) Faculty of Architecture, Design and Planning, The University of Sydney, NSW, 2006, Australia

ABSTRACT
Auralizing computer-modelled rooms can be accomplished with relative ease using room acoustical software such as Odeon, Ease etc., when the source(s) and the receiver(s) are located separately in space. However, the same task is not so straightforward when the source (human mouth) and receiver (two ears) are concentric, e.g., within the same head, which can enable the simulation of sound that one hears from one's own voice in different room environments. Previously, studies have employed humans, or more generally head and torso simulators for obtaining impulse responses from the mouth to the two ears of the same head in real rooms, referred to as an oral-binaural room impulse response (OBRIR). Measuring OBRIRs for more than one room and for different orientations with the same room can be very time-consuming and cumbersome, which can be a limitation in studies that require a large number of rooms with modular features. The present paper is addressing this issue with a preliminary study of the variations in the acoustical parameters derived from OBRIRs of a real room and

a computer model of the same room, where important room modeling issues are highlighted for future studies.

61 **Spatial analysis of acoustic support on auditorium stages: modelling and measurement using high-order transducers**

Cabrera, Densil (1); Miranda, Luis (1); Jin, Craig (2); Epain, Nicholas (2)
(1) Faculty of Architecture, Design and Planning, The University of Sydney, NSW 2006, Australia
(2) School of Electrical and Information Engineering, The University of Sydney, NSW 2006, Australia

ABSTRACT
Acoustic support on auditorium stages is conventionally quantified using the stage support parameters (e.g., ISO3382-1). These parameters are derived from room impulse responses measured between an omnidirectional source and receiver. For early stage support (STEarly), the source and receiver are horizontally separated by 1 m, and the degree of support is represented as an energy ratio between early reflections (20-100 ms) and the direct sound (0-10 ms). The project described by this paper introduces two modifications: firstly, the source and receiver are colocated (or at least, concentric); and secondly, the source and receiver can both be resolved into higher order spherical harmonics (enabling detailed spatial analysis). This concept has been realised within room acoustical modelling software, as well as in a prototype transducer array for room acoustics measurement. This paper describes the methods used to achieve modelling and measurement in this way, provides examples of such work, and outlines the potential practical benefits of spatial analysis of the acoustic response around a point on stage.

S02D Occupational noise and vibration 1
Thursday 0935-1035, Room D

46 **Occupational Noise Surveys – Making a Difference**

McLoughlin, Jim
SVT Engineering Consultants, Perth, Australia

ABSTRACT
Occupational noise survey reports should provide the first step towards reducing exposure but often fail to initiate change. Engineering noise controls may be given only a cursory examination or, more commonly, noise control recommendations are not focused on the equipment and activities that result in excessive noise exposure. Consequently there is no persuasive argument for implementing noise control and this can lead to over-reliance on hearing protection. This paper outlines an approach to compiling occupational noise survey reports that is more likely to achieve success in reducing noise exposure for workers. This approach relies on answering three fundamental questions: Who is exposed? What is causing the exposure? What can be done to reduce the exposure?

13 **20 years of using the Noise Exposure Indicator and new strategies in effective occupational noise management**

Tickell, Colin
Hatch Associates, Neutral Bay NSW, Australia

ABSTRACT
The Noise Exposure Indicator (NEI) is a risk-based tool for ranking and assessing occupational noise exposure in different parts or areas of a workplace. It was conceived by John Macpherson in about 1992 as part of the team undertaking the major revision of AS1269 -1989, and taken by the author and developed for use in occupational noise management. A paper describing the NEI was presented at the 1996 AAS conference. For some sites the method has been used to compare results and improvements over two sets of surveys 5 years apart. This paper describes its application over the long term. Information is also presented on recent observations and recommendations of how to take occupational noise management to the next level, where it is the responsibility of an accountable team from hygiene, engineering, maintenance and procurement departments at a workplace.

35 **Assessing the most effective and efficient solutions for noise control in a complex workplace**

Pamley, Richard John
Principal Acoustics, SLR Consulting Australia Pty. Ltd, Perth, WA, Australia

ABSTRACT
When looking to mitigate noise levels in the workplace, the obvious solution is not always the most effective. Many questions arise from the initial assessment that may not be easily answered and solutions can sometimes appear to be counterintuitive. The noise exposure assessment will determine whether noise exposures are above the regulatory limits, but will not explain how these exposures may be mitigated. Sometimes the solution is obvious, particularly in simple scenarios, but it may not be so simple to be sure that any specific area, task or item of equipment is the cause of the problem. Even when the most significant source of the exposure is known, knowing which solution in the hierarchy of controls meets the As Low As Reasonably Practicable (ALARP) principle is essential. Even if an engineering or administrative solution is favoured, the effects of the final solution need to be determined if the solution is to be efficient and effective.

The following paper presents a case study and lessons learned when determining noise exposure in a complex workplace. Analyses determined not only which employees were receiving the highest noise exposure levels, but which areas/tasks/equipment are contributing most significantly to those exposures. Discussions include the expected effects of various mitigation measures and their application to the noise exposure of those employees. Further analysis demonstrates the importance of producing a tangible benefit when looking at costbenefit analyses. The approaches used allowed specific methods of mitigation to be modelled and decisions to be made which were considered to be ALARP, be they engineering or administrative controls. By taking this approach the importance of producing a coherent noise action plan, which adhered to the hierarchy of controls is also discussed.

The study demonstrates how the processes used met the required noise exposure levels for the most affected employees. It was considered that the results of the study met ALARP, produced an auditable trail for the decision making process in achieving ALARP, and produced the most effective solution at the optimum cost.

S03A Underwater acoustic modelling and measurement 2

Thursday 1100-1240, Room A

3 Comparison of a Small Slope Approximation Model of Reflection Loss at the Rough Ocean Surface with Stochastic Modelling using PE

Jones, Adrian (1); Maggi, Amos (2); Bartel, David (1); Duncan, Alec (2); Zinoviev, Alex (1)
(1) Defence Science and Technology Organisation
(2) Centre for Marine Science & Technology, Curtin University of Technology

ABSTRACT
The accurate modelling of underwater acoustic reflection from a wind-roughened ocean surface is a challenging problem. Some complicating factors are the presence of near-surface bubbles and the potential for shadowing of acoustic energy by parts of the surface itself. One essential factor, which is the subject of the present paper, is the specular reflection of coherent plane waves at an ocean-like rough surface. We tested the accuracy of the rough surface reflection model adopted by the authors, the small-slope approximation (SSA) approach as used by Williams et al. (JASA, 116, Oct. 2004). The SSA model was used to compute values of the coherent plane wave reflection loss per bounce for wind speeds between 5 and 12.5 m/s, frequencies between 1.5 and 9 kHz, and grazing angles between about 1 and 10 degrees. These values were compared to those obtained from a Monte-Carlo approach based on the Parabolic Equation (PE) method, where realistic ocean surfaces were generated based on the Pierson-Moskowitz spectrum for ocean surface heights. The SSA model compared favourably with the more rigorous PE method for most of the range of parameters considered.

5 Modelling sound propagation under ice using the Ocean Acoustics Library's Acoustic Toolbox

Alexander, Polly (1); Duncan, Alec (2); Bose, Neil (3)
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(2) CMST Curtin University, Kent Street, Bentley, Perth, WA, 6102, Australi
(3) Australian Maritime College, UTAS, Maritime Way, Launceston, TAS 7248, Australia

ABSTRACT
Acoustic propagation in the Arctic and Antarctic is largely characterised by the presence of a highly variable ice canopy. To model sound in these environments requires both a way of effectively representing the ice layer and modelling its effect on signal transmission. The Ocean Acoustics Library has a powerful open source Acoustics Toolbox that contains Fortran code for running Ray, Normal Mode, and Wavenumber Integration models. There are two parts to modelling a sea ice environment: modelling the ice as an elastic acoustic medium, and modelling the roughness of the ridging characteristics of the ice. This work considers the scenario of an Autonomous Underwater Vehicle (AUV) producing a survey under ridged sea ice. This specifies a range of interest of 10km and a frequency band of interest of 3kHz-13kHz. An overview of methods for modelling ice as an acoustic medium and as a ridged surface is provided, and the applicability of different propagation and ice models for this scenario is discussed. The scenario is then implemented as a specific test case for two example ice canopy profiles. The ice canopy profiles used are sea ice draft measurements recorded in the Arctic using an upward looking SONAR on a nuclear submarine. Beam and ray methods are the only computationally fast propagation codes for this frequency range and are included in the BELLHOP module of the Acoustics Toolbox. With these methods the options for including the elastic properties of the ice are limited and only include reduction in the coherent field on reflection. Two methods for including the ridging of the ice canopy are implemented, one statistically based and one using direct input of measured ice canopy data. The statistically based method uses Twersky boss scattering, and the direct method inputs the draft data as an altimetry file. Gaussian beam tracing using BELLHOP is run to generate ray trace and coherent transmission loss estimates of this environment. The advantages and limitations of these implementations are discussed with suggestions for future improvements to the Acoustics Toolbox to better model the ice scenarios outlined. The improvements identified from this review and test case are: the capability to include specific ice condition data where available, better consideration of the elastic properties of the ice in BELLHOP; and new statistical methods for modelling unknown variable surface boundaries that provide statistical distribution information as well as mean field values.

29 The loss mechanisms of plane-wave reflection from the seafloor with elastic characteristics

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ABSTRACT
As an integral part of the waveguide, the seafloor plays an important role in underwater acoustic propagation, particularly in shallow water environment where the acoustic waves strongly interact with the seafloor. It is therefore critical to understand the fundamental loss mechanisms from the interaction between acoustic waves and the seafloor for both forward and inverse underwater acoustics problems in shallow water. This paper reviews the classic theory of plane-wave reflection from layered solid media, and its application on revealing the mechanisms of the reflection loss from the seafloor with a specific geoacoustic structure consisting of a sediment layer of weak elasticity overlaying a solid substrate. The significant reflection loss mechanisms include the compressional-shear wave conversion, the possible sediment-substrate surface wave excitation, and the resonances in the sediment layer.

68 An Investigation of Plane Wave Propagation through a Layer with High Sound Speed Gradient

Zinoviev, Alex (1); Bartel, David (1); Jones, Adrian (1)
(1) Maritime Operations Division, Defence Science and Technology Organisation, Edinburgh, 5111, Australia

ABSTRACT
In modelling the reflection of sound from an ocean surface, it is necessary to include the refractive effects of near-surface bubbles generated by wind action for certain frequencies. The vertical sound speed gradient in the near-surface region is, however, so extreme that ray acoustics cannot be applied, and thus a wave approach is necessary. This paper describes the nature, and application, of a suitable wave-based description of the refraction of the intensity vector in this region of very high sound speed gradient. It is shown that the sound speed profile in the high-gradient layer can be well approximated by the sound speed profile in the "transitional" layer described by

Brekhovskikh (Waves in Layered Media, Academic Press 1960). This exact solution of the wave equation is used to calculate the depth dependence of the acoustic pressure amplitude of the incident plane wave. The fluid particle velocity vector at the surface is also calculated and, together with the pressure amplitude, is used to obtain the intensity vector. Results show that, close to the resonance frequencies, the grazing angle at the surface is significantly larger than that predicted by the laws of geometrical acoustics. It is also shown that these resonance-like phenomena are characteristic not only of sound speed gradients typical of near-surface bubbles, but also of the less-severe gradient typical of conventional isothermal conditions.

88 **Low frequency acoustic propagation over calcarenite seabeds with thin, hard caps**

Duncan, Alec (1); Gavrilov, Alexander (1)
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ABSTRACT
Much of Australia's continental shelf consists of a relatively soft limestone called calcarenite, which is variable in geoacoustic properties and covered by a thin veneer of unconsolidated sediment vanishing in some areas. Low frequency underwater acoustic propagation in such environments is strongly influenced by the geoacoustic properties of the calcarenite, which typically has a shear speed slightly lower than the sound speed in water. This often results in strong frequency dependence of the acoustic transmission loss with some frequency bands having a much lower transmission loss than the nearby frequencies. In some cases the upper part of the calcarenite consists of a thin (~1m) layer of hard, well-cemented calcarenite overlaying softer, semi-cemented layers. This paper considers the effect that this hard cap has on the acoustic reflectivity of the seabed and on the resulting acoustic propagation at frequencies sufficiently low that the upper, well-cemented layer is thinner than its shear and compressional wavelengths.

S03B Noise control 1
Thursday 1100-1240, Room B

105 **Active-passive control of portable generator set radiated noise**

Fuller, Chris (1); Papenfuss, Cory (1); Saux, Tom (1)
(1) Vibration and Acoustics Laboratories, Virginia Tech, Blacksburg, Virginia, USA

ABSTRACT
This paper summarizes work on applying active and passive noise control to minimize the globally radiated noise of a 2kW portable generator set. The radiated noise of the operating baseline generator set was first measured with a near field microphone array and far field pressure was then estimated using spherical harmonic radiation functions. The spectrum of the radiated noise showed strong tonal characteristics at low frequencies due to the diesel engine making it a good candidate for active noise control (ANC) in that frequency region. However calculations indicated that ANC on its own, while providing high attenuation in the control bandwidth, will lead to only a small reduction in overall A weighted sound pressure levels. Thus passive treatment was applied to control the mid to high frequencies. An optimization technique based upon noise measurements of the passively treated, operating generator set and spherical harmonic radiation functions used in conjunction with a genetic algorithm were used to design the ANC system. The designed ANC system was implemented as a fully integrated, self powered installation into the generator set and the passive and active/passive attenuation in sound measured during operation. The results indicate around 10dBA passive attenuation and additional 5dBA attenuation due to the active system and indicate the performance advantages of an optimally designed ANC system. The work also demonstrates how, in many applications, it is necessary to apply a combined active/passive approach to obtain a wide bandwidth of attenuation and a corresponding significant reduction in overall A weighted sound pressure level.

79 **Development of an Adaptive Quarter-Wave Tube Attached to a Large Diesel Engine**

Craig, Richard (1); Howard, Carl (1)
(1) School of Mechanical Engineering, The University of Adelaide, Adelaide, S.A. Australia

ABSTRACT
An adaptive quarter-wave tube was developed for a large diesel engine that has the capability of tuning to variations in engine speed, exhaust gas temperature, and load on the engine. The system is robust to the diesel exhaust gas that reaches temperatures of over 450°C and contains soot. This paper describes the components of the system and some experimental results that demonstrate the effectiveness of the device, where noise reductions greater than 20dB were achieved.

80 **Variation in Acoustic Performance of an Adaptive Quarter Wave Tube with Orifice Geometries of Side-Branches in a Duct with Flowing Gas**

Howard, Carl (1); Craig, Richard (1)
(1) School of Mechanical Engineering, The University of Adelaide, Adelaide, S.A. Australia

ABSTRACT
It is well known that the acoustic performance of silencing elements decreases with an increase in exhaust gas flow.

Tests were conducted on three orifice geometries of side-branches on an adaptive quarter-wave tube to determine which was the least compromised by the high-speed exhaust gas passing over the side-branch. The geometries that were tested included a sharp edge, a backward inclined branch, and a bell mouth. The experimental results show that the side-branch with a bell-mouth resulted in the greatest noise reduction by an adaptive quarter-wave tube.

152 **Leading Element Dichotomous Coordinate Descent Exponential Recursive Least Squares Algorithm for Multichannel Active Noise Control**

Felix Albu,
Valahia University of Targoviste, Romania

ABSTRACT
In this paper, a new multichannel modified filtered-x (MFX) recursive least square (RLS) algorithm for active noise control (ANC) based on leading element dichotomous co-ordinate descent (LEDCD) iterations is proposed. It is shown that the proposed algorithm has less than half of the complexity of MFX fast transversal filter (FTF) algorithm with good performance for ideal plant models and improved robustness for noisy plant models.

161 **Active control of propagated noise in a duct by using Matlab simulation and adaptive filtering**

Forouharmajd, Farhad (1); Masoumeh, Ahmadvand (2); Hadian, Mohammad (2)
(1) Dept. Of Occupational Health Engineering, Isfahan University of Medical Sciences, Isfahan, Iran
(2) Fars Shasi Company, Montazerieh Industrial Park, Najaf Abad, Isfahan, Iran

ABSTRACT
The original, unwanted sound and the anti noise acoustically combine, resulting in the cancellation of both sounds. In this method, the primary noise is acquired via a microphone, and the anti-noise propagates with the same amplitude and the reverse phase at the primary noise path via a speaker cancels the original noise. Matlab simulation is used to process signals and create anti-noise by means of data acquisition card (DAQ). The conclusions present a noise reduction of 16-20 dB overall. With regard to the wide range of frequencies of different noise sources, to having optimized circumstances in the duct, microphone location on the duct body or even the distance of the speakers may be important in signal processing, noise sampling and anti-noise production.

S03C Signal processing and measurement 1
Thursday 1100-1240, Room C

127 **Sound Intensity Measurements for Ranking Noise Transmission Through Building Envelope Elements**

Taylor, Jeremy
Savery & Associates Pty Ltd, Brisbane Queensland

ABSTRACT
Entertainment and community buildings frequently have to be designed to contain performance noise in order to meet acceptable noise levels at surrounding noise sensitive premises. Typically, a noise source would be generated within the building and sound pressure measurements would be conducted externally to determine the noise level radiating from various elements of the building envelope. Due to the microphone systems typically used on sound level meters, extraneous ambient noise, such as traffic noise, or noise transmission through adjacent building elements may be inadvertently included in the noise measurements. During the design of a proposed building upgrade, a study was conducted to rank noise emissions through the building elements of a local community building. As an alternative to the sound pressure level measurement method, sound intensity was utilised to focus on the noise transmission through individual building elements. These individual sound intensity measurements were conducted in a grid point array along all sides of the external façade of the building and above the roof. This allowed the construction of sound power level contour maps for use in determining a ranking of the acoustic performance of the building elements. The measurements were conducted generally in accordance with ISO9614.1-1993. This paper presents the results of the sound intensity measurements, and investigates the validity of using the sound intensity technique for noise ranking of building elements. Additionally, sound pressure measurements were conducted adjacent to the building elements, including windows, doors, walls and roof, to enable calculation of sound power levels. A comparison of the results achieved for the two methods is discussed.

55 **Sound absorption coefficient measurement: Re-examining the relationship between impedance tube and reverberant room methods**

McGrory, Mathew (1); Castro Cirac, Daniel (1); Gaussen, Olivier (1); Cabrera, Densil (2)
(1) Wood & Grieve Engineers, Sydney, Australia
(2) Faculty of Architecture, Design and Planning, The University of Sydney, Sydney, Australia

ABSTRACT
Absorption is one of the most commonly used parameters in linear acoustics. It is well known that the absorption for any material will differ when the properties of the material change. These properties include: thickness, density, flow resistivity, method of mounting, etc. Previous studies have shown that the results for an absorption coefficient test are dependent on the testing method, that is, the absorption coefficients of the same material with the same properties will vary depending on the testing method. Two techniques commonly used to perform such measurements are: 1) Reverberant room method and 2) Impedance tube transfer function method. Intuitively a relationship between the results of the two measurement methods for the same material should exist. This paper aims to develop a methodology to establish and define a clear relationship between the two resulting absorption coefficients measured from samples of the same type of material. To do this, 28 polyester samples have been tested using the two aforementioned methods. A set of variables has been considered for each sample such as thickness, density, and flow resistivity. This paper presents the results of the multivariate linear regression study of the absorption coefficients and provides a new model to convert the normal incidence sound absorption coefficient measured in an impedance tube into a random incidence sound absorption coefficient.

41 **Frequency Shifting Listening Device**

Wong, Wei Shern (1); Cheng, Nicholad Peng-Hao (1); Cazzolato, Benjamin (1); Prime, Zebb (1); Hewett, Keith (2)
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(2) ARUP, Australia

ABSTRACT
Sound identification is important in vibration and acoustic related engineering fields. The frequency spectrum of sound in some environments falls into the infrasound frequency range below 20 Hz, which is too low for the average human ear. Furthermore, sound above this frequency is still often difficult to identify due to interference and masking by other ambient noise sources. The focus of this paper is on the design and construction of a frequency shifting listening device which is able to shift frequency in real time and amplify low frequency noise into the audible frequency range, typically around 20 Hz to 20 kHz. The design phase of this device includes programming in Matlab/Simulink and rapid prototyping hardware using a Texas Instruments (TI) TMS320C6713 Digital Signal Processor Starter Kit (DSK).

44 **A system for providing audible separation of mixed sound sources**

Bullen, Robert (1); Erlach, Bjoern (2); Abel, Jonathan (2)
(1) SoundScience P/L/, Level 4, 272 Pacific Hwy, Crows Nest, NSW, Australia
(2) Centre for Computer Research in Music and Acoustics, Stanford Unierstity, CA, USA

ABSTRACT
The problem of providing an audible separation of mixed sound sources is important for a number of applications, including speech recognition, noise reduction in communication channels, re-mixing of recorded music, and using environmental sound in musical compositions and film scores, as well as applications in environmental noise control. Many approaches to the problem have been investigated, each with application in a specific area. This paper presents a novel approach that would have application where: a) high-quality reproduction is desired with minimum artifacts; b) measurement using a multiple-microphone array is possible; and c) real-time performance is not required. As such it would apply particularly to audio-oriented applications, but may also have application in environmental noise. The technique involves a constrained least-squares decomposition of spectrogram values recorded at multiple microphones, together with an optional adaptive filtering step. Performance of the algorithm is described for simulated mixtures, and compared with published data for other techniques. It compares well with other systems, particularly in terms of rejection of audible artifacts.

147 **Unattended noise monitoring: how to to fulfill IEC 61672 sound level meter standard for 0 degree and 90 degree reference directions with the same device**

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(2) ACOEM, 200 Chemin des Ormeaux, F-69578 Limonest FRANCE

ABSTRACT
Unattended noise measurements are more and more common for noise assessment in the environment. Multiple sources are usually measured with a random position with respect to the measurement point. Noise generated by ground transportation, leisure activities, construction sites is coming from all directions, although mainly the horizontal direction. Placed vertically and configured for a reference direction of 90° from its axis, the goal is to meet the requirements of the IEC 61672 standard on sound level meters taking into account noise incidence from the horizontal direction. The main technical difficulty is the criterion for the maximum level difference allowed between two random incidence angles (directivity). The objective can be fulfilled using a cone-shaped device on top of the microphone. When measuring attended noise with the instrument in hand, the sound level meter must be pointed at the source according to standard IEC 60651. The purpose of the paper is to describe the different research &development phases to fulfill IEC 61672 sound level meter standard for 0° and 90° reference directions with the same device.

S03D Occupational noise and vibration 2
Thursday 1120-1240, Room D

126 **Which is Safer – Tonal or Broadband Reversing Alarms?**

Popoff-Asotoff, Peter (1); Holgate, Jonathan (1); Macpherson, John (1)
(1) Noise Regulation Branch, Department of Environment and Conservation, Perth, WA, Australia

ABSTRACT
Tonal reversing alarms have been identified as a source of noise annoyance to the community (DEC 2012). There has been a drive to replace tonal reversing alarms with broadband alarms. However, there has also been resistance in replacing the tonal with broadband alarms, due to perceived safety concerns. Many owners and operators of heavy vehicles believe that their tonal reversing alarm provides a safety system superior to the broadband alarm. Recently SafeWork Australia (2011a) issued their document Managing Noise and Preventing Hearing Loss at Work, within which ISO 9533:2010 is selected as the standard to measure audible reversing alarms on vehicles. In order to address the above safety concerns, the Noise Regulation Branch of WA's Department of Environment and Conservation (DEC) studied 21 DEC vehicles with tonal reversing alarms against the ISO 9533 Standard. Also tested were 5 vehicles from the City of Subiaco. The investigation found that a large proportion of the tonal reversing alarms tested failed to comply with the ISO 9533. Some of the tonal reversing alarms were then replaced with broadband alarms with the similar sound power levels. The test results demonstrate that all these broadband reversing alarms are able to meet the requirements of ISO 9533, when properly installed. This study also indicates that broadband reversing alarms are much less annoying at the distances further away (say further than 100 m), where the sound of the alarm is substantially merged in the background noise.

9 **The effects of the mechanical properties on the attenuation of earmuffs**

Williams, Warwick
National Acoustic Laboratories

ABSTRACT
The attenuation of ear muffs is dependent on their design and the materials used for construction. This work attempts to draw some generalised outcomes by presenting the results of an examination of the physical properties of 39 sets of ear muffs commonly available in Australia. The results indicate that attenuation increases with clamping force up to a limiting value of around 11 Newtons above which expected increases in attenuation are very small for large increases in clamping force. Likewise increasing the volume and mass of the hearing protector cup increases the attenuation but, as with clamping force a limit is reached where increased size and mass increases discomfort and wearing difficulty. While the physical and mechanical properties can be an indication of an ear muffs likely attenuation they are not an absolute predictor of performance.

58 **Noise and vibration training and its practical connection with real life practice in today's world**

Groothoff, Beno
Environmental Directions Pty Ltd, Brisbane, Australia

ABSTRACT
Presenting noise and vibration workshops, seminars and lectures over the last 20+ years to audiences ranging from people wanting only to gain awareness to university students and pro-

fessional people who need to know, demonstrates the need for constantly updating the study material. Updating needs to include not only legislative changes such as the current 2011 Work Health and Safety legislation but also current subject knowledge and technology available to keep the presented material fresh, relevant and meaningful for audience expectations. Modern computer technology such as Excel and PowerPoint enhances capabilities of presenting case studies realistically by using audio and video of real life noise and vibration scenarios. Practical exercises in courses highlight the 'how to do it right' and the "how to avoid pitfalls" with measuring instruments and evaluations aiming to get accurate results and avoid basic mistakes. Such presentations enhance students' and other participants' involvement and problem solving skills.

14 **Overview of the occupational exposure limits for hand-arm and whole-body vibration**

Burgess, Marion (1); Foster, Gary (2)
(1) Acoustics & Vibration Unit, School of Engineering and Information Technology, UNSW, Canberra
(2) Foster OHS Pty Ltd, Sydney

ABSTRACT
The introduction in 2002 of the Directive of the European Parliament, 2002/44/EC, established exposure limits for hand-arm and whole-body vibration in the occupational work environment. The requirements of this Directive have led to legislation and regulations in the member countries. The subsequent efforts by the regulatory authorities have increased the awareness of the potential injury from excessive exposure. Advances in instrumentation have increased the understanding of the actual exposures in the workplace. The introduction of the EU Machinery Directive requiring declaration of vibration levels in machinery specifications has led to data measured under controlled standard conditions. At this time Safe Work Australia is considering the need for occupational vibration exposure limits. This paper will discuss the vibration exposure limits, provide an overview of the EU requirements and consider the lessons that can be learnt.

S04A Array processing
Thursday 1340-1520, Room A

7 **Estimation of steering vector errors for adaptive beamforming**

Bao, Chaoying (1); Bertilone, Derek (1)
(1) Defence Science and Technology Organization, Australia

ABSTRACT
Steering vector errors can severely degrade the performance of adaptive beamforming. For the case of a platform-mounted array, unknown scattering from the platform can be a major source of bearing and frequency dependent errors. These errors can be estimated using a technique based on maximizing the signal-to-interference-plus-noise ratio (SINR) in the spatial spectrum computed using the minimum power distortionless response beamformer with sample matrix inverse (MPDR SMI). This technique is simple compared to some other techniques in the literature, and can be used if the noise is spatially correlated and weak interferers are present. We use simulations to show that good results are obtained if the uncertainty in the signal bearing is not too large, and interferers are sufficiently weak compared to the calibration signal.

10 **On Robustness of Constrained Least Mean Square Beamformer**

Meegan, Isaac (1); Bao, Chaoying (2); Pan, Jie (1)
(1) School of Mechanical and Chemical Engineering, University of Western Australia, Australia
(2) Defence Science and Technology Organisation, Australia

ABSTRACT
Adaptive beamformers suffer from performance degradation when the assumptions made of the environment, signal sources, or sensor array, are violated. This paper investigates the robustness of the constrained least mean square beamformer with respect to its adaptive step size, in the presence of model errors and direction of arrival mismatches. A sacrifice in convergence speed can be used to improve the robustness of the algorithm, as simulation results show improved performance in the presence of errors as the algorithms step size is made small. A comparison is made between the effect of the popular diagonal loading method and a reduced step size on the robustness of the algorithm, showing improved results with a reduced step size.

39 **Source localization with orthogonal horizontal arrays in shallow water**

Su, Lin (1); Guo, Shengming (1); Lu, Licheng (1); Ma, Li (1); Zhang, Chunhua (1)
(1) Key laboratory of underwater Acoustics Environment, Institute of Acoustics, China Academy of Sciences, Beijing, China

ABSTRACT
The source location using matched filed processing (MFP) is based on the correlation of the measured and the calculated sound signal. Recently, MFP has been extensively used in shallow-water environments. Some experiments have been successfully done by using a vertical line array (VLA) to examine the source localization. But the finite water depth in shallow water can impose severe limitations on matched field source localization with VLA, such as the limited aperture of the VLA. To obtain higher resolution, large aperture array is imperative. A horizontal line array (HLA) can overcome the aperture limitation. This paper demonstrates passive localization using linear matched field processor with data obtained during the experiment in the South China Sea in November 2011. In the experiment, two bottom-moored HLA are deployed approximate orthogonal, and two sources transmit signal at the same time at different depth. The simulation results indicate that two orthogonal HLA can improve the resolution of two sources in different depth and different direction, but experiment results are not so good. Mismatch of the environment and the source moving should be considered in the later work.

40 **Performance analysis of virtual array processing for source ranging using different frequency bands**

Yao, Meijuan (1); Lu, Licheng (1); Guo, Shengming (1); Ma, Li (1)
(1) Key Laboratory of Underwater Acoustics Environment, Institute of Acoustics, Chinese Academy of Sciences, Beijing, China

ABSTRACT
This paper discusses a virtual array technique for source ranging in a range dependent shallow water environment which avoids the complicated computation of matched field processing and reduces the requirement for knowledge of environmental parameters. The virtual horizontal array is con-

structed by correlating two signals which are received by vertical array and can be identified respectively in time. Combining with the waveguide invariant ß, the range of the object source is determined by estimating the slope of the resulting correlation pattern. An underwater propagation experiment was carried out in South China Sea in 2004 and a lot of explosive sources were used. The performance of virtual array processing for source ranging is analyzed using different frequency bands.

30 **Passive Measurement of Vertical Transfer Function in Ocean Waveguide using Ambient Noise**

Xinyi, Guo (1); Fan, Li (1); Li, Ma (1); Geng, Chen (1)
(1) Key Laboratory of Underwater Acoustics Environment, Institute of Acoustics, Chinese Academy of Science, Beijing 100190, China

ABSTRACT
This paper introduces a function of correlation between two hydrophones, basing on the Kuperman-Ingenito ocean ambient noise model. There is a similarity in form between the cross correlation function and the transfer function in ocean waveguide from a point source to a receiver. Thus, the noise cross correlation function between two hydrophones in vertical location can extract actual transfer function, and then the acoustics ray arrival structure of propagation in vertical waveguide can be analyzed. In this paper, the transfer function in vertical ocean waveguide can be obtained from broadband ambient noise cross correlation function of vertical line array. There are some analysis about physical significance of noise interference basing on compared simulation and experiments. This method can be used to research stratification sea floor considering the arrival time structure of each propagation route.

S04B Road and rail traffic noise
Thursday 1340-1520, Room B

52 **Wayside horn noise investigation**

Moore, Simon
AECOM, Level 28, 91 King William Road, Adelaide, Australia

ABSTRACT
Warning horns are used by trains and sounded when approaching a level crossing to warn of its presence. The functional requirement of the horn is to be loud, so that it is audible when sounded at a large distance from the level crossing. Due to this, the use of warning horns can sometimes result in complaints from nearby noise sensitive receivers, for whom the horn noise is not intended. The wayside horn concept replaces the use of the loud train horn, with a lower noise, permanent horn installation at the level crossing. Therefore, an audible sound to warn of the trains' presence can be produced at the level crossing focusing on the area in which the audible sound is required, and significantly reducing the potentially disturbed area. This paper presents the results of a trial study of a wayside horn installation undertaken at a level crossing in Whyalla, South Australia. The wayside horn noise has been compared with the noise of a train horn, and both were compared against criteria for the assessment of the audibility of danger signals and also sleep disturbance.

64 **Further Investigations of Low-frequency Noise Problem Generated by Freight Trains**

Guo, Jingnan (1); Macpherson, John (1); Popoff-Asotoff, Peter (1)
(1) Noise Regulation Branch, Department of Environment and Conservation, Government of Western Australia

ABSTRACT
The Western Australia Department of Environment and Conservation (DEC) studied the rail noise and vibration at a residence in a Western Australian suburb in 2009. The study had identified very strong low frequency components in the range from 12-32 Hz inside that residence. In this follow-up investigation, four more residences in the same suburb and with similar distance to the rail track were studied. It has been confirmed that the low-frequency noise problem caused by the train movements does exist at all four residences, especially inside the houses. The sound transmission loss of the building of the residence was measured to be mostly above 20 dB at frequencies higher than 50 Hz, but dropped significantly at frequencies lower than 50 Hz and even enters the negative territory at lower frequencies, meaning the noise level at such low frequency range was amplified when transmitted from outdoor to indoor.

86 **Is the 2.5 dB(A) Façade Correction for Road Traffic Noise Correct?**

Mortimer, J (1); Kean, S; White, T (1)
(1) The University of New South Wales, Sydney, NSW, Australia

ABSTRACT
Reference measurements for Australian road traffic noise criteria are currently made at a set distance of 1 m from a building façade. Before using the collected data, a façade correction is applied. A common industry view is that the usually-applied correction of 2.5 dB(A) is potentially overstated. Reported in this paper are results from a software suite developed to explore the parameters relating to façade amplification. Also described is the mathematical model upon which the software suite was built. The predictions made by the software have been validated experimentally. The 2.5 dB(A) correction was found to be a function of the angle of view, the dimensions of the façade, the distance from the carriageway and the frequency spectra of the passing traffic. Measured frequency spectra were found to vary with speed and road surface.

153 **Inland tsunami destroys Grantham**

Hall, Arthur (1); Grant, Robert (1)
(1) Department of Transport and Main Roads, Queensland

ABSTRACT
Under the Queensland Development Code Mandatory Part 4.4, Buildings in a Transport Noise Corridor (QDC MP 4.4), the Department of Housing and Public Works (DHPW) requires residents to check their noise category when building near a State-controlled road or railway so that new buildings are designed and constructed to reduce road traffic and railway noise intrusion. In early 2011 an inland tsunami devastated the Grantham area due to intense rainfall in South East Queensland and particularly in the Lockyer Valley. Many houses in the flood plane were swept away. Residents were given the opportunity to rebuild at a new development site on higher ground away from the State-controlled road. Two of the residents elected to rebuild on their properties in the flood plain rather than move to the higher ground. Their original houses were located 30m from the Gatton-Helidon Road, as State- controlled road. These new houses thus become subject to requirements of the QDC

MP 4.4. At the request of DHPW, members of the Queensland Department of Transport and Main Roads (TMR) elected to conduct a detailed road traffic noise assessment at no cost to these residents, recognising the hardship they had suffered. TMR staff met with the residences to discuss their road traffic noise concerns, and conducted an acoustical assessment thereby enabling the residents to rebuild their houses at reduced cost due to the findings of the detailed assessment which determined the noise impact on each house façade whereas the prescribed QDC MP 4.4 requirements do not.

99 **Transport Infrastructure Noise: Beyond 2050**

Burgemeister, Kym (1); Johnson, Bruce (2)
(1) Arup Acoustics, Melbourne, Australia
(2) Arup Transportation Planning, Melbourne, Australia

ABSTRACT
Noise from transport infrastructure - roads, railways and airports - is usually required to be assessed as a part of the broader environmental assessment of major transport infrastructure developments. Acoustic engineers routinely make noise predictions for likely future operational scenarios of the road, railway or airport - usually 10 or more years after the proposed project opening date, which may be 12–15 years after the date of the study itself, depending on the required construction period. The key parameters driving the assessment of the future scenario are the source noise levels of the vehicles, and the vehicle flow rates. The former is usually estimated based on existing noise levels, with some (small) allowance for technological improvements. The future vehicle flow rates are usually provided to the Acoustic engineer by a Transport or Traffic Engineer, and are based on extrapolations of previously measured flow increases mixed with estimates of patronage demand. In the past, this seems to have resulted in a reasonable assessment of noise from transport infrastructure projects. However, within the next 10–20 years, there are likely to be several major 'shocks' - the primary one being oil depletion (also known as 'peak oil'), which could seriously challenge the key assumptions underlying many of the noise assessments currently being undertaken and invalidate the results. This study broadly investigates the potential impacts of technological, political and energy supply changes on noise assessments for large transport infrastructure projects. These changes are likely to result in further shifts to rail-based transportation of freight and passengers, and a softening in demand for air-travel.

S04C Architectural acoustics 2
Thursday 1340-1520, Room C

167 **Acoustics and the Engineering Team**

Charlton, Emma
AECOM, Brisbane, Queensland, Australia.

ABSTRACT
This paper shares some insights into how the role of engineers in general, and acoustical engineers in particular, is changing. The paper covers the changing nature of engineering work, the influences of globalisation and technological change on the way we work and the role of innovation and collaboration. While the number of professional engineers in Australia has increased over the last 10 years, fewer and fewer work in traditional fields. Major shifts in the world economy and technological change has meant more and more engineering services can be supplied from anywhere in the world. This has a much greater impact on less complex engineering services than on high value, creative engineering. It is important therefore for graduates to think about the skills needed to be a 'great engineer' in this environment. Attributes like creativity, project management skills, communication skills and experience in working with diverse groups will become increasingly important.

81 **Notes on the acoustical design of animal holding rooms within medical research facilities**

Zoontjens, Luke
Norman Disney & Young, Level 10, 200 St Georges Terrace, Perth, Australia

ABSTRACT
The acoustical design of animal holding and behaviour rooms is particularly important to the function of medical research facilities. Achieving suitable internal conditions is crucial to the operation of animal houses and the research outcomes they support. State-of-the-art research literature remains inconclusive regarding objective (i.e. measureable) criteria, but demonstrates high risks associated with adverse noise and vibration environments in animal research laboratories. For animals subjected to adverse noise and vibration, these risks include significant impacts on reproduction and sensory development, behaviour, and even physical injury from startle responses. This paper reviews relevant work to date and measurements of existing facilities and activities. The discussion focuses on common design limitations, proposed criteria and general recommendations.

155 **A cost benefit analysis of providing a 'sound' environment in educational facilities**

James, Deb (1); Stead, Matthew (1); Clifton-Brown, David (2); Scott, David (2)
(1) Resonate Acoustics, 97 Carrington Street Adelaide SA 5000, Australia
(2) Donald Cant Watts Corke, Level 5, 115 Grenfell Street, Adelaide SA 5000, Australia

ABSTRACT
Speech and aural interaction is very important in the teaching and learning process, and as such, good acoustic design is essential to facilitate effective learning. Critical issues in acoustic design revolve around reverberation control, isolation of noise into learning spaces and control of extraneous noise sources, including noise from building services and traffic noise ingress. The Association of Australian Acoustical Consultants (AAAC) Guideline for Educational Facilities Acoustics (2010) provides the first Australia wide guide to providing a good acoustic environment in educational facilities. Often good acoustic design can be compromised by the high cost of construction. An analysis of the cost versus acoustic benefit of the guideline is considered to aid in building better educational facilities and better educational outcomes.

103 **Room acoustic design to improve speech privacy in passenger cars of high-speed trains**

Jeon, Jin Yong (1); Jang, Hyung Suk (1)
(1) Department of Architectural Engineering, Hanyang University, Seoul, Republic of Korea

ABSTRACT
In the present study, room acoustic environments in high-speed trains were investigated to identify design elements for passenger cars. Absorption coefficients of the interior finish materials were tested, and reverberation time (RT) and sound pressure level (SPL) were measured at the ear height of passengers. A room acoustic simulation model for the passenger cars was constructed from actual measurements carried out at different

positions in the passenger cars. Design elements were identified and classified through computer modelling of different interior surfaces with different absorption coefficients. It was found that appropriate absorptive material and ceiling shape help improve speech privacy inside passenger cars. The privacy distance (rP) improved by 2.7 m by increasing the absorption coefficients and by 1.8 m by adding ceiling banners.

121 **Investigation into the airborne flanking sound transmission paths of wastewater pipes and acoustic lagging**

Tommasini, Paolo (1); Tardio, Darren (1)
(1) Pty Ltd, VIC, Australia

ABSTRACT
As it is becoming increasingly popular to do away with ceilings in some types of commercial buildings, is airborne sound transmission via plastic wastewater pipes likely to be a problem where there are residential tenancies above? There is much laboratory and practical evidence for the benefits of convoluted foam lagging with respect to reduction of turbulent fluid flow noise within pipes, but there is little knowledge available with respect to airborne noise transfer through PVC pipes, back up to the point of ingress. This study presents the findings of acoustic field testing intended to determine the effects of airborne sound transmission via wastewater pipes and the effect of lagging on such sound transmission. The study demonstrates that wastewater pipes could feasibly be considered a noise transmission path and that convoluted foam lagging improves the sound insulation of such pipes, specifically in the intelligible speech frequencies.

S04D Marine environmental and bioacoustics 1
Thursday 1340-1520, Room D

137 **Project BRAHSS: Behavioural Response of Australian Humpback whales to Seismic Surveys**

Cato, Douglas (1); Noad, Michael (2); Dunlop, Rebecca (2); McCauley, Robert (3); Gales, Nicholas (4)
(1) Maritime Operations Divsion, Defence Science and Technology Organisation, Sydney, NSW; University of Sydney Institute of Marine Science, University of Sydney, NSW
(2) Cetacean Ecology and Acoustics Laboratory, School of Veterinary Science, University of Queensland, Gatton, Qld
(3) Centre for Marine Science and Technology, Curtin University of Technology, Perth, WA
(4) Australian Marine Mammal Centre, Australian Antarctic Division, Kingston, TAS

ABSTRACT
BRAHSS is a major project aimed at understanding how humpback whales respond to noise, particularly from seismic air gun arrays. It also aims to infer the longer term biological significance of the responses from the results and knowledge of normal behaviour. The aim is to provide the information that will allow seismic surveys to be conducted efficiently with minimal impact on whales. It also includes a study of the response to ramp-up in sound level. Ramp-up is widely used at the start of operations as a mitigation measure intended to cause whales to move away, but there is little information to show that it is effective. BRAHSS involves four experiments with migrating humpback whales off the east and west coasts of Australia with noise exposures ranging from a single air gun to a full seismic array. Two major experiments have been completed off the east coast, the second involving 70 scientists. Whale movements were tracked using theodolites on two high points ashore and behavioural observations were made from these points and from three small vessels and the source vessel. Vocalising whales were tracked underwater with an array of hydrophones. These and other moored acoustic receivers recorded the sound field at several points throughout the area. Tags (DTAGs) were attached to whales with suction caps for periods of several hours. Observations and measurements during the experiments include the wide range of variables likely to affect whale response and suf- ficient acoustic measurements to characterise the sound field throughout the area. The remaining two experiments will be conducted further off shore off the west coast in 2013 and 2014.

67 **Investigation of the noise exposure on marine organisms from fisheries acoustic instruments**

Kloser, Rudy
CSIRO

ABSTRACT
There is increasing concern about the impact of sound on the behaviour, hearing and non-auditory systems of marine animals (in particular mammals). This has lead to the development of noise exposure criteria in many countries. Often a very simplistic source level exposure criteria is defined without reference to frequency, beam pattern and duration of the signal. These source level criteria are being applied to seismic operations in particular but increasingly for operation of all acoustic instrumentation in marine parks. Standard fisheries acoustic instruments exceed the source level criteria at close range and regulators need to place these instruments in context with appropriate noise exposure for marine animals of concern. This talk looks at the incorporation of fisheries acoustic instruments found on many new research vessels into a noise exposure framework. Issues such as instrument beamwidth, power, frequency and pulse duration are catalogued for each instrument. Quantification of the noise exposure of these instruments and the potential of cumulative exposures is discussed.

87 **Measurement of long-term ambient noise and tidal turbine levels in the Bay of Fundy**

Martin, Bruce (1); Whitt, Christopher (1); McPherson, Craig (2); Gerber, Andrea (3); Scotney, Murray (4)
(1) JASCO Applied Sciences, Halifax, Nova Scotia, Canada
(2) JASCO Applied Sciences, Brisbane, QLD, Australia
(3) University of New Brunswick, Fredericton, New Brunswick, Canada
(4) ROMOR Ocean Solutions, Halifax, Nova Scotia, Canada

ABSTRACT
The Fundy Ocean Research Center for Energy (FORCE) is a leading research centre for in-stream tidal energy technology. Located at Minas Passage in the Bay of Fundy, the currents can exceed 6 m/s (Oceans Ltd., 2009), making it ideal for testing in-stream technology in harsh environments. The effect of turbine noise on marine life is recognised as a potential environmental impact of in-stream turbines that must be understood (Polagye et al., 2011). It is expected that the rotating mechanical equipment in tidal turbines will emit continuous tones into the water, potentially at levels that may harm or harass marine life (Polagye et al. 2011; Stein, 2011). The differences between the soundscapes with and without the turbine in place must be measured to assess impact. Ideally recordings should be made in all seasons, weather and tidal states and flow noise in the data must be minimised. FORCE made drift measurements of the sound levels at Minas Passage in 2008 and 2009 before and after the installation of an Open Hydro turbine, however, the

results were deemed not reliable due to vessel and surface noise issues and the short term nature of drifting measurements (Schillinger, 2010). In 2011 JASCO began a project to demonstrate long-term measurements of ambient and turbine noise at FORCE using a special purpose high-flow mooring (HFM) previously developed for measurements in Bristol Channel. The extreme conditions at Minas Passage make deployments and retrievals challenging. The initial deployment was called off when shock loading severed the anchor block on the acoustic releases. Both moorings in the second deployment were lost. Detailed hydrodynamic modelling and discussions with mooring experts were conducted before the third deployment in March 2012. The HFM and a more traditional stream-lined buoy design were deployed and recovered. The data show that the high-flow mooring provides usable measurements in all tidal states.

92 **Model based sound level estimation and in-field adjustment for real-time mitigation of behavioural impacts from a seismic survey and post-event evaluation of sound exposure for individual whales**

Racca, Roberto (1); Rutenko, Alexander (2); Bröker, Koen (3); Gailey, Glenn (4)
(1) JASCO Applied Sciences, Victoria, British Columbia, Canada
(2) Pacific Oceanological Institute, Vladivostok, Russia
(3) Shell Global Solutions, Den Haag, The Netherlands
(4) Texas A&M University, Galveston, Texas, USA

ABSTRACT
While it is common practice to use sound propagation modelling to estimate the safety shutdown radius around a seismic survey source, only rarely are numerical estimation methods applied to the real-time mitigation of behavioural effects that occur at much greater ranges. For a seismic survey in 2010 near a critically endangered whale population on their feeding grounds, a strategy was implemented for the prediction and field calibration of behavioural safety boundaries that were used for shutdown decisions by shore and vessel based observers equipped with ranging instruments and geo-referencing software. This summary paper describes the steps involved in the estimation, selection and validation of the noise boundaries for different survey lines and under variable propagation conditions. Results of post-event analyses to estimate sound exposure levels and other acoustic parameters of the received seismic pulses along the paths of visually tracked whales are also presented.

117 **A case study on the effects of underwater noise during the construction of large offshore wind farms**

Mason, Tim (1); Barham, Richard (1); Nedwell, Jeremy (1)
(1) Subacoustech Environmental Ltd. Hampshire UK.

ABSTRACT
The installation of wind farms is considered a key step towards the provision of sustainable energy supply in the UK. Offshore wind farms offer a great potential in terms of availability of resources in terms of space and energy with the minimum of impact on human activity. A growing body of evidence, however, suggests that the construction and operation of wind farms are likely to pose a risk to offshore wildlife. As such, these wind farms must undergo detailed environmental impact assessment prior to installation to determine their impact on marine fauna. In this paper, we discuss the construction of a large UK wind farm, for which a comprehensive noise study was produced reviewing its impacts and the calculation of their severity. The impacts on underwater wildlife considered included lethality and physical injury, auditory effects and behavioural avoidance response. The use of an underwater broadband noise propagation model which has been implemented as software, and which has been validated for shallow water is described. The range of effects of unweighted, dBht(Species) and M-weighted Sound Exposure Level were calculated for a variety of appropriate species with this software. This software tool was used interactively by the engineers, regulators and marine specialists, and it offered the constructor the ability to assess and minimise the development's potential for environmental impact from an early point. This allowed the developer an accurate impression of the likelihood of gaining consent for the project and provided a direction for the best way to minimise or mitigate the introduced noise.

S05A Discussion forums
Thursday 1550-1730, Room A

171 **Underwater Hearing Impacts: What do we know? What do we need to know? How do we find out?**

Ketten, Darlene
Woods Hole Oceanographic Institution

ABSTRACT
While there are many lightless regions on Earth, none are soundless. From the deep ocean to fresh water rivers and estuaries, perception and analysis of sound are critical for survival. Our increasing use of the ocean raises concerns about anthropogenic noise corrupting oceanic soundscapes and physically impacting species within our "acoustic reach", but because species and individuals vary substantially in their ability to perceive and analyse sounds, each can have a different susceptibility to noise impacts. Thus, no single "sound byte" is universally safe or hazardous for all species. The key is to understand the critical interplay of how anthropogenic sounds interact with hearing in the real world, in a range of soundscapes, with mobile animals, and with the range of ear conditions present in wild populations. In a sense, we are faced with trying to determine how the industrial noise that we are contributing to the oceans through exploration, shipping, transport, recreation, defence, and construction must be mitigated or metered to avoid serious harm, just as we concern ourselves with workplace exposures. The first step is to determine what critical and representative species hear and how susceptible they are to hearing loss and related stress and disruption of significant behaviours. This special session will review what we know about "ear health", and what we still need to learn. Representatives from various stakeholders in the marine environment are invited to discuss their needs, their hopes, their concerns.

168 **Australian Standards - Current situation and role for Australian Acoustical Society**

Burgess, Marion
Acoustics & Vibration Unit, School of Engineering and Information Technology, UNSW, Canberra

ABSTRACT
Australian and International Standards provide the basis for measurement and assessment over the wide field of acoustics ranging from performance of building materials, environmental and occupational noise assessments, aircraft noise, noise in buildings and in the marine environment, instrumentation etc . Over the years the operating model for Standards Australia has changed - as has the capacity for those working in the subject areas to contribute to the work of the committees. To com-

mence this workshop Marion Burgess will give an example of the application of the current operating model by outlining the process that was necessary to get to the point of raising a project within Standards Australia for a straightforward direct text adoption of an ISO on Hand Arm Vibration. For any substantive work on any Australian Standards, it is important for the AAS to develop a plan that optimises and priorities efforts into the future. Just for example should AAS efforts be directed to update 2107 on noise levels inside buildings or to update of 2021 on aircraft? This discussion session will seek guidance on the role and the way ahead for AAS in regard to Standards Australia.

S05B Sonar performance and propagation effects
Thursday 1550-1730, Room B

50 **Multi faceted advances in underwater operational sonar prediction systems**

Sendt, Janice
Thales Underwater Systems, Thales Australia, Australia

ABSTRACT
Over the past twenty years there have been a number of advances in underwater acoustic range prediction systems namely: - increased spatial and temporal fidelity of the underwater environmental data sets, the ability to include more insitu measurements, additional input parameters data and the increase in available computing power. This paper describes an initial assessment of the role of glider data as an input into a nowcast acoustic range prediction model. It includes an analysis of the temporal and spatial variability of the water column data measured by a glider in shallow Australian waters.

124 **Comparison of the physical acoustic channel response of a line array of thin rectangular bars to an equivalent model of thin vibrating rectangular pistons**

Chambers, Shane (1); James, Ralph (1); Duncan, Alec (2)
(1) School of Physics, University of Western Australia
(2) Centre for Marine Science and Technology, Curtin University, Western Australia

ABSTRACT
The resolution of an array is determined by the number and spatial distance of apertures (channels) within the array and the geometry of each aperture. The accurate design of acoustic sensing arrays relies on an a prioiri estimate of the expected far field radiation pattern of reciprocally behaved elements chosen for each aperture which is difficult to calculate under damped and loaded conditions. The estimated response of one channel of a vertical line array, when modeled as a series of rectangular vibrating pistons on a rigid baffle, is compared to the measured response of one channel of a line array comprised of a series of thin rectangular bars under load and operating off resonance. Although simple modeling can predict the 3dB main lobe width of the channel with some accuracy, loading and damping effects will alter the individual element response and hence the sensitivity of the array and side lobe magnitudes when off axis steering. This is important to note when estimating array gain and noise contributions from sidelobes under steered conditions.

26 **Acoustic Emission of Bubbly Flow and Its Size Distribution Spectrum**

Chen, Li (1); Wood, Shane (2); Moore, Stephen (1); Nguyen, Binh (2)
(1) Maritime Platforms Division, DSTO Melbourne, Australia.
(2) Maritime Operations Division, DSTO Edinburgh, Australia

ABSTRACT
Acoustic emissions were used to predict bubble size distribution resulting from air discharged through a single orifice. Air was discharged at a particular flow rate through an orifice into quiescent water contained in a large tank. Acoustic measurements were made at different locations in the tank using a single hydrophone and the experiments were carried out with two orifice sizes. The bubble size distribution was estimated based on the acoustic measurement. It was found that the model used to estimate the bubble size distribution was sensitive to the initial displacement of bubbles. The model predicted that an increased number of large bubbles were produced by a high flow rate through a large orifice compared with a low flow rate through a small orifice. This result was verified qualitatively in the experiments. Further work will be carried out to improve the measurement of acoustic emissions and to quantify the bubble generation rate in the experiments.

31 **Acoustic travel-time perturbations due to shallow-water internal waves in the Yellow Sea**

Fan, Li (1); Xinyi, Guo (1); Tao, Hu (1); Li, Ma (1); Yaoming, Chen (1)
(1) Key Laboratory of Underwater Acoustic Environment, Chinese Academy of Sciences, Beijing, China

ABSTRACT
Internal waves in shallow-water cause sound speed profiles variations, leads to acoustic travel-time perturbations. In summer 2007, a combined acoustics/physical oceanography experiment was performed to study both the acoustical properties and the ocean dynamics of the Yellow Sea. The internal waves were recorded by the thermistor arrays. The hydrophones receiving array is enabled to monitoring of acoustic travel-time fluctuations over the internal waves. It is shown that the activity of high frequency internal waves occurs frequently during the experiment and dominated the experiment area. In the paper, we compare the high frequency of internal wave with acoustic fluctuations and analyse the correlation between them.

115 **Acoustic Model of the Remnant Bubble Cloud from Underwater Explosion**

Kouzoubov, Alexei (1); Castano, John (2); Godoy, Carlos (2); Hyman, Mark (3)
(1) Defence Science and Technology Organisation, Edinburgh, SA, Australia
(2) Naval Undersea Warfare Center, Newport, RI, USA
(3) Naval Surface Warfare Center, Panama City, FL, USA

ABSTRACT
A model of formation, development, and acoustic properties of the bubble cloud resulting from an underwater explosion is presented. The model includes several parts: explosion globe dynamics, initial break-up of the explosion globe, turbulence created by the explosion globe fragmentation, and further break-up of the bubbles by the turbulence. The time history of the bubble cloud properties is calculated under the assumption of the cloud being a collection of non-interacting bubbles.

Model results are compared with the available experimental data.

S05C Physiological, psychological and musical acoustics

Thursday 1550-1730, Room C

102 **Hearing, the perception of sound and expert evidence in litigation**

Woolford, Donald Henry (1); Alais, David (2); Best, Virginia (3); Semmler, Carolyn (4); Niall, Paul (5)
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(2) Dept. Psychology, Univ. of Sydney, NSW. Australia
(3) National Acoustic Laboratories, Sydney, NSW. Australia
(4) Dept. Psychology, Univ. of Adelaide. SA. Australia
(5) Consulting Audiological Physician. NSW. Australia

ABSTRACT
The recently published Chapter 145, "Hearing and the perception of sound", in the Thomson Reuters series on expert evidence, (Editors Ian Freckelton and Hugh Selby), was prepared to acquaint expert witnesses, litigators and the legal profession about science and practice directed to hearing and the perception of sound. Sounds such as speech in various acoustic environments, warning signals, background noise, and listeners with hearing impairments, can assume significance in civil disputes or criminal matters. A synopsis of the chapter, authored by David Alais, Virginia Best, Paul Niall, Carolyn Semmler and Donald Woolford will be presented by Donald Woolford. The presentation will conclude with a brief examination of a lay witness followed by an expert witness to illustrate acoustic forensics.

32 **Low frequency response of the vocal tract: acoustic and mechanical resonances and their losses**

Hanna, Noel (1); Smith, John (2); Wolfe, Joe (2)
(1) School of Physics, The University of New South Wales, Sydney, 2052, Australia; Department of Speech and Cognition, GIPSA-lab, Université de Grenoble, France
(2) School of Physics, The University of New South Wales, Sydney, 2052, Australia

ABSTRACT
The impedance spectrum of the vocal tract was measured at the lips from 10 Hz to 4.2 kHz using the three- microphone, three-calibration technique. A broadband signal synthesised from sine waves allows high precision measurements irrespective of the fundamental frequency of phonation. From these measurements, the frequencies, magnitudes and bandwidths of the resonances and antiresonances are determined directly. Resonances have impedance magnitudes of 20-100 kPa.s.m–3 and antiresonances 2-10 MPa.s.m–3. The bandwidths measured with a closed glottis are typically around 50 Hz for resonances and antiresonances between 400 Hz and 2 kHz and increase slightly outside this range. This is in qualitative agreement with previous measurements estimated from phonations measured outside the mouth. The measured bandwidths are discussed in relation to viscothermal losses at the duct boundary, radiation from the mouth and mechanical losses in the surrounding tissues.

60 **Finite element modeling of brass musical instruments**

Rose, Nicholas (1); Holloway, Damien (1)
(1) School of Engineering, University of Tasmania, Hobart, Australia

ABSTRACT
This paper studies the contributions of mouthpiece and tubing to the acoustical properties of three nominally similar musical instruments from the brass family: trumpet, cornet and flugelhorn. Geometries of these instruments were used for an axisymmetric FEA simulations of the harmonic response to sinusoidal pressure at the mouthpiece. ANSYS software was used, with elements modelling the Helmholz equation. Frequency spectra for these instruments were obtained by FFT from sustained tones produced by advanced players under controlled studio conditions and significant differences were noted. While the FEA did not model the players' lips the sound transmission functions produced by these analyses again showed significant differences between instruments and generally favourable agreement with the measured spectra, in particular a strong 3rd harmonic for the cornet and a strong fundamental for the flugelhorn. Actual mouthpieces were not interchangeable but the FEA model was able to show that the mouthpiece and tubing each make a substantial contribution to the spectral differences. As expected the tubing had greater effect on the lower harmonics while the mouthpiece affected predominantly the mid range (around 700 Hz for the trumpet and cornet, and 1100 Hz for the flugelhorn).

65 **Stable, quantised pitch in singing and instrumental music: signals, acoustics and possible origins**

Wolfe, Joe (1); Schubert, Emery (2)
(1) School of Physics, The University of New South Wales, Sydney 2052
(2) School of the Arts and Media, The University of New South Wales, Sydney 2052

ABSTRACT
Unlike most artificial instruments, the voice usually has no resonator to stabilise the pitch. Singing pitch depends on geometry and muscle tension in the larynx but also, strongly, on the sub-glottal pressure. Consequently, pitch and loudness of the voice are strongly correlated, which is why a messa di voce - a gradual increase and decrease in loudness at constant pitch - remains a difficult exercise. Why do we sing in a style that is suited to musical instruments, but arguably much less suited to the voice itself? This paper discusses the advantages of digitised pitch in musicial signals for storage, processing and harmony. It then uses acoustical and musicological arguments to support the hypothesis that styles of singing with stable, categorical pitch, which is controlled independently of loudness, may have evolved since and because of the development of artificial musical instruments. Because stable pitch instruments are at least tens of thousands of years old, and probably much older, it is possible that this influence on song is similarly ancient. We argue that, through the generational transmission of memes, the mimicking of artificial instruments may have given rise to the 'unnatural' fixed pitch singing, which consequently became the one of the dominant styles in Western and other musics.

S05D Vibration 2
Thursday 1550-1730, Room D

140 **Boundary control of vibration in coupled nonlinear three dimensional marine risers**

Nguyen, T.L. (1); Do, K.D. (2); Pan, Jie (1)
(1) School of Mechanical and Chemical Engineering, The University of Western Australia, WA 6009, Australia
(2) Department of Mechanical Engineering, Curtin University, WA 6102, Australia

ABSTRACT
This paper presents a design of boundary controllers implemented at the top end for global stabilization of a marine riser in three dimensional space under environmental loadings. Based on the energy approach, nonlinear partial differential equations of motion including bending-bending and longitudinal-bending couplings for the risers are derived. These couplings cause mutual effects between the three independent directions in the riser's motions and make it difficult to minimize its vibrations. The Lyapunov direct method is employed to design the boundary controller. It is shown that the proposed boundary controllers can effectively reduce the riser's vibration. Stability analysis of the closed-loop system is performed using the Lyapunov direct method. Numerical simulations illustrate the results.

145 **An experimental study of flow induced vibration of a flexible model riser**

Lu, Ji (1); Do, Duc (2); Pan, Jie (1)
(1) School of Mechanical and Chemical Engineering, University of Western Australia, WA 6009, Australia
(2) Department of Mechanical Engineering, Curtin University of Technology,WA 6102, Australia

ABSTRACT
This paper experimentally identifies some non-linear effects, e.g. modal coupling effect and beating motion, on a flexible model riser due to variable curvature when vortex-induced vibration (VIV) occurs. The VIV on the riser can cause enlarging dynamic stress of the body and reducing its fatigure life. This work expands existing numerical and analytical investigations on a model riser with constant curvature in shear flow condition. The results indicate that for a flexible model riser displaced in non-uniform shear flow when VIV occurred, the curvature shows substantial effects on lock-in response and multimode non-lock-in response. The modal coupling effect on lock-in response repeats the same effect on the structure in air, which indicates that modal coupling effect seems independent to the lockin phenomenon. This experimental investigation embeds the situation when displacing a flexible rubber cable with initial caterany shape stretching its bottom end to most tensioned straight condition for varying the curvature. The effect of varying curvature on the vibration characteristics of the rubber cable is identified when displaced in air. The same effect on the structure when vortex-induced vibration occurred is taken into account through a fan produced wind loading.

83 **Investigation into the Dynamic Effects of Lateral Buckling of High Temperature / High Pressure Offshore Pipelines**

Reda, Ahmed (1); Forbes, Gareth (1)
(1) Department of Mechanical Engineering, Curtin University, WA, Perth, Australia

ABSTRACT
A subsea pipeline laid onto a flat seabed will buckle laterally from a combination of pressure and temperature due to the pipeline's 'out-of-straightness'. The pipeline will tend to buckle laterally due to horizontal imperfections associated with the pipeline laying process, and the horizontal frictional restraint force is less than the pipeline submerged weight. The lateral buckling may take place as a dynamic 'snap' if the out-of-straightness, or imperfection, in the pipeline length is small. The pipeline 'snap' will result in dynamic motion. Seabed soil friction factors, in both axial and lateral directions, are also parameters which govern the lateral buckling, beside the size of the initial out-of- straightness. All of these parameters will influence the lateral buckling, and under which conditions dynamic buckling behaviour can occur. This paper investigates the influence of these different parameters and their effect on the onset of dynamic buckling.

160 **Transmission of vibration of a power transformer from the internal structures to the tank**

Jin, Ming (1); Pan, Jie (1); Huang, Hai (2); Zhou, Jianping (3)
(1) University of Western Australia
(2) Department of Instrument Science and Engineering, Zhejiang University, China 310027
(3) Shaoxing Substation, State Grid Corporation of China, China 310027

ABSTRACT
Vibration-based transformer condition monitoring aims to identify the conditions of a transformer's internal structures, such as its windings and core, by measuring the vibration of the transformer tank. The correlation between the vibration signals from the internal structures and those from the transformer tank is dependent on the characteristics of the transmission path between them. Such vibration transmission is determined by direct mechanical coupling between the internal structures and the tank, and by indirect coupling through the fluid-structure interaction. This paper examines the vibration transmission characteristics based on experimental work on a 110kV power transformer. A series of dynamic and electrical tests were conducted on the power transformer with and without transformer cooling oil. Both internal and tank vibration were measured simultaneously. The effects of the transformer cooling oil on the vibration transmission are discussed. Finally, optimal locations on the tank for vibration measurement and monitoring of the transformer internal structures are presented.

89 **Vibration control of pedestrian bridges**

Marks, Tim
Marshall Day Acoustics, Melbourne, Australia

ABSTRACT
Single arch bridges with pedestrian walkways spans of 50-200m have very low natural frequencies that are in the range 1-4Hz.

As those natural frequencies can potentially coincide with marching or walking step pacing frequencies, particularly for the case of large crowds, the control of pedestrian bridge vibra-

tion response is often essential particularly if there are lateral modes such as that occurred at the Millenium Bridge in London.

For a new pedestrian bridge in Melbourne, the response of a new dramatic design single span bridge was modelled and the expected response to crowds of up to 900 walking persons was predicted.

The modelling technique was validated by field tests on an existing timber pedestrian bridge. The results enabled appropriate vibration control to be specified and selected. Following completion of the bridge construction, dynamic testing was undertaken that included a Tuned Vibration Absorber (TVA) that was designed from the model study. Also, studies of the effect of crowd size on the bridge response, the possible effect of lateral motion synchronization with crowd movement and the criterion for vibration acceptance were related. These studies then enabled the TVA to be tuned and operated to restrict the bridge vibration amplitudes to a criterion value at peak pedestrian loads.

S06A Underwater communications
Friday 0845-1025, Room A

49 **Measurements of Doppler and delay spreading of communication signals in medium depth and shallow underwater acoustic channels**

Caley, Michael (1); Duncan, Alec (1); Ghiotto, Alessandro (2)
(1) Curtin University Centre for Marine Sciences and Technology, Perth, Australia
(2) L3-Communications Nautronix Ltd, Fremantle, Australia

ABSTRACT
Recent measurements of Doppler and delay spreading of underwater acoustic communication signals are presented for 84m and 14m deep marine environments off the coast of Perth, Western Australia. The data-sets are being utilised to develop a computer model of the transient Doppler and delay spreading effects of surface waves. The work supports the on-going development of a dynamic underwater acoustic communication channel simulator to assist the testing of modems and signalling strategies in varied conditions in a cost-effective manner.

84 **Experiments on Underwater Acoustic Communications Using Turbo-Encoded Sweep-Spread Signals**

Kebkal, Veronika (1); Kebkal, Anzhelika (1); Kebkal, Konstantin (1); Kebkal, Oleksiy (1)
(1) Evologics GmbH, Ackerstrasse 76, 13355 Berlin Germany

ABSTRACT
While using the turbo-codes in non-Gaussian channels the efficiency of turbo-decoding can be very poor. Deviations of signal characteristics from those expected for Gaussian channels may lead to mismatch of turbo-decoder metrics and thus lead to accumulation of decoding errors. This makes inappropriate the application of turbo-codes in underwater acoustic channels. In order to improve the signal in the receiver, making its characteristics to look more like Gaussian, Sweep-Spread Carrier Communication (S2C) technology has been applied. The use of the swept carrier provided conditions for suppressing or reducing the influence of non-synchronous multipath components onto the result of turbo-decoding. On the output of the complex correlator the ratio between the energy of synchronous multipath arrival and scattered energy of non-synchronous multipaths usually became significantly higher than such ratio on the receiver input. Moreover, the distribution of the signal became close to normal one, thus the use of S2C signals made the application of turbo-codes suitable for data transmissions in reverberant environments, what, in turn, provided noticeable increase in reliability of data transmission under condition of low signal-to-noise ratios. Paper describes experimental performance of a receiver combining optimal quadrature demodulator and turbo-decoder.

106 **Reliability in Underwater Acoustic Networks**

Ghiotto, Alessandro (1); Andronis, Nick (1); Dragojevic, Michael (1)
(1) L-3 Nautronix, 108 Marine Terrace Fremantle WA, Australia

ABSTRACT
The concept of communications networks for underwater sensors and systems is emerging as a viable and relatively inexpensive method for relaying sub-sea data to the broader terrestrial network. The underwater environment however, presents an extremely challenging and variable communication channel, and has thus far prevented the widespread commercial realisation of underwater networks. This paper describes the major pitfalls of underwater communications and the methods and principles that have been applied by L-3 Nautronix to maximise reliability in underwater communications services.

107 **Voices from the deep – Acoustic communication with a submarine at the bottom of the Mariana Trench**

Roberts, Paul (1); Andronis, Nick (1); Ghiotto, Alessandro (1)
(1) L-3 Nautronix

ABSTRACT
In March 2012 the first solo submarine dive to the bottom of the Mariana Trench was successfully completed by movie director and explorer, James Cameron. An Australian built submarine was piloted untethered 10.9 km downwards to the deepest ocean point on earth, whilst maintaining reliable voice and data communications to two surface vessels throughout the journey. This paper gives an account of the dive, and describes how the communications equipment was made to perform reliably in these unique circumstances.

118 **Practical issues of combined underwater acoustic communication and long-baseline positioning**

Kebkal, Oleksiy (1); Kebkal, Konstantin (1)
(1) EvoLogics GmbH, Berlin, Germany

ABSTRACT
Long baseline (LBL) acoustic positioning systems are widely covered in scientific publications and are available as commercial solutions. These systems are based on specific protocols and were designed to solve one particular task, namely the positioning of remote targets. This paper proposes a solution that extends the application range of such systems by combining them with underwater acoustic communication systems. A significant challenge for combining LBL positioning with digital communication is the media access control (MAC) protocol. This paper suggests a protocol for long baseline positioning, based on the use of hybrid MAC protocol, namely the D-MAC protocol, designed as general purpose data-link layer protocol for underwater acoustic communication and positioning. This paper demonstrates that the proposed algorithm ensures relia-

ble performance of the positioning system, describes the practical issues of LBL antenna deployment, including position estimation using sound velocity profile. Presented results were obtained by positioning of the optical modules of the Baikal Neutrino Telescope.

S06B Industrial noise and modelling
Friday 0845-1025, Room B

33 **Understanding variability in an ambient noise environment: implications for planning and mine noise management**

Sparke, Clayton
Senior Environmental Scientist, Advitech Pty Ltd, Newcastle, Australia

ABSTRACT
The New South Wales Industrial Noise Policy requires that monitoring be undertaken to characterise receiving environments, and subsequently develop impact assessment criteria for proposed developments. The minimum requirements for monitoring establish a need for only seven days of valid monitoring data for each of the day, evening and night monitoring periods, following application of meteorological exclusion rules. Analysis of approximately 12 months of monitoring data from a rural receiving environment adjacent to a NSW coal mine was undertaken to evaluate the variability in background noise levels, and to investigate the impact of the monitoring regime design on the resultant noise criteria. The paper will consider monitoring results and the potential risks that this may expose rural receivers and mining projects to in terms of mine design, planning, property acquisitions and noise management plans.

43 **The Harmonoise noise prediction algorithm: Validation and use under Australian conditions**

Bullen, Robert
SoundScience P/L, Level 4, 272 Pacific Hwy, Crows Nest, NSW, Australia

ABSTRACT
The most commonly-used algorithms for external noise level prediction in Australia are the ISO 9613 and CONCAWE algorithms, neither of which allows detailed investigation of propagation under adverse meteorological conditions. The ENM algorithm has been accepted and used for this purpose, but it is not open-source and the only software that implements it is now out of date and not supported. The European Harmonoise algorithm has been developed over more than 10 years, and offers a consistent method for prediction of noise levels under arbitrary meteorological conditions. It is implemented in open-source code, and has been validated to some extent in Europe. This paper provides a detailed comparison between Harmonoise and ENM predictions, as well as a comparison with measurement data recorded in Australia. Recommendations are made regarding the usage of the algorithm under Australian conditions. The software available from the Harmonoise project allows basic point-to-point calculations, and can be incorporated into more sophisticated modelling procedures.

48 **Environmental management of two industrial sites in NSW using Pollution Reduction Programs**

Tickell, Colin (1); Zammit, Lawrence (2); Schianetz, Karin (3); Collings, Stephen (1)
(1) Hatch Associates, Wollongong, Australia
(2) BlueScope Steel, Port Kembla NSW, Australia
(3) Boral Cement, New Berrima NSW, Australia

ABSTRACT
Regulation of noise emissions from major industrial facilities in NSW comes under the control of the EPA. Pollution Reduction Programs (PRPs) are one method that has been used to manage noise emissions from sites developed many decades before any pollution control acts came into being. Since 2003, two of the authors have been providing the consulting services for two major industrial sites subject to PRPs – Port Kembla steelworks and Berrima Cement works. This paper describes the components of the PRPs, the methods used to respond to them and progress in their implementation. Monitoring methods required for the studies included identifying background sound levels for sites that operate 24-hours per day 365 days per year. Noise source data-bases and identifying control options for major plant items were also a part of the studies.

151 **Assessment of Noise from CSG Pipeline Construction**

Matthew Terlich,
Savery and Associates Pty Ltd

ABSTRACT
The noise emissions from construction of gas and water pipelines is of interest to both government and individuals living nearby to the numerous coal seam gas (CSG) activities throughout Australia and particularly central Queensland. The construction of pipelines involves several crews working simultaneously on different activities and with different rates of progress in terms of kilometres completed per day. The noise emitted from each of these activities, from earthworks and trenching to welding are of significant interest as is the interaction between these activities, resulting in a potentially significant number of residences being affected, depending on the noise criteria. The typical activities associated with the construction of high pressure gas pipelines as well as gathering networks will be discussed along with the difficulties in modelling of these activities and determination of compliance with relevant noise criteria.

21 **Helicopter Noise Impacts on Hospital Development Design**

James, Aaron (1); Zoontjens, Luke (1)
(1) Norman Disney & Young, Level 10, 200 St Georges Terrace, Perth, Australia

ABSTRACT
Control of helicopter noise is currently a key driver in the design of facade systems and external building elements within major Australasian hospital developments. However, the issue lacks specific and objective guidance on acceptability within hospital environments from the local scientific and engineering community. This paper explores appropriate criteria for hospital developments, and commonly encountered practical issues in achieving them. From the literature there appears to be consensus that a maximum level around LAmax 45dB is the lower limit to avoid any sleep disturbance for frequent noise events. However, this target is often not practicable to achieve or reasonable in the context of ambient internal conditions and other design requirements. A maximum limit of no less than LAmax 65dB for general hospital wards and sensitive spaces appears

reasonable against the likely ambient noise levels from typical activities. Critically sensitive spaces identified as potentially benefiting from further acoustic controls (e.g. NICU / PICU, individual patient wards) should be carefully considered on a case by case basis.

S06C Marine environmental and bioacoustics 2
Friday 0845-1025, Room C

8 **Dhu they or don't they? A study of sound production by three fish species of commercial and recreational importance in Western Australia**

Parsons, Miles (1); Lewis, Paul (2); Longbottom, Simon (3); McCauley, Robert (1); Fairclough, David (2)
(1) Centre for Marine Science and Technology, Curtin University, Perth, WA, Australia
(2) Department of Fisheries, Government of Western Australia, Hillarys, WA, Australia
(3) Curtin Aquatic Research Laboratory, Curtin University, Perth, WA, Australia

ABSTRACT
Over 800 species of fish produce sound, for a variety of reasons including distress, spawning and agonistic behaviour. An increasing number of sparids have been shown to be soniferous, but while studies of glaucosomatids (pearl perches) have shown the presence of likely 'sonic' muscles confirmed reports of sound production in the wild has been elusive. In Western Australia, a project examined whether West Australian dhufish (Glaucosoma hebraicum), snapper (Pagrus auratus) and black bream (Acanthopagrus butcheri) produce sound. Recordings of dhufish, an iconic fish in Western Australia, have provided proof of sound production and some acoustic characteristics of dhufish sounds are presented. For black bream, while sounds were recorded at a known spawning location at a time of spawning, black bream could not be confirmed as the source. No confirmed evidence of sound production was found for snapper, either during spawning or upon capture. It is possible that in data-limited situations for fisheries, monitoring of sound-producing fishes using passive acoustic techniques could elucidate additional information about ecology, reproductive behaviour and relative abundance.

20 **Passive acoustic detection of Shark Bay dugongs (Dugong dugon)**

Parsons, Miles (1); Holley, David (2); McCauley, Robert (1)
(1) Centre for Marine Science and Technology, Curtin University, Perth, WA, Australia
(2) Department of Environment and Conservation, Government of Western Australia, Shark Bay, WA, Australia

ABSTRACT
Shark Bay, Western Australia is home to the one of the largest populations of dugongs (Dugong dugon) in the world. During winter months the dugongs predominantly reside in warmer western and northern waters of the gulfs, moving south between September and October as the shallower, more southern waters warm. Two underwater noise loggers, sampling at 12 kHz were deployed off Guichenault Point and Skipjack Point in Shark Bay's eastern gulf between the 16th September and 21st October, 2011 to record sounds produced in waters between 4 and 15 m depth. Speculated dugong calls were recorded sporadically throughout the deployment. However, on the 4th and 5th October several hours of biological 'short chirps' were recorded by the Guichenault Point logger. These calls displayed similar acoustic characteristics to chirps in previous reports, though of much shorter duration. Maximum received levels of 134 dB re 1µPa (±5.2 s.d., max = 143.3, min = 123.8) and maximum received sound exposure levels 114 dB re 1µPa2.s (±5.3 s.d., max = 121.9, min = 103.4) were observed from 40 calls. Mean spectral peak frequency of 333 Hz (±316, max = 3610, min = 1957) with a 6 dB down bandwidth of 2746 Hz (±1685, max = 5250, min = 731) over a duration of 0.2 s (±0.17, max = 0.7, min = 0.004) were observed over the group of calls. The calls were also split into 3 smaller types and the acoustic characteristics of these speculated dugong calls are discussed.

114 **Acoustic modification of tilapia behaviour**

McPherson, Geoff
Global Detection Systems, Cairns, Australia; Engineering & Physical Sciences, James Cook Uni, Cairns, Australia

ABSTRACT
Cichlid fish utilise sound to dominate conspecifics. The aggressive behaviour is thought to induce stress in males reducing reproductive success. A pilot project was developed to assess if sound could modify the behaviour of male Mozambique tilapia (Oreochromis mossambicus). 'Mouth fighting' (brief encounters involving the grasping of combatants jaws, a brief push-pull swimming behaviour associated with sound production) were observed and acoustically monitored in a small lake in the centre of Cairns, North Queensland. The exchanges were part of longer term agonistic chorusing between males defending adjacent territorial areas that were concluded by a 'terminating sound' from one male (the last sound in a series that was substantially greater magnitude than any other) that stopped sound production in the other male fish for several minutes. Agonistic exchanges could begin again although between different adjacent males defending territories. A 'terminating' sound generated by a male that was a clear winner of an agonistic exchange was used in a single playback experiment using a 50 watt amplifier and 10" subwoofer set in an air tube extending into the water. Communication by males over a wide area of adjacent territories immediately ceased yet a male O. mossambicus, larger than any previously observed, responded with physical confrontation to the sound source and generated agonistic sounds of shorter duration yet comparable intensity to the amplified sequence. The waveform envelope of the response sound was substantially different suggesting capability for variable responses to sounds. Potential exists for exploring the possibility of population control of this feral fish by utilising acoustic calls to interrupt social and reproductive behaviour. The project objective was to search for a sound that could be used to interfere with male social and reproductive communication and behaviour, as an attractant to males / females with relevance to an acoustic baited trap.

113 **Monitoring Ambient Noise from a European Perspective**

Thomsen, Frank
Ecology and Environment Department, DHI, Agern Alle 5, DK-2970 Hørsholm, Denmark

ABSTRACT
Several studies around the globe indicate that levels of ambient noise have been increasing over the least decades mainly due to increased shipping. Elevated levels of ambient noise could mask biologically relevant signals and could also compromise orientation along acoustic cues. The EU Marine Framework Strategy Directive (MSFD) aims to protect the marine environment across Europe. It sets out eleven high level descriptors of Good Environmental Status (GES). Descriptor 11 states that the 'Introduction of energy, including underwater noise, is at levels

that do not adversely affect the marine environment.' Continuous low frequency sound has been identified by the MSFD as one indicator for measuring good environmental status and member states are asked to provide information on trends in ambient noise levels measured by observation stations. However, baseline information in most regions is not readily available and the methodology for measuring ambient noise is also still in its infancy. Here, an overview of the history and the progress of monitoring ambient noise for the EU MSFD are provided. The requirements for monitoring are reviewed as well as suggestions for the analysis of the data and specifications of monitoing equipment. Finally, further work to realise ambient noise measurements across Europe will be mentioned.

38 **Fish choruses from the Kimberley, seasonal and lunar links as determined by long term sea noise monitoring**

McCauley, Robert
Centre for Marine Science and Technology, Curtin University, GPO Box U1987 Perth 6845 WA

ABSTRACT
Calling fish are a dominant component of Kimberley sea noise. Sea-noise loggers set in the Kimberley since 2004 under Industry and Defence funding have recorded a plethora of call types and choruses, where many fish call enmasse. Fish choruses show daily and seasonal periodicity and most show lunar periodicity. At the longest site sampled over 2006-2010 from Scott Reef southern lagoon, a chorus produced by nocturnal planktivorous fishes displayed coupled daily, lunar and seasonal trends with calling most intense over late evening from October to April, least intense over June to August, but continuing at some level all year. This chorus is believed associated with feeding. As a comparison a nearshore chorus produced by fish of the family Terapontidae is only produced over November to May, again at night. This chorus is believed associated with reproduction. As has been observed before, where multiple chorus occur each night which overlap in frequency content, time separation acts to reduce competition for the 'sound space'

S06D Vibration 3
Friday 0845-1025, Room D

76 **Order-Tracking with and without a tacho signal for gear fault diagnostics**

Coats, Michael (1); Randall, Robert (1)
(1) School of Mechanical and Manufacturing Engineering, University of New South Wales, Sydney 2052, Australia

ABSTRACT
Order-tracking is a method to remove speed fluctuations from a varying frequency signal allowing constant frequency based Machine Condition Monitoring (MCM) analysis techniques to be employed. Even small amounts of speed variation have to be compensated for by order-tracking when fine analysis is to be carried out, such as time synchronous averaging (TSA) for gear diagnostics. Some machines, such as wind turbines, have much more widely varying operating speeds, and so order-tracking is necessary before even basic diagnostics can be conducted. This paper describes a method whereby angular resampling can be carried out with and without a tacho signal, using progressive iterations in a multi-stage approach, even in the case of large speed variations. Measurements were made on a gear test rig with a faulty gear, with speed varying over a number of different ranges up to ±25%. Results show that speed fluctuations could be removed successfully allowing subsequent TSA and gearmesh demodulation techniques to correctly diagnose a seeded tooth root crack.

133 **Correlation of pump efficiency and shaft torsional vibration using torsional laser vibrometry**

Guzzomi, Andrew (1); Pan, Jie (1)
(1) School of Mechanical and Chemical Engineering, The University of Western Australia

ABSTRACT
The extensive use of centrifugal pumps in mining, potable water supply and sanitary installations potentially present an opportunity for energy savings through pump efficiency monitoring. Pumping units in these applications typically incorporate a flexible coupling between the motor and the pump. This coupling permits some shaft misalignment and provides vibration isolation. It is however unknown how significant torsional vibration is between the motor output and the impeller input. Changes in shaft torsional vibration could be a result of variations in the impeller's torque due to hydrodynamic loading, which may indicate the pump's efficiency. This paper presents a preliminary experimental study into the shaft torsional vibration on each side of the coupling of a centrifugal pump. This is achieved using a non-contact technique involving two torsional laser vibrometers. In addition to providing a correlation to pump efficiency, the method also permits the investigation of impeller angular velocity frequency content and these aspects are discussed in the context of current state-of-the-art in monitoring of pump's performance.

146 **A Study of Transformer Winding Vibration using a Laser Doppler Vibrometer**

Zheng, Jing (1); Pan, Jie (2); Hai, Huang (3)
(1) School of Mechanical and Chemical Engineering, The University of Western Australia; Department of Instrument Science and Engineering, Zhejiang University, China
(2) School of Mechanical and Chemical Engineering, The University of Western Australia
(3) Department of Instrument Science and Engineering, Zhejiang University, China

ABSTRACT
Many reported transformer failures are due to failures in the windings. Investigation of the behaviours of windings under different failure modes has become a focus for research into fault diagnosis of power transformer windings. In this paper, a laser Doppler vibrometer (LDV) is used to study the winding vibration of a single-phase disk-type power transformer with various causes of failure, such as loosening of winding clamping pressure and removal of insulation blocks on the winding. The results demonstrate that these causes can be identified and characterized by the pattern of surface velocities due to winding vibration. The winding's vibration pattern displays a significant change as the winding clamping pressure gradually decreases. Missing or shifting insulation blocks often lead to a rise in winding vibration and a change in the vibration pattern. The obtained spatial distribution of transformer winding vibration is useful for understanding the details of transformer vibration and for future study of the interaction between the winding and the transformer tank.

156 **Automated diagnosis of piston slap faults in internal combustion engines: based on a simulation model**

Chen, Jian (1); Randall, Robert (1); Peeters, Bart (2); Van der Auweraer, Herman((2)
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(2) LMS International, Interleuvenlaan 68, B-3001 Leuven, Belgium

ABSTRACT
The lateral motion of the piston is an inherent kinematic characteristic of reciprocating Internal Combustion (IC) engines. Piston slap is a common mechanical fault in the engine operation. Oversized clearance from scuffing or wear leads to excessive impacts between the piston and cylinder inner wall. Up to now, many researches have investigated the dynamic process of piston slap and some of them have proposed using vibration signals measured on the surface of the block to detect and identify the piston slap faults. However, during the implementation process, all the methods require an expert to interpret the analysis results from measured vibration signals. An Artificial Neural Network (ANN)-based automated system for piston slap diagnosis is described in this paper. The automated diagnostic system consists of three main stages: fault detection, fault localization and severity identification. Simulation models were built to simulate different piston slap faults. Instead of having to experience large numbers of piston slap faults in experiments, simulated data with added random variations (based on a small number of experiments) provided sufficient input data to train the networks. Recent advances by the authors in simulating piston slap are also described in this paper. The effects of the lubrication oil and piston ring were modelled as fixed (free) length spring/damper units, smaller than the clearance. In order to validate and update the simulation model, a small number of experiments with normal clearance and two different oversized piston/inner wall clearances were carried out. Signal processing techniques were applied to extract diagnostic features from the vibration signals. Finally, the experimental cases were used to test the performance of the networks and the results have demonstrated that the developed system can efficiently diagnose different piston slap conditions, including location and severity.

162 **Periodic stiffness of a cracked shaft**

Wu, Helen
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ABSTRACT
Shaft fatigue crack is one of the most common defects in rotating equipment, due to its extensive operation with continuous heavy loads. Finding an efficient way to evaluate the true stiffness variation due to the crack rotation is the key step to develop both on-line and off-line crack diagnostic techniques. This study analyzed time-variant bending stiffness of elastic shafts with experimentally-induced fatigue, welding and wire cut transverse cracks. It was found that crack gap has a significant effect on the opening and closing behaviour of the transverse crack. As in the case of a cut crack, large crack gap could completely prevent the crack from closing during rotation. A fatigue crack without a clear gap shows a typical opening and closing behavior. Further, it remains fully closed within a small angular range and most of time it is partially closed. It was also observed that both switch and harmonic models cannot describe periodic stiffness variation well enough to represent the actual breathing function of the fatigue crack.

S07A Sonar signal processing
Friday 1055-1155, Room A

23 **Method for the Generation of Broadband Acoustic Signals**

Swincer, Paul (1); Nguyen, Binh (2); Wood, Shane (2)
(1) School of Electrical and Electronic Engineering, University of Adelaide, Adelaide, Australia
(2) Maritime Operations Division, Defence Science and Technology Organization, Edinburgh, Australia

ABSTRACT
Conventional active sonar systems use narrowband pulsed waveforms. It is suggested that using broadband acoustic pulses will exploit more details of the acoustic scattering from the target target, medium and the environment that will assist in the development of improved target detection and classification algorithms. Problems of generating broadband signals such as resonances, distortion and ripples have been studied by several researchers. In this paper, we explore several aspects of the problem including methods for equalisation of the amplifier and transducer used to transmit the pulses. Several approaches for equalising the received pulses are also examined.

28 **Diver Detection and Localization Using Passive Sonar**

Lo, Kam (1); Ferguson, Brian (1)
(1) Maritime Operations Division, Defence Science and Technology Organisation, 13 Garden Street, Eveleigh, NSW 2015 Australia

ABSTRACT
An open-circuit scuba diver's acoustic signature (radiated sound) consists predominately of a sequence of regularly spaced wideband pulses each corresponding to the inhaling phase of the diver's breathing cycle. A cyclic frequency analysis of the output signal from a single hydrophone leads to the automated detection of the diver and an estimate of the diver's breathing rate. Measurement of the differential time of arrival (DTOA) of the radiated sound at a pair of widely separated hydrophones requires computation of the wideband cross-ambiguity function. By fitting a DTOA model to the measurements for pairs of sensors over a sufficiently long period of time enables estimation of the diver's motion parameters. Results are presented for real data collected in a shallow water experiment where an open- circuit scuba diver swam at constant speed and altitude above and along the axis of a horizontal linear array which consisted of eight hydrophones uniformly spaced at 14 m and located 1 m above the sea floor.

36 **Passive acoustic detection and tracking of targets in harbour environments using hydrophone arrays**

Pusey, Grant Mark (1); Allen, John (1); Siderius, Martin (2)
(1) Department of Mechanical Engineering, University of Hawaii at Manoa, Honolulu, HI, USA
(2) Department of Electrical and Computer Engineering, Portland State University, OR, USA

ABSTRACT
A series of experiments conducted outside Honolulu Harbor sought to help determine the effectiveness of various underwater target detection and tracking methods using passive acoustics. Two 24-element hydrophone arrays were deployed in a depth of approximately 10 m, in an area of high ambient noise levels and vessel activity. The instruments were powered ex-

ternally and operated continuously for several days, collecting ambient noise data during off-peak times. Array orientation was modified during the field trials to determine the effectiveness of different geometries. Targets deployed in the area for tracking included open circuit (scuba) divers, rebreather divers, fast water craft and an Autonomous Underwater Vehicle (AUV). This paper presents the initial tracking results for scuba divers and vessels, including small craft and large cruise ships.

S07B Urban noise
Friday 1055-1155, Room B

37 **Evaluating aural comfort in tropical high-rise environment**

Alam, Sheikh Mahbub (1); Lee, Siew Eang (1)
(1) Department of Building, National University of Singapore

ABSTRACT
This study endeavours the evaluation of daytime 'Acoustic Comfort' among the high-rise apartment dwellers in tropical Singapore. Based on a holistic evaluation framework that is founded on Stallen's (1999) theory of noise annoyance and the profound theory of Evaluation Response Model (ERM), a multinomial logistic regression model for aural comfort is developed. The comfort model has been established based on extensive noise survey and objective evaluation of the aural environment of the subjects. Aural comfort is found related to the noise exposure level, the subjective perceptions of noisiness within the apartments and the level of subjective disturbances due to dominant noise sources that includes road traffic noise and train noise. The validation of the model has been done through a psychoacoustical investigation in laboratory environment. Absolute evaluation, mixed evaluation and paired-comparison evaluation techniques have been used for subjective evaluation of the binaurally recorded objective sound levels in laboratory environment. The analysis shows that 'moderate' favourable subjective perception is observed in semantic space for road traffic sound at a level of 55 dB(A), at a mean loudness of 10 sone and at a five percentile roughness of 28 centi-asper. For train noise, a 'moderate' favourable subjective perceptions is observed in semantic space at a level of 56 dB(A), at a five percentile loudness of 10 sone, at a five percentile sharpness of 1.35 acum and at a mean roughness of 26 centi-asper.

132 **Evaluation of noise emissions from an evaporative air conditioning unit and their environmental impact**

Hongmei, Sun (1); Fenton, Rhys (1); Popoff-Asotoff, Peter (2); Jingnan, Guo (2); Macpherson, John (1)
(1) School of Mechanical and Chemical Engineering, University of Western Australia, WA, 6009
(2) Department of Environment and Conservation, WA, 6000

ABSTRACT
Noise from evaporative air conditioners has long been an environmental issue. There is neither an existing database for its estimation nor a cost-effective method to control it. This paper provides in situ measured sound power levels from a number of evaporative air conditioners used in residential areas in Western Australia. By analysing the frequency characteristics of the sound power with respect to the modes of operation, conditions of installation and noise propagation, useful information is summarised for evaluating the environmental noise impact of evaporative air conditioners.

138 **Influence of upwind turbines on wind turbine sound power output**

Cooper, Jon (1); Evans, Tom (1)
(1) Resonate Acoustics, 97 Carrington Street Adelaide, SA 5000, Australia

ABSTRACT
One of the more common objections raised regarding acoustic assessments of proposed or existing wind farms is lack of accuracy of the noise modelling. In particular, objectors often allege that the modelling fails to consider a significant increase in sound power output of the turbines that may result when the turbine is in the wake of an adjacent wind turbine. This paper quantifies the increase in turbine sound power level that results when a turbine is in the wake of an adjacent turbine, through comparison of wake and non-wake affected sound power measurements at a site where a turbine was located at the end of a line of turbines. It was found that, while there may be a minor increase in noise levels at low wind speeds, this increase was inconsistent and did not occur at higher wind speeds where the turbine sound power is greatest. Furthermore, it is likely that this increase would be offset by the reduction in wind speed at the turbine resulting from the wake created by the upwind turbines.

S07C Marine environmental and bioacoustics 3
Friday 1055-1155, Room C

34 **Real-time tracking of blue whales using DIFAR sonobuoys**

Miller, Brian Seth
Australian Marine Mammal Centre, Australian Antarctic Division, 203 Channel Highway, Kingston, Tasmania 7050 Australia

ABSTRACT
Passive acoustic tracking of blue whales has been proposed as a key component in a strategy to obtain a circumpolar abundance for Antarctic blue whale as proposed in a project of the IWC Southern Ocean Research Partnership. While a theoretical basis for passive tracking of blue whales has been demonstrated, there are substantial differences between these theoretical scenarios and a fully-operational, dedicated, real-time, tracking program. Because passive acoustic tracking relies upon the use of complex electronic systems, it is important to understand the capabilities and limitations of the hardware and software that comprise the system in order to understand what constitutes sensible use. We present preliminary results from two research voyages where a fully-operational, dedicated, real-time tracking system was used to locate blue whales over distances of more than 60 km. In order to test the tracking system locally before embarking upon an expensive Antarctic voyage, pygmy blue whales in Northern Bass Strait were used as a surrogate for Antarctic blue whales in the Southern Ocean. The core element of the acoustic tracking system consisted of DIFAR sonobuoys, VHF radio receivers, and custom analysis software driven round the clock by a team of acousticians. The tracking system operated continuously during the voyages, recording nearly 500 hours of audio, while acousticians processed over 7000 blue whale calls all in "real-time". During the 20 days at sea 32 vocalising blue whales were "targeted" and, of these, 29 yielded visual sightings of one or more blue whales giving a combined success rate greater than 90%. While there are many differences between the Bass Strait and the colder waters around Antarctica, acoustic detection ranges of blue whales in the Southern Ocean far outstrip visual sighting rang-

es, so real-time acoustic tracking may be able to increase the total number of whale encounters, thus making more efficient use of expensive ship time. The success of the real-time tracking system during these two voyages supports the use of acoustics as a key tool in determining the circumpolar abundance of blue whales in the Southern Ocean.

130 **Clumped distribution of vocalising dugongs (Dugong dugon) monitored by passive acoustic and visual observations in Thai waters**

Ichikawa, Kotaro (1); Akamatsu, Tomonari (2); Shinke, Tomio (3); Arai, Nobuaki (4); Adulyanukosol, Kanjana (5)
(1) Research Institute for Humanity and Nature, Kyoto, Japan
(2) National Research Institute for Fisheries Engineering, Ibaraki, Japan
(3) AquaSound Inc., Kyoto, Japan
(4) Graduate School of Informatics, Kyoto University, Kyoto, Japan
(5) Marine and Coastal Resources Research Center, Samut Sakhon, Thailand

ABSTRACT
Distribution pattern of dugongs is a key component for space-based managements. Vocal interaction of dugongs may result in a distinctive distribution pattern. This study described the distribution patterns of vocalising dugongs, solitary and cow-calf pairs of dugongs. Total of 31 hours and 24 minutes of aerial surveys over southern Thai waters were conducted to observe distribution of the dugongs in 2006, 2008 and 2010. We also conducted towed acoustic surveys to observe the distribution of vocalising dugongs. Total of 473 adult dugongs and 122 calves and 223 vocalizations were found. The distribution of vocalising dugongs was clumped with the range of about 1 km^2. Groups with cow-calf pairs (9 animals on average) were also clumped. Their distribution range was about 3 km^2 and did not overlap that of vocalising dugongs. Average number of individuals in groups without cow-calf pairs was about 1, indicating that the most of the group members were solitary. They distributed widely throughout the focal area with the distribution range of about 41 km^2.

148 **Passive acoustic monitoring of baleen whales in Geographe Bay, Western Australia**

Salgado Kent, Chandra (1); Gavrilov, Alexander (1); Recalde-Salas, A (1); Burton, C (2); McCauley, Robert (1)
(1) Centre for Marine Science and Technology, Curtin University. Perth,WA. Australia
(2) Western Whale Research Pty. Ltd, Dunsborough, Western Australia, Australia

ABSTRACT
Baleen whales were monitored in Geographe Bay, Western Australia between 2008 and 2011 using passive acoustics. We aimed to monitor migratory timing through Geographe Bay, characterise whale vocalizations, and estimate detection ranges of vocalising whales in different background noise conditions. The results indicated that humpback and blue whales migrated through Geographe Bay every year, however the frequency and timing of their vocalisations varied among years. Humpback whale songs changed in composition among years, but most energy was consistently between 200-500 Hz. Blue whale calls were those of the eastern Indian Ocean pygmy blue whale with low quasitonal sounds with harmonics ranging from 20-100 Hz and variable down-sweep impulses with frequencies decreasing from ~100 Hz to ~20 Hz. No significant changes in calls were observed among years. Based on a range independent propagation model, the detection range for vocalising pygmy blue whales was estimated to be between 6-8 km, and for humpback whales ~20-30 km. The prevalence of high levels of noise from vessel traffic affected the detection range significantly for passive acoustic monitoring, and would have also affected the capacity for whales to communicate and perceive important cues in their environment.

S07D Discussion forum
Friday 1055-1155, Room D

169 **Aircraft noise discussion forum – Scope for revision of AS2012:2000?**

Tickell, Colin
Hatch Associates, Wollongong, Australia

ABSTRACT
Following from the National Airports Safeguarding Framework (NASAG) report earlier this year, there has been a call for revision of AS2021:2000 Acoustics-Aircraft noise intrusion-Building siting and construction. AS2021 has been widely used in land use planning and building design around major airports, and uses as its basis the ANEF (Australian Noise Exposure Forecast) metric. The NASAG report (Guideline A) envisaged reference to 'a broader suite of assessment metrics' than ANEF for land use planning purposes.

Any review of AS2021 is likely to begin with a scoping process for the review, and Acoustics 2012 is an opportunity to bring to the table the thoughts of many interested persons with expertise in aircraft noise. The forum will focus on identifying and discussing issues relevant to a review of AS2021, with the objective of providing feedback to Standards Australia to assist with the scoping process. Some of the questions may be:
- Does ANEF need to be revisited?
- Are there other metrics, e.g. N60, that should be considered for land use planning purposes?
- What metrics are appropriate for general aviation, military and regional airports?
- In what ways does AS2021 need updating generally, e.g. the table of aircraft noise levels?

S08 Plenary 2 - Geoacoustic perspectives, Ross Chapman
Friday 1200-1240, Room A

96 **Geoacoustic perspectives: what have we learned about modelling sound propagation in the ocean bottom**

Chapman, Ross
School of Earth and Ocean Sciences, University of Victoria, Victoria, BC, Canada

ABSTRACT
This paper reviews the development of geoacoustic inversion as a statistical inference process to estimate geoacoustic model parameter values and their associated uncertainties. Nonlinear inversion methods are examples of model-based signal processing techniques that were enabled by the introduction of efficient numerical techniques for searching multi-dimensional model parameter spaces. Applications of inversions based on acoustic pressure field data (matched field processing methods) are discussed and analysed. The paper concludes by pointing out limitations in the present day inversion techniques that can severely limit performance, and discusses some new approach-

es that provide robust performance without compromising the accuracy of the estimated model parameters.

S09A Underwater acoustic modelling and measurement 3

Friday 1340-1520, Room A

70 **FMBEM analysis of sound scattering from a damping plate in the near field of a hydrophone**

Wilkes, Daniel (1); Alexander, Polly (2); Duncan, Alec (1)
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(2) Australian Maritime College, UTAS, Maritime Way, Launceston, TAS 7248, Australia; Intelligent Sensing and Systems Laboratory, CSIRO ICT Centre, Hobart, TAS, 7000, Australia

ABSTRACT
As part of research into the effect of underwater noise on the communication between an under-ice Autonomous Underwater Vehicle (AUV) and it's stationary launch vessel (the Aurora Australis), fast multipole boundary element method (FMBEM) acoustic modeling was conducted. In particular, a steel damping plate with a complex 3-dimensional structure was modeled (using up to 1.6 x 10^5 boundary elements) and the effect of sound scattering from a pinger near the ship was determined at the receiver hydrophone, which was in close proximity to the damping plate. The direct incident field from the pinger was modeled as a plane wave at a number of incidence angles (to account for the depths to which the hydrophone was lowered) and over a range of frequencies up to the pinger frequency of 10kHz. This paper presents these results and discusses some of the interesting effects observed at the 'non-unique' frequencies when using the different methods available to provide stability to the numerical solution. Thus far, the modeling conducted for the damping plate has treated the object as rigid. The FMBEM code being developed at CMST now has the capability to model fully coupled fluid-structure interactions and some initial results from treating the damping plate as elastic are also presented.

134 **Sound radiation of a plate into a reverberant water tank**

Pan, Jie
School of Mechanical and Chemical Engineering, University of Western Australia, WA, 6009

ABSTRACT
This paper presents a study on sound radiation from a finite plate into a reverberant water tank and its dependence on the modal coupling of the plate's modes through their radiating field. The results of this study are compared with that of sound radiation of the plate into a free space for establishing a general understanding of the effects of fluid loading on the structural vibration and sound radiation into various spaces.

15 **Recorded noise as a source for measurement of propagation loss**

Tindle, Chris (1); Jeffs, Andrew (2); Ghazali, Shahriman (2); Radford, Craig (2)
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(2) Leigh Marine Laboratory, University of Auckland, PO Box 349, Warkworth 0941, New Zealand

ABSTRACT
Repetitive bursts of recorded reef noise were broadcast from an underwater loudspeaker and used to measure propagation loss in shallow water. The method has advantages because sound levels in the bandwidth of interest can be measured directly and give a simple determination of attenuation due to bottom interaction. Surface scattering can be neglected because it does not contribute to energy loss when the signal of interest is recorded noise. A comparison of summer and winter results gives a direct measure of the extra propagation loss due to downward refraction.

18 **An Application of Range-Frequency Striations to Seafloor Inversion in Shallow Oceans**

Jones, Adrian (1); Bartel, David (1); Clarke, Paul (1)
(1) Defence Science and Technology Organisation, P.O. Box 1500, Edinburgh, SA 5111, Australia

ABSTRACT
For shallow oceans, as is well known, multi-path interference generates a pattern of striations when broadband data received from a source are viewed on a range-frequency display. The frequency variations within this data are known to be related to the ocean depth, and to the seafloor acoustic properties (Jones and Clarke, Proceedings of 20th Intl. Congress on Acoustics, ICA 2010). Using a process in which the frequency spacing of the data is extracted, it is shown that a reasonable description of the seafloor acoustic properties may be inverted from the striations. The technique is demonstrated by simulations for a seafloor consisting of a uniform half-space.

16 **Shallow Water Seafloor Inversion using Ship-generated Striation Patterns**

Clarke, Paul (1); Jones, Adrian (1)
(1) Defence Science and Technology Organisation, P.O. Box 1500, Edinburgh, SA 5111, Australia

ABSTRACT
The accuracy of transmission loss model predictions in a shallow water environment is typically highly dependent on the acoustic reflectivity of the seafloor. Using sediment type databases can help determine the seafloor reflectivity, but a lack of data and conversion to acoustic properties limits reflectivity estimation accuracy. A method of inferring the seafloor reflectivity from the striation pattern produced by a ship as it transits past a hydrophone is demonstrated. This method expands on a technique devised previously (Jones and Clarke, Proceedings of 20th Intl. Congress on Acoustics, ICA 2010) in which seafloor reflectivity was inferred from multi-path interference of broadband, including impulsive, transmissions. This paper discusses the application of the striation-based method to ship data obtained from a trial conducted in shallow water off Perth, Western Australia. This includes comparisons of measured transmission loss with transmission loss model predictions using (i) sediment grabs, (ii) the impulsive inversion technique, and (iii) the striation-based inversion technique.

S09B Wind farm noise 1

Friday 1340-1520, Room B

139 **Influence of wind direction on noise emission and propagation from wind turbines**

Evans, Tom (1); Cooper, Jon (1)
(1) Resonate Acoustics, 97 Carrington Street, Adelaide, South Australia 5000

ABSTRACT
Noise predictions undertaken for wind farms generally seek to

determine noise levels under worst case conditions, which are normally cited as being conditions when the receiver is located directly downwind of a wind turbine. In practice, it is rare for a receiver to be located directly downwind of all of the wind turbines that form a wind farm. In some cases, a receiver may be located between two groups of turbines, such that when it is downwind of one group of turbines it will be upwind of the others. This paper presents an analysis of noise measurements taken over two weeks at a range of distances from a modern wind turbine. The aim of the analysis is to determine the relative noise emissions from the wind turbine and propagation of the noise over distance under various wind conditions. Understanding the influence of wind direction on noise propagation allows for more accurate noise predictions, the assessment of noise exposure of receivers under various conditions and the potential suitability of wind sector management as a noise mitigation option for wind farms.

6 **Variations in sound pressure levels under random change of atmospheric conditions**

Lenchine, Valeri
Science & Assessment Division, SA Environment Protection Authority

ABSTRACT
Variations in sound power of many environmental noise sources have certain limits. Changes in the environmental conditions also evoke deviations in the measured sound pressure levels within certain boundaries. A span of the possible changes in the noise levels associated with a particular noise source is normally less for consequent time intervals. Its limits can be established from feasible changes of atmospheric conditions and sound power of the source. Measured sound pressure levels (SPLs) of a noise source represent a sequence of probable magnitudes that vary within certain limits. In some cases, variations of the SPLs can be treated as a Markov chain and respectively be explored using statistical methods. It is shown that under certain assumptions the random noise contribution variations tend to be periodic. Conclusions about character of signal from source of interest can be obtained from measurements when the source controls the total noise. Information about the SPLs variations can be utilised for data analysis aiming to calculate noise contribution from a particular noise source. Analysis of data pertained to monitoring of wind farm noise is considered as a case study. The suggested technique can be engaged to extract wind farm noise from SPL logging data without employment of special instruments or excessively complex procedures. If necessary, it can be adopted for other applications.

42 **Wind farm noise – what is a reasonable limit in rural areas?**

Hansen, Kristy Lee (1); Henrys, Nicholas (1); Hansen, Colin (1); Doolan, Con (1); Moreau, Danielle (1)
(1) School of Mechanical Engineering, Adelaide University, Australia

ABSTRACT
Wind farms are a rapidly growing source of renewable energy, but can be a source of persistent noise complaints, despite compliance with the relevant wind farm noise regulation being achieved. This paper presents a review of wind farm noise assessment criteria and methodology with a focus on the South Australian guidelines. The results of this review indicate that the noise limits may not be appropriate for some locations which are characterised by very low background sound levels at night time. The assumption in the guidelines that background noise is capable of reducing annoyance from wind farm noise is also not necessarily borne out in reality. Measurements of the outdoor-to-indoor noise reduction for a typical dwelling, with the window open, show that the reduction is slightly lower than assumed by the guidelines, and varies significantly with frequency. Measured low frequency noise and infrasound complied with all criteria addressed in the literature with the exception of one. Reliable compliance measurements are often difficult to achieve for wind farm noise, therefore it seems appropriate to adopt a conservative approach in setting noise limits and predicting noise emissions.

45 **A personal perspective on trends and changing emphasis in UK wind farm noise assessments**

Simpson, Pete
Sinclair Knight Merz, Perth, West Australia

ABSTRACT
This paper draws on the author's previous experience as a noise consultant and specifically as a UK Expert Witness at Public Inquiries and Planning Committees in the UK from 2005 to 2011 to consider emerging themes and changes in wind farm assessment over the last 7 years. The paper looks at trends in the focus of assessments, changes in techniques and in the level of detail, and then considers some of the factors that have lead to these trends. In summary, the paper draws out parallels and discussion points for how future wind farm noise assessment trends could develop in Australia. Through reviewing the key issues presented as evidence, the paper considers the related changes in public perception to windfarm noise including the organisation of groups opposed to schemes, as well as the spread of ideas and perceptions through internet forums. From this follows a discussion of how differing scrutiny from various bodies helps to drive the direction of assessment trends, whether it is due to pressure from specific focus groups or the championing of causes from consultants. A brief consideration of current noise topics discussed in the public domain in Australia will provide lead-in discussion points for how the approval challenges currently facing on-shore wind development in the UK could be mirrored or avoided in Australia.

59 **Characterisation of noise in homes affected by wind turbine noise**

Nobbs, Benjamin (1); Doolan, Con (1); Moreau, Danielle (1)
(1) School of Mechanical Engineering, The University of Adelaide, Adelaide, Australia

ABSTRACT
A growing need for low carbon energy production necessitates the use of renewable resources such as wind power. However, residents living near wind farms often state that annoyance due to wind farm noise is a serious problem that affects their well-being. This paper describes a new methodology for recording noise and annoyance within residents' homes affected by wind turbine noise. The technique records time-series noise measurements allowing complete analysis of the signal using a variety of post processing techniques. Preliminary results from the system in a single home near a wind farm are presented including overall sound pressure level with A, C and Z weighting, narrow band frequency spectrum and amplitude modulation depth correlated with resident rated annoyance level. This information provides insight into the nature of noise in homes close to wind farms.

S09C Acoustic characterisation of marine habitat
Friday 1340-1520, Room C

71 **Can singing be used to predict critical habitats?**

Rogers, Tracey (1); Ciaglia, Michaela (1); Klinck, Holger (2); Southwell, Colin (3)
(1) Evolution & Ecology Research Centre, School of BEES, University of New South Wales, Sydney, New South Wales, Australia
(2) Cooperative Institute for Marine Resources Studies, Oregon State University and Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration
(3) Australian Antarctic Division, Department of Sustainability, Environment, Water, Population and Communities

ABSTRACT
Climate-induced changes may be more substantial within the marine environment, where following ecological change is logistically difficult, and typically expensive. As marine animals tend to produce stereotyped, long-range signals, they are ideal for repeatable surveying. In this study we illustrate the potential for calling rates to be used as a tool for determining habitat quality. With a good understanding of the vocal behaviour of the species, their seasonal and diurnal patterns, sex and age-related differences, an underwater passive-acoustic survey conducted alongside a visual survey in an arc of 4,225 km across the Davis Sea, Eastern Antarctica, showed that while acoustic and visual surveys identified similar regions as having high densities, the acoustic surveys surprisingly identified the opposite regions as being 'critical' habitats. We propose that density surveys of species that cannot be differentiated into population classes can be misleading because overall density can be a negative indicator of habitat 'quality' for some species where dominant individuals secure space in prime habitats.

66 **Seabed mapping of key ecological features of the Australian continental margin**

Kloser, Rudy (1); Keith, Gordon (1)
(1) CSIRO

ABSTRACT
Key Ecological Features (KEFs) are those features of the marine environment that are not specifically protected under the Environment, Protection and Biodiversity Conservation Act 1999 (EPBC Act), however, are considered to be important or unique characteristics of the region. Seamounts, canyons and shelf edge rocky reefs have been proposed as KEFs in marine regions and knowledge of their distribution, morphology and substrate composition around the continental margin is needed. A multibeam echosounder mapping program based on research and opportunistic transit voyages from the marine national facility MRV Southern Surveyor has been providing hi-resolution bathymetry and backscatter maps since 2004. A consistent approach of interpreting acoustic backscatter to infer ecological hard and soft substrate that maximises the spatial resolution whilst minimises sources of error was developed in conjunction with a seabed scattering model. In particular minimisation of errors due to changing absorption with temperature and depth, calibration drift, pulse length and incident angle were required. The consistent nationally applied acoustic backscatter processing method is highly correlated with visual and physical sampling of the seabed as well as mega fauna diversity. Mega fauna diversity of 6 taxon grouping ~2000 species is highly correlated to both the seabed hardness and the depth of sampling. For shelf incising canyons and deep reefs we document their distribution, morphology and substrate composition around the Australian continental margin.

93 **High-frequency seafloor acoustic backscatter from coastal marine habitats of Australia**

Parnum, Iain (1); Gavrilov, Alexander (1)
(1) Centre for Marine Science and Technology, Curtin University, Perth, Western Australia, Australia

ABSTRACT
Backscatter strength versus incidence angle has been measured from a variety of seafloor types from Australian coastal waters using a Reson Seabat 8125 multibeam echo-sounder (MBES) operating at 455 kHz. MBES surveys were carried out at six sites around Australia (between 2004 and 2006). Seafloor habitats surveyed in this study included: seagrass meadows, rhodolith beds, coral reef, rock, gravel, sand, muddy sand, and mixtures of those habitats. The highest backscatter strength was observed not only for the hard and rough substrate, but also for marine flora, such as rhodolith and seagrass. The main difference in acoustic backscatter from the different habitats was the mean level, or angle-average backscatter strength. However, additional information was also obtained from the rate of change (or slope) of backscatter strength with incidence angle. Overall, analysis of MBES backscatter data found at least six different seafloor habitats could be identified, in descending order of their average backscatter strength: 1) Rhodolith, 2) Coral, 3) Rock, 4) Seagrass, 5) sand-dominated bare (i.e. no epibenthic cover) sediment, 6) mud-dominated bare (i.e. no epibenthic cover) sediment.

110 **Topics In Acoustic Seabed Segmentation – Current Practice, Open Software, and Data Fusion**

Hamilton, Les

ABSTRACT
The primary topic of this presentation is the inference of seabed characteristics from multibeam sonar backscatter data. This process may be carried out using one or more of four different approaches. These are feature analysis, image processing, inverse modelling, and use of part or all of the backscatter curve as a geometric entity. Acoustic seabed segmentation from single beam systems (echosounders) is also briefly discussed as a prelude to two other topics. These are (1) fusion of seabed acoustic data obtained from different types of acoustic systems (single beam, sidescan sonar, and multibeam sonar), and (2) the growing call for open software for acoustic seabed segmentation. Fusion of acoustic seabed segmentation data has received little attention, whether for data from the same types of acoustic instruments, or for different types. Sufficient detail has been published on method and theory of acoustic seabed segmentation for open software to be a reality, although the benefits of commercial software may prove more useful to many users.

165 **Using multibeam echo-sounder backscatter to characterise the seafloor of Davis Harbour, Antarctica: preliminary results**

Mair, Elizabeth (1); Parnum, Iain (2); Schut, Tom (1)
(1) Department of Spatial Sciences, Curtin University, Perth, Western Australia, Australia
(2) Centre for Marine Science and Technology, Curtin University, Perth, Western Australia, Australia

ABSTRACT
A seafloor survey of Davis Harbour and surrounding coastal

areas in Antarctica was carried out by Geoscience Australia (GA) between January and March 2010. The survey was conducted using a Konsberg-Simrad EM 3002 multibeam echo sounder (MBES). Processing and analysis of the bathymetry data was carried out by GA. This is a separate desktop study that used CARIS HIPS and SIPS version 7.1 software to process and analyse the acoustic backscatter data collected by the MBES to characterise the seafloor substrate. This paper presents preliminary results of the seafloor backscatter map and the outputs of the Angular Range Analysis model implemented in CARIS.

S09D Vibration 4
Friday 1340-1520, Room D

77 **Optimisation of an Inertial Mechanism within a Uni-Axial Vibration Isolator to Suppress Internal Resonance**

Dylejko, Paul
Maritime Platforms Division, Defence Science and Technology Organisation, Fishermans Bend VIC 3207, Australia

ABSTRACT
Internal resonances within vibration isolators have been shown to increase force transmissibility and radiated noise from supporting structures. This paper theoretically investigates the optimal use of an inertial mechanism within a uni-axial vibration isolator to reduce the influence of these internal resonances. The inertial mechanism under consideration is associated with a device which exerts an inertial force proportional to the relative acceleration of its connection points. Examples of such devices include dynamic antiresonant vibration isolators, resonance changers and inerters. It has been shown that these devices can be used to establish suppression bands in vibration transmission. Previous research has examined the use of such a device for attenuating low frequency vibration transmission. This work considers the inertia of the isolator and minimises the force transmissibility over a wider frequency range to include the effect of internal resonances. The optimisation is carried out using a combination of a particle swarm and gradient based optimisation algorithm. It is shown that this isolator configuration has the potential to reduce the force transmissibility to levels approaching an ideal vibration isolator over a wide frequency range.

143 **Structural responses of a fluid-loaded cylinder/plate structure using deterministic and statistical approaches**

Wu, Hongjian (1); Nicole, Kessissoglou (1); Mace, Brian (2)
(1) School of Mechanical and Manufacturing, University of New South Wales, Sydney, Australia
(2) Department of Mechanical Engineering, University of Auckland, Auckland, New Zealand

ABSTRACT
This work studies the dynamic responses of a coupled fluid-loaded cylinder/plate structure. The cylindrical shell closed at each end by circular plates is driven by an axial force applied centrally to one end plate, resulting in an axisymmetric case. Analytical expressions for the axial and radial displacements of the cylindrical shell are derived. The spatially and frequency averaged energy due to radial motion of the cylindrical shell is compared with results obtained from a Statistical Energy Analysis (SEA) model. Results from a fully coupled finite element /boundary element (FE/BE) model are also presented. The dynamic responses estimated by the deterministic and stochastic approaches are discussed.

95 **Effect of Internal Mass Isolation on the Radiated Sound Power of a Submerged Hull**

Peters, Herwig (1); Kinns, Roger (1); Kessissoglou, Nicole (1); Marburg, Steffen (2)
(1) School of Mechanical and Manufacturing Engineering, The University of New South Wales, Sydney, NSW 2052, Australia
(2) LRT4 – Institute of Mechanics, Universität der Bundeswehr München, D-85579 Neubiberg, Germany

ABSTRACT
The primary aim of machinery isolation in submarines is to isolate structural vibration of the onboard machinery from the hull and to reduce far-field radiation of noise from the submarine. The isolation system can also be used to protect sensitive components from underwater explosions. A substantial proportion of the total submarine mass is on flexible mounts that isolate supported masses from the hull at frequencies above the mounting system resonant frequency. This reduces the dynamically effective mass of the hull and affects the signature of the submarine due to propeller excitation. A fully coupled finite element / boundary element (FE/BE) model has been developed to investigate the effect of system isolation in a submarine hull. The finite element model of the structure includes internal structures to represent the machinery and other flexibly mounted components. Sound power plots demonstrate the effect of machinery isolation on the acoustic signature of a submarine due to excitation from its propeller.

135 **Nonlinear Control of Propeller Induced Vibration**

Liu, Wei (1); Pan, Jie (1)
(1) School of Mechanical and Chemical Engineering, University of Western Australia, Crawley WA 6009, Australia

ABSTRACT
Effective control of propeller induced vibration (PIV) is crucial not only in reducing underwater sound radiation from submarine hull structures, but also in noise analysis and control of unmanned underwater vehicles. The fact that PIV transmits along the same shafting which normally sustains enormous thrust means that the traditional insertion of elastic mounts between the thrust bearing housing and hall structure is not feasible, since the thrust transmission system will be softened. Thus active control (AC) and active & passive control (APC) techniques become attractive options for minimizing the dynamic PIV energy transmission into hull structures without globally softening the system.

This paper is a study of the dynamics of the active-controlled system with different configurations for understanding the controllability of this self-contained system where the dynamic energy will always be confined within the system without dissipation. A robust nonlinear backstepping method is then employed to implement the control strategy to handle the inherent nonlinear dynamics of the system. A double-side Active Magnetic Bearing (AMB) is utilized as the actuator, and proper switch functions are introduced to achieve differentiable vector sum of the forces from the two sides of the AMB. The parameter uncertainties and the unknown input of the PIV present another challenge which is addressed by using parameter estimators without bringing substantial complexity to the nonlinear controller. The effect of different design constants on the controller's performance is also discussed in detail. Simulation results show that the nonlinear active controller is stable and robust in minimizing the dynamic PIV energy transmitted into the hull structure. The results summarized in this paper also

provide a basis for further development of more sophisticated active control systems for reducing PIV.

163 **Effect of excitation loads on the low frequency structural responses of a submerged hull**

Zhang, Cong (1); Kessissoglou, Nicole (1)
(1) School of Mechanical and Manufacturing Engineering, The University of New South Wales, Sydney, Australia

ABSTRACT
This paper studies the effect of different excitation loads on the low frequency vibrational behaviour of a submerged hull. The submerged hull is modelled as a fluid-loaded cylindrical shell closed at each end by circular plates. The ex- ternal pressure acting on the hull due to the fluid loading is analytically calculated using an infinite model. To simulate excitation of the hull from propeller fluctuating forces, both axial and radial excitation was simultaneously considered. The effect of varying the degrees of load in the axial and radial directions on the hull structural responses, in particular, on the hull breathing and bending modes, is examined.

S10A Underwater acoustic modelling and measurement 4
Friday 1550-1650, Room A

69 **Suitability of PVDF films for use in pressure-gradient acoustic intensity vector probes**

Killeen, Damien (1); Matthews, David (1); Munyard, Andrew (2)
(1) Maritime Operations Division, DSTO, HMAS Stirling, Western Australia.; Department of Applied Physics, Curtin University, Western Australia.
(2) Maritime Operations Division, DSTO, HMAS Stirling, Western Australia.

ABSTRACT
Pressure gradient vector probes are adversely affected by diffraction around internal components of the probe; however by constructing a pressure gradient probe from polyvinylidene difluoride (PVDF) sensor elements, which have acoustic impedance similar to seawater, the diffraction effects within the probe can be effectively minimised. For use in a pressure-gradient intensity vector probe though, the elements must be omni-directional. This paper discusses the design, construction and initial characterisation of a prototype two-dimensional pressure-gradient vector probe using four PVDF films as the sensing elements.

97 **The effect of backing material on the sensitivity of PVDF hydrophones at high frequencies**

Munyard, Andrew (1); Matthews, David (2); Killeen, Damien (2)
(1) MOD, Defence Science and Technology Organisation, HMAS Stirling, Western Australia.
(2) MOD, Defence Science and Technology Organisation, HMAS Stirling, Western Australia; CMST, Curtin University of Technology, Bentley, Western Australia

ABSTRACT
PVDF (polyvinylidene difluoride) piezoelectric film has many properties that make it attractive for underwater acoustic applications. In order to utilise these it has been necessary to understand some of the basic mechanisms affecting the performance of this material as an underwater sensor. In order to do this, hydrophones have been constructed using thick film (28 µm) PVDF elements which have been mounted on various substrates and encapsulated in polyurethane. The effect of the substrate shape and material on the sensitivity and directionality of the hydrophones has been measured at frequencies from 40 kHz to 100 kHz and their useability as an underwater sensor discussed.

150 **Recent Advances in Fibre Optic Array Technologies**

Foster, Scott (1); Tikhomirov, Alexei (1); Van Velzen, John (1); Harrison, Joanne (1)
(1) Defence Science and Technology Organisation, PO Box 1500, Edinburgh, Australia

ABSTRACT
An acoustic array technology based on distributed feedback fibre laser sensors is described. Details of an advanced fibre laser hydrophone based on a flexural beam "bender" mechanism are presented, including laboratory data demonstrating sea-state-zero acoustic sensitivity, excellent vibration rejection and a flat acoustic response over a bandwidth exceeding 5kHz. Details of the system architecture including the interferometric interrogation system are also presented and some of the key practical constraints on system performance discussed.

S10B Discussion forum
Friday 1550-1650, Room B

170 **Wind farms discussion forum – Where are we at?**

Macpherson, John
Department of Environment and Conservation, Western Australia

ABSTRACT
The Acoustics 2012 conference program contains 6 papers on noise from wind farms, indicating that this issue continues to present many challenges to the acoustics community. Discussion about possible health issues associated with low frequency noise and infrasound has spilled over into the political arena, with a Senate Inquiry and some interventions into noise policy for wind farm developments. Meanwhile there has been growth in the understanding of wind turbine noise generation and propagation, and in the methodologies for assessing wind farm noise against background noise.

The workshop will draw together current thinking on issues such as the health effects of wind farm noise, assessment methodologies and approaches to setting noise criteria.

S10C Marine environmental and bioacoustics 4
Friday 1550-1650, Room C

4 **Clustering of snapping shrimp snaps on long time scales: a simulation study**

Legg, Matthew (1); Chitre, Mandar (1)
(1) Acoustic Research Laboratory, Tropical Marine Science Institute, National University of Singapore

ABSTRACT
Fields of snapping shrimp produce a great number of impulsive snapping sounds throughout the world's tropical and subtropical shallow water regions. Snaps from snapping shrimp appear as short spikes in timeseries obtained from hydrophone measurements. Clustering of the spikes in the timeseries can occur on at least three different time scales corresponding to three spatio-temporal mechanisms. The mechanism for clustering on short time scales is multipath propagation, because a

single snap from a shrimp evolves into a cluster of snap signals at the hydrophone. Mechanisms for clustering on medium and long time scales remain intriguing and inconclusive. This paper investigates diurnal snap-rate variations and their effect on clustering over long time scales. Simulation of spike timeseries made use of the Cox-Ingersoll-Ross driven doubly stochastic Poisson process with diurnal variation introduced by varying one model parameter. Fano-factor analysis of the simulation results showed that diurnal variations have a profound effect on clustering of snapping shrimp snaps on long time scales.

94 **Underwater ambient noise of Fremantle inner harbour: dolphins, pile driving and traffic**

Salgado Kent, Chandra (1); McCauley, Robert (1); Parnum, Iain (1); Gavrilov, Alexander (1)
(1) Centre for Marine Science and Technology, Curtin Univeristy

ABSTRACT
Underwater noise measurements were made over a period of 5 months within the Fremantle Inner Harbour (from April 1st-July 2nd, and July 26th-August 20th, 2010). Noise was recoded from a range of sources, including vessel traffic which was intense at periods, noise from trains and vehicles passing over a nearby bridge, machinery noise from regular operation of the Fremantle Port, and pile driving (either vibratory pile driving, impact pile driving, or both) recorded during wharf construction over approximately 57 days, (mainly during the months of May, July, and August). All sources recorded are common to a busy and expanding port. Noise levels in the port during periods when pile driving was not occurring were typically between 110 and 140 dB re 1Pa2 (mean squared pressure). Vibratory pile and impact pile driving increased noise levels within the Inner Harbour. Biological noises were also detected in the recordings. Dominant biological sources were snapping shrimp, followed by mulloway chorusing in early to mid-April, and grunts from other fish species detected throughout the recordings. Indo-Pacific bottlenose dolphin (Tursiops aduncus) whistles were also detected in the noise logger recordings.

S10D Noise control 2
Friday 1550-1650, Room D

11 **On the sound produced by flow interaction with a wall mounted finite length cylinder**

Moreau, Danielle (1); Doolan, Con (1)
(1) School of Mechanical Engineering, The University of Adelaide, Adelaide, South Australia, 5005, Australia

ABSTRACT
A cylinder immersed in flow is often considered a source of unwanted sound and is relevant to a wide range of engineering applications including aircraft landing gear, rail pantographs and automotive side-mirrors. To investigate this flow-induced noise source, this paper examines the sound generated by a wall mounted finite length circular cylinder in cross-flow. Noise measurements have been taken in an anechoic wind tunnel at the University of Adelaide at a range of flow speeds and for a variety of aspect ratios (cylinder length to diameter ratio) to determine the influence of these parameters on noise generation. The experimental data presented in this paper give further insight into the underlying sound generation mechanism and can be used to validate numerical predictions of flow-induced noise from wall mounted finite length cylinders.

12 **Prediction of noise from a wing-in-junction flow using computational fluid dynamics**

Doolan, Con (1); Coombs, Jesse (1); Moreau, Danielle (1); Zander, Anthony (1); Brooks, Laura (1)
(1) School of Mechanical Engineering, University of Adelaide, Australia

ABSTRACT
The leading edge turbulence interaction noise model of Amiet was extended to incorporate span-wise variations in flow properties and integration with modern computational fluid dynamics codes. The present implementation of the leading edge noise model was validated against experimental data in the literature. To demonstrate the use of the extended leading edge noise model, the flow and noise from a wing-in-junction test case was simulated numerically. Noise was calculated using flow data from different upstream positions to illustrate the importance of choosing the most appropriate turbulence data for noise prediction. The effect of span-wise discretisation on the acoustic prediction was shown and a study of the noise contributions from each span-wise part of the wing was performed. This showed that the upper part of the wing produced the most noise. Thus, any noise mitigation strategies should be con- centrated in this area for maximum effect.

142 **Performance Analysis of the Wave Trapping Barrier**

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(3) Mechanical Engineering Department, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

ABSTRACT
The design of a noise barrier for reducing unwanted noise is a common practice in acoustical engineering. However, when the barrier is placed in front of the source with large reflective surface, multiple reflections between the source and barrier happen and significantly reduce the noise reduction performance of the barrier. In order to minimize this deterioration effect, the Wave Trapping Barrier (WTB), which has a designed surface profile and resonance sound absorption, has been developed. The designed surface aims to change the direction of the reflective noise and thereby trap them within the domain bounded by the source surface and noise barrier. In this paper, the performance of WTB is numerically investigated and compared with T-shape and Tilted barriers. It is found that a WTB with absorption material on its surface achieves the best result. We also underline the mechanism involved in the improved performance of the WTB.

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