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A TEMPUS EXPERIENCE: NEW CURRICULUM IN SOUND AND VIBRATION CONTROL IN EGYPT

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Abstract

The reduction of noise is of environmental and strategic importance for Egypt. Noise and acoustic annoyance is considered to be a dominant source of pollution within the Egyptian community. A need to develop and strengthen education and specialization in Sound and Vibration Control was therefore identified by Ain Shams University (ASU) in Cairo. The main objective was to produce a new generation of engineers capable of performing constructive research and development in the acoustics and vibrations field. They should be able to select the appropriate hardware to accurately measure acoustic parameters, perform experiments, to come up with better solutions, analyse and simulate acoustic changes and contribute to better understanding of the noise problem. This paper describes the activities of a project funded from the European Commission through the Tempus Program. The project was implemented at Ain Shams University in cooperation with KTH (the Royal Institute of Technology) in Sweden, and ISVR (the Institute of Sound and Vibration Research) in United Kingdom. The project addressed three levels of education: undergraduate, postgraduate students and engineers already working in the industry. The activities of the project included: Improving and updating the courses at ASU – Introducing new teaching methodologies aiming at elaborating more interaction between teachers and students – Establishing a new Sound and Vibration Laboratory. The main aim is to give all students the opportunity to do measurements themselves in order to get better feeling of different phenomena – Train the current teachers and university staff on the new courses, methodologies and equipment – Offer retraining and support for engineers working in the field of sound and vibration to update their. In addition to the main goals, other advantages followed. These include the establishment of the Acoustical Society of Egypt, close collaboration between consortium member universities, and strengthening the link between Egyptian Universities, industries and research institutions.

1. INTRODUCTION

Sound is such a common part of everyday life. It provides enjoyable experiences, such as listening to music or to the singing of birds. Sound enables spoken communication with family and friends. It can alert or warn us, for example with the ringing of a telephone, or a wailing siren. Sound also permits us to make quality evaluations and diagnosis. Yet, too often in our modern society, sound annoys us. Many sounds are unpleasant or unwanted – these are called Noise.

Many countries and communities have recently introduced legislations making it a legal requirement to measure community noise level, to reduce noise at source, and to maintain an acceptable noise level in factories to prevent hearing damage or loss and in residential areas to minimize annoyance. In 1997, Egypt issued a Law for the Environment in which Annex 7 describes the noise exposure limits in different residential areas and inside work premises and closed places. Due to increased environmental awareness, the Egyptian Government has established a new Ministry for Environmental Affairs to follow up the implementation of this law. These efforts are quite recent to the Egyptian Society who has started to consider noise pollution as a main source of environmental annoyance. Considerations of noise control and noise abatement procedures are not considered a luxury any more.

Therefore, there must be a good basis for the future engineers to handle these problems. In order to achieve this goal, university students in Egypt need to acquire more knowledge and technical skills in the field of sound and vibration. The acquired knowledge will benefit the Egyptian society & economy in different fields of applications. There is a need to develop and strengthen the specialization of Sound and Vibration Control at the Egyptian Universities.

In Egypt, there is an increasing demand for engineers to work in the field of noise and vibration. Statistics have shown that almost one third of the graduated students deal with the field of sound and vibration. Employers, from both the private sector and the government, have substantial complaints about the qualifications of the newly graduated engineers because the courses have not been kept up to date with modern requirements. Ain Shams University recognized that the current Egyptian courses need to be revised a lot to reach the level of the courses currently taught at the universities in Europe. Information about vibrations is basic and more applications should be included. Acoustics are not dealt with in the courses at Egyptian Universities.

Ain Shams University applied for a fund from the European Union within the TEMPUS Program. The Trans-European mobility scheme for university studies funds projects between the higher education sector in the EU and its 26 partner countries to facilitate university modernisation, mutual learning between regions and peoples and understanding between cultures. The Tempus partner regions are the Western Balkans, Eastern Europe and Central Asia, North Africa and the Middle East. The Tempus programme funds cooperation projects in the areas of curriculum development and innovation, teacher training, university management, and structural reforms in higher education. It puts special emphasis on the mobility of academic and administrative staff from higher education institutions, both from the EU and the partner countries.

Other consortium members were the Royal Institute of Technology (KTH) in Stockholm, and the Institute of Sound and Vibration Research (ISVR) in Southampton. There were also three individual experts from Sweden, France and the Netherlands. The fund was granted a project started in 1 September 2004 for three years. The project had the following objectives:

1. Improving and updating the courses given to undergraduate and postgraduate students at ASU. They will include the new knowledge and technology needed for a

modern skilled engineer.

2. Introducing new teaching methodologies aiming at elaborating the interaction between teachers and students.
3. Establishing a Sound and Vibration Laboratory at Ain Shams University. The main aim of the laboratory is to give all students the opportunity to do measurements themselves in order to get better feeling of different sound and vibration phenomena.
4. Training the Egyptian university staff and teaching assistants on the topics, methodologies and equipment of the new courses.
5. Attracting PhD students to join the Sound and Vibration group and work as teaching assistants for the courses.
6. Offering retraining and support for engineers working in the field of Sound and Vibration to acquire the knowledge they missed at the undergraduate level.

Other benefits followed. These include the establishment of close collaboration between consortium member universities. They also include building a strong link between Egyptian Universities, research institutions, and industries.

2. PROGRAMMES AND COURSES

The courses developed within this project addressed a wide range of "education" levels. Each level has its own approach to implement the new courses. A complete package was developed for each course. This includes: Course material, lecture notes, assignments, solved examples, lab exercises, exams, teaching aids, and demonstration kits. This task started by surveying the current curricula at ASU and other Egyptian universities. The study also included the courses given at KTH and ISVR. The survey covered undergraduate, postgraduate and advanced short courses. Based on this study, the consortium members decided on all practical details of the project and the contents of the courses. Further comparisons were carried out. A survey of the educational systems in the three countries and the differences in teaching and examination methodologies were reported.

On the undergraduate level, only vibrations were taught. The vibration courses which were given were very basic, with very little applications, and no lab exercises. No acoustics was mentioned in any course. The initial plan was to develop the existing basic courses in vibration that are taught to three Mechanical Divisions at ASU (Production, Power, and Automotive), and introduce few Acoustics concepts. These courses are already included in the existing curricula. Now, after disseminating our activities, we have been asked by the top management of ASU to introduce two new elective courses for the Production and Power divisions. This is a step to make these courses compulsory during the next change in the curricula scheduled in 2008. We were also asked by the Architectural department to develop a course for their undergraduate students. Teachers at the Mechatronics Department asked the permission that their students would use the lab in one of their courses. The conclusion is that the project will now serve 7 undergraduate courses instead of 3. It is the role of teachers at ASU to develop the syllabus and teaching materials of these courses from the material they get from KTH and ISVR.

Three postgraduate courses were introduced: Advanced Acoustics, Advanced Vibration, and Noise and Vibration Control. There was a problem for postgraduate students at ASU preparing their theses in the field of Sound and Vibration because there was only one vibration course. Therefore, they had to take any other irrelevant courses to complete their required credits. The procedure for introducing new postgraduate courses is easier because all courses are elective, and students choose those courses relevant to their field of research. There was a need to introduce new courses for those postgraduate students specialized in the field of sound and vibration. ISVR was responsible for the material of these courses. For each

of these courses, the ISVR teachers trained ASU teachers on how to teach this course.

Six short courses were designed to meet the requirements of the Egyptian Industry. The short courses are: Building Acoustics, Insight into Engineering Noise Control, Machine Condition Monitoring, Vibration Measurement, Machine Noise and Vibration Control, and Acoustic Design of Mufflers. The short courses are given for the first time by teachers from KTH and ISVR and attended by teachers from ASU. ASU teachers repeated these courses later. This is a good source of sustaining the project activities after the project ends.

3. THE SOUND AND VIBRATION LABORATORY

The main objective of the lab was teaching. Nevertheless, it was taken into consideration the possibility to use it later for other projects in order to ensure sustainability of the lab after the project ends. A staff was dedicated to this lab, consisting of 5 teachers, 4 assistant teachers, and 1 lab technician. All teachers at the Faculty can request to use the lab facilities under the supervision of the lab staff. The purchased equipment can be categorized in the following categories.

1. Computers and other office equipment
   A computer lab used for the acquisition and analysis of sound and vibration measurements was established with a capacity of 26 students. The lab was further equipped with teacher computers, 2 laptops (one for teaching and one for use with some analyzers), printers, scanners, fax, copying machine, and projectors.
2. Sound and Vibration Analyzers
   One Multi-channel analyzer (16 input and 8 output channels), one two-channel analyzer (needs a laptop), one portable vibration analyzer and data collector.
3. Sound analyzers and sound level meters
   One multi-purpose portable sound analyzer and two sound level meters.
4. Sound and Vibration measurement accessories
   Microphone calibrator, accelerometer calibrator, intensity probe and its calibrator, rotating microphone boom, reference sound source, impact hammer, photoelectric probe, omnidirectional loudspeaker, and shaker.
5. Transducers
   Microphones and accelerometers of different sizes and quality. Force transducer.
6. Software and Books
   Several software for data collection, analysis, and simulation. Some of this software was a gift to the new lab. Several books were purchased for the laboratory internal library.
7. Three test facilities were built that are need for conducting different acoustic measurements. A Semi-anechoic room, a reverberation room, and an acoustic flow test rig.

There are experiments associated with each course. Each course attendant (for all education levels) should have the opportunity to acquire measurement data, do the calculations, and perform post-processing. There were several difficulties to make this happen. a) We have a large number of undergraduate students (about 150 taking the course each semester). b) Sound and vibration equipment are expensive. c) There is limited time for lab exercises.

Based on surveying what is being done at KTH and ISVR, the configuration in Figure 1 was developed. A classroom with 13 computers was carefully designed to match the requirements of the lab exercises. There is usually one experimental rig that can have up to 8 transducers mounted simultaneously. The transducers can be either ICP microphones or

accelerometers. Conditioning is supplied with external devices. Then the data of the 8 transducers are fed into an analog network to each workstation. Each Desktop computer is equipped with a 24-bit high quality Creative Sound Card (Audigy 2 ZS). This sound card has one stereo “line in” input which can take 2 analog channels. There is a switch box to convert the 8 input channels from the transducers to only 2 channels. Depending on the number of channels needed, the measurement is done on several steps, 2 channels at a time. The data acquisition is controlled by either MATLAB or LABVIEW. The lab instructor chooses which software to use depending on the complexity of the post-processing, the number of channels, the levels of the students, and the time allocated to the lab.

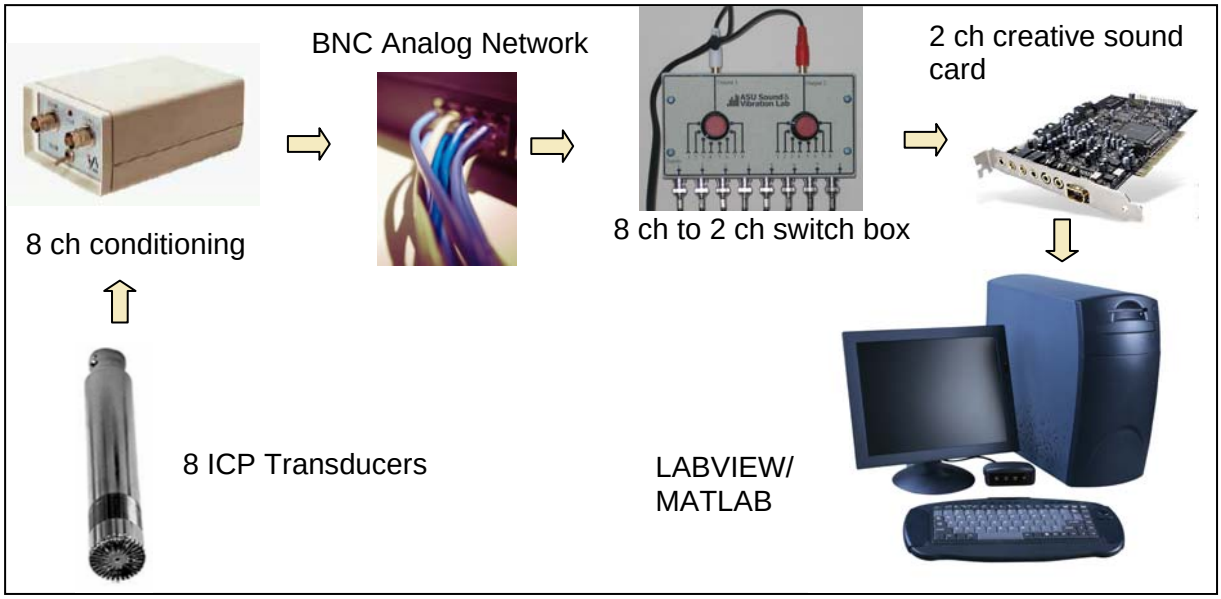

Figure 1. A schematic diagram showing the components of the measurement classroom.

Figure 2. The measurement classroom with 13 stations.

Figure 3. An example of a sound power measurement using ISO 2744 inside a semi anechoic room.

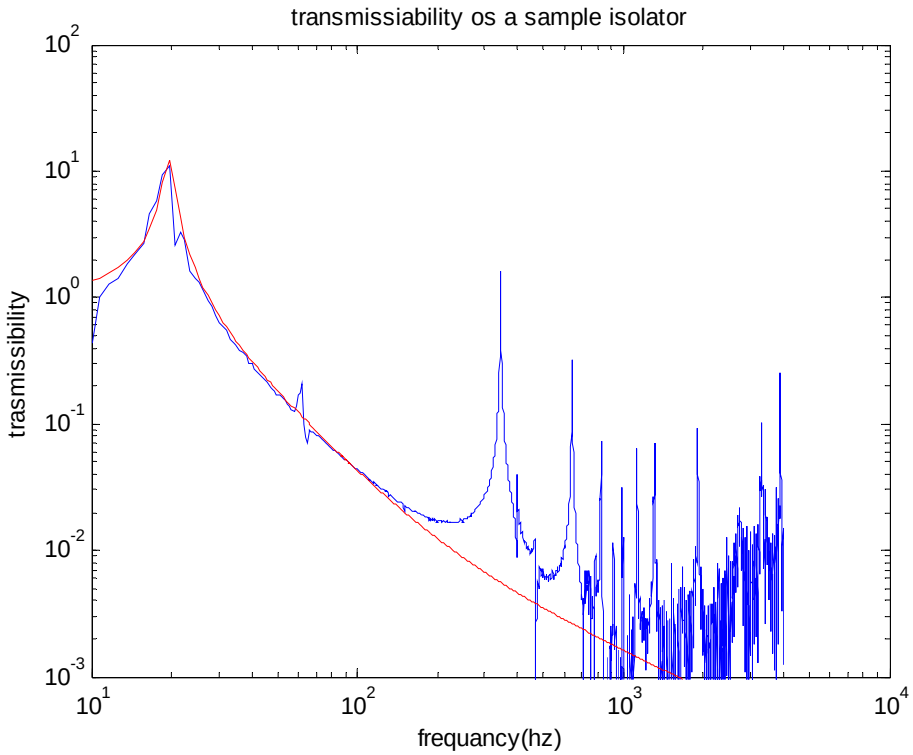

Figure 4. An example of vibration isolation exercise, comparison between measurement of transmissibility and simulation using SDOF system.

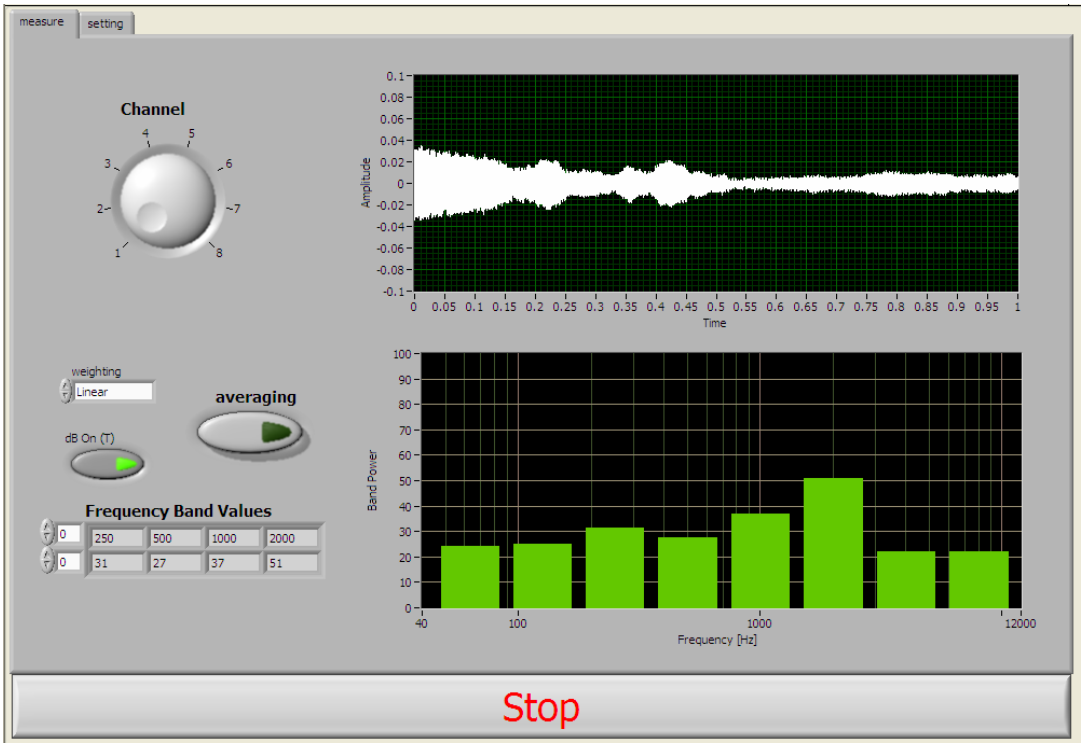

Figure 5. An example of the LABVIEW window of a sound level meter with octave filters used in acoustic measurement exercises.

4. DISSEMINATION AND SUSTAINABILITY

As indicated earlier, one of the objectives of the project is to target sound and vibration teaching, research and engineering in Egypt and the Arab Countries. Therefore, several efforts were dedicated to effectively disseminate information bout the project activities and the new laboratory capabilities among all university staff and industry interested in the field. Dissemination started from the early beginning when a seminar was held at ASU with the kick-off meeting. Teachers from other Egyptian universities in the field of Sound and Vibration were invited to present their courses and tell them about the project objectives and plans. The other universities are: Cairo University, Alexandria University, and the Military Technical College.

It became obvious that there are already researchers and engineers interested in the field in Egypt, but they are few and their efforts are scattered. Therefore, it was very important to establish the Acoustical Society of Egypt. A good opportunity to disseminate the project activities among Acousticians in Egypt, and to develop new contacts for future projects. The society attracted a lot of interest from many people from the academic sector and the industry.

The ASU Sound and Vibration Lab, in cooperation with the Acoustical Society of Egypt, organizes an annual international workshop on Acoustic Education and Research in Egypt. The workshop's attendance is growing every year. We try to invite several international speakers to give presentations at the workshop in order to introduce the Egyptian members of the society to the recent advances in the field. This workshop is partly funded by the Swedish Research Council (SIDA) within the Swedish Research Links Program.

As a result of establishing good contacts with other international institutions, the ASU Sound and vibration lab joined the European Network of Excellence on Aircraft External Noise Reduction (X3-Noise). The lab is the regional focal point for all MEDA Countries.

It is also very important to look at different ways to ensure the sustainability of these activities after the Tempus project ends. Sustainability is divided into two parts: money and

staff. There should be a continuous flow of money to the lab to support its teaching activities, and there should be a big staff to run the lab, organize courses and continuously improve them. As for the lab staff members, this has been growing since day 1 of the project. There are now around 15 persons working for the lab: teachers, assistant teachers, engineers, technicians, and administration. The sound and vibration field is new in Egypt and the start of the lab is unique trying to implement new teaching methodologies and working environment. More students now are interested to join our group through the organization of information days, and the good reputation we get from teaching the courses.

Regarding the securing of funds, there are three main routes to achieve this: Organizing courses, applied research, and consultancy measurements. The new lab is equipped with state of the art equipment and all courses are organized that students would do measurements themselves. Having these nice facilities, well-prepared course material, and qualified teachers will enable us to organize successful and popular courses.

In the field of research, the lab started to be included in some research projects inside and outside Egypt. For consultancy, the lab is now the choice number 1 in Egypt to perform noise and vibration measurements and studies. One the biggest projects we have been in charge of the vibration measurements and monitoring during the relocation project of Ramses II Statue.

5. SUMMARY

This paper presents the efforts that have been done at Ain Shams University in Cairo to enhance sound and vibration education. The main task was to develop a set of new courses for undergraduate, postgraduate, and short courses students. A new sound and vibration lab was established equipped with most of the necessary equipment, transducers, and accessories. A semi-anechoic room and a reverberation room were built in the lab. There are a set of lab exercises associated with each course where each student has the opportunity to do the measurement and analysis himself. The outcomes of the project were successful because of the help of two well-known universities in Europe, the Royal Institute of Technology, and the Institute of Sound and Vibration Research. ASU Sound and Vibration laboratory is now well known as a pioneer in this field in Egypt and the Arab Countries.

ACKNOWLEDGMENT

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