Technical Note

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PHYSCLIPS: A MULTIMEDIA, MULTI-LEVEL INTRODUCTION TO MECHANICS, WAVES AND SOUND

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Physclips is a web-based learning, teaching and reference resource in introductory physics. It is aimed at levels from senior high school to early university. The volume Waves and Sound has recently been completed and added to the volume Mechanics. Together, these present an introduction to acoustics and vibration, with resources for students and teachers.

The volume on Waves and Sound contains chapters on oscillation, travelling waves, sound, the Doppler effect, quantifying sound, interference and standing waves. The last chapter, called Human Sound, introduces speech and hearing.

While the content is fairly standard for introductory physics, the platform is not. We have constructed it using multimedia

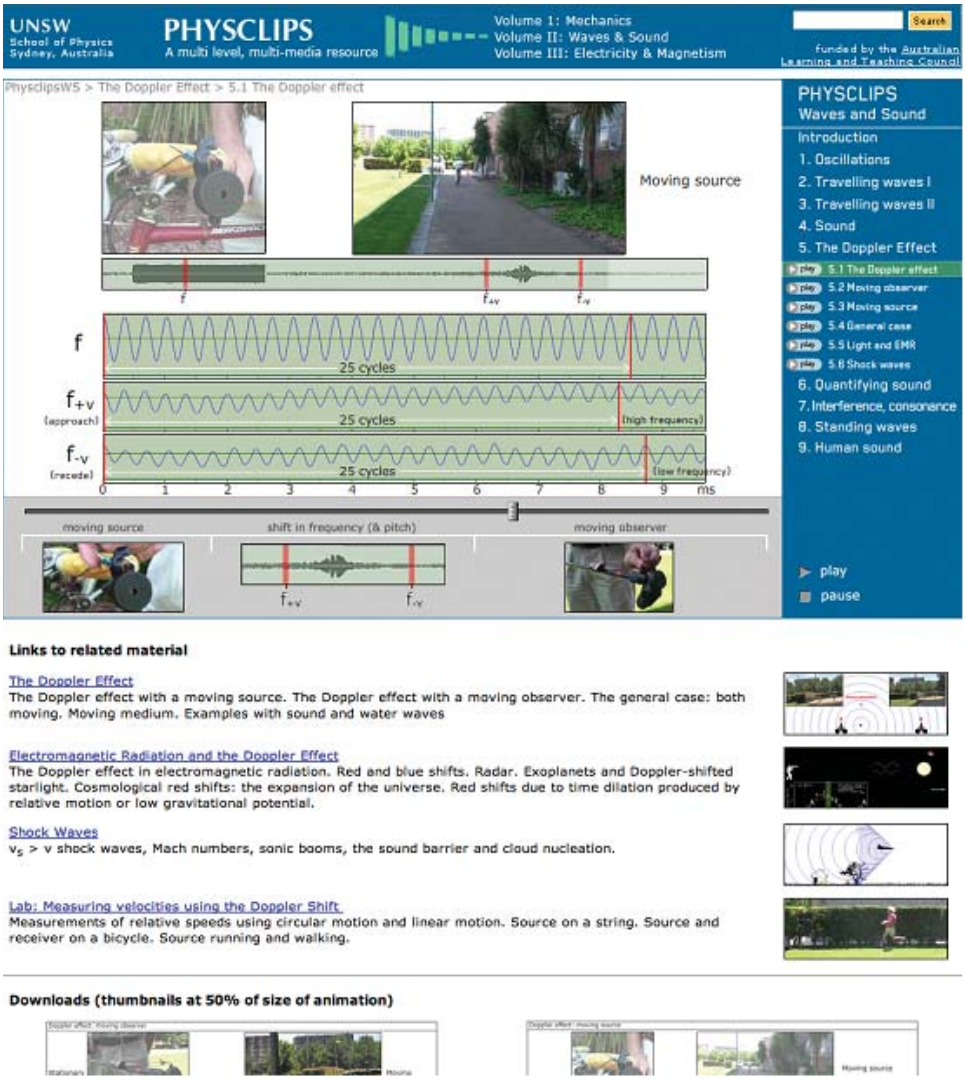

Figure 1. This screen grab from section 5.1 is from a clip demonstrating the Doppler effect using a piezo buzzer mounted on either a bicycle or a fixed stand. Three sections of the sound track are expanded to show the period for stationary, approaching and receding source. Below the main screen is a list of the html support pages and, below that, the top of the directory of downloads.

and hyperlinks, aiming to make it highly flexible and easily navigable, so that each learner can construct a learning path that suits his/her needs and abilities, so that teachers can readily find and download film clips and animations for use in lessons and so that elements can be readily found for revision or reference.

Each chapter in Physclips covers much the same material as does a chapter in a traditional text book. Each Physclips chapter has a rich multimedia tutorial, which gives an overview and a logical development of the material, and which includes film clips of key experiments and demonstrations. The film clips are central to our philosophy: physics is an experimental science and a film clip shows the real situation, not an idealisation. Film clips are, however, often combined with or complemented by animations.

The tutorials are brief—typically ten minutes in length—but information-rich. For this reason, pauses with 'click to continue' buttons are included, and each screen has a scroll bar to allow repeats. Navigation is facilitated by icons below the scroll bar (see Fig 1).

Rigour and breadth are maintained, without interrupting the flow of the tutorials, by including hyperlinks that branch to a series of html pages that give deeper and broader material as well as sections that introduce calculus, vectors and other needed materials.

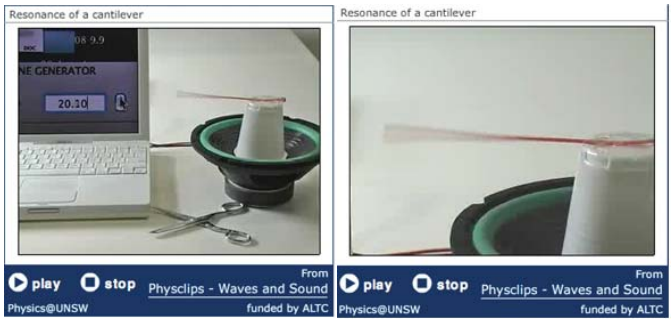

Figure 2. This home experiment, from the chapter Oscillations, uses a cable tie to investigate cantilever resonance. Scissors vary its length. It is driven by a downloadable signal generator, an audio amplifier, a loudspeaker and a disposable cup.

Other pages present simple experiments that may be performed using only readily available and/or cheap components, plus a computer and in some cases software developed for the project (see Fig 2).

The film clips and animations from each chapter are available for download, either separately or compressed into one folder, for teachers to use directly in lessons.

For many students, what is difficult about physics is also what makes it such a powerful discipline: the process of seeing, in a real world problem, the relevant principles and variables, then quantifying and analysing them. For this reason, the combination of film clip and animation is a powerful pedagogical tool: animations superimposed on film clips can show abstractions such as force, phasors, energy, etc; quantities that the expert 'sees' with the mind's eye. These then allow the beginner to experience an expert view of a physical situation.

The layout and presentation of Physclips is consistent with and guided by evidence-based guidelines in the field of multimedia learning with respect to principles known in that field as modality, segmentation, spatial contiguity, personalisation and signalling [1]. The collaborative design process between educator and designer is further moderated by user-feedback [2]. We describe its construction elsewhere in more detail [3].

Physclips and its components have won several international awards. Elements of it are used in lessons at Harvard and MIT, but also in outback Australia and Africa. It is also proving popular: typically a few thousand different users access Physclips every day. Because each user usually downloads a few dozen files, the hit rate is in the tens of thousands per day. Physclips is at www.animations.physics.unsw.edu.au.

REFERENCES

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