Using a Personal Computer Platform to Develop an Information–Rich Learning Environment for Instruction in Acoustics

Robert D. Celmer

Acoustics Program & Laboratory, College of Engineering, University of Hartford, West Hartford, CT 06117

Abstract: Teaching students the subject of acoustics involves large amounts of technical information, including equations, derivations, and example problems. It also requires the explanation of a multitude of concepts, many of which are often difficult for students to grasp and equally frustrating for the instructor to disseminate. Part of the difficulty can be traced to the use of text (a visually based medium) to teach about sound (an audibly based medium). This presentation will describe the development of multi–media techniques for in–class presentation of acoustics instruction.

INTRODUCTION

A shift in teaching pedagogy appears to be emerging in higher education, including such disciplines as engineering and science, away from a “teaching paradigm” towards a “learning paradigm” in order to effect greater student learning. Part of this change involves re–thinking the traditional lecture–based instruction method and embracing new approaches and new technologies (1). Indeed, the latest ABET Engineering Criteria 2000 (2), as well as recent Engineering Education Reform request for proposals by the NSF (3), are replete with references to student learning and a redefinition of the instructor’s role. These changes are viewed as a road to life–long learning, and as a means of addressing the shortcomings of the traditional approach. The latter issue is particularly applicable to acoustics pedagogy.

Facilitating students to learn about the subject of acoustics involves large amounts of technical information, including equations, derivations, and example problems. It also requires the explanation of a multitude of concepts, many of which are often difficult for students to grasp and equally frustrating for the instructor to disseminate. Part of the difficulty can be traced to the use of text (a visually based medium) to teach about sound (an audibly based medium).

SHIFTING IN STAGES

Initially, acoustics instruction in the ‘60s and ‘70s at the University of Hartford’s undergraduate engineering program was delivered using a conventional “chalk and talk” technique. However, this approach was observed to have intrinsic drawbacks: It was slow, inefficient, and inconsistent. Class meetings were tantamount to rote copying sessions, with students frantically transcribing notes as the instructor scribbled on the blackboard. As a result, there was little time for discussion, questions/answers, or example problems. Students were not actively engaged in the learning process.

During the 1980’s, the advent of the personal computer enabled an initial shift in delivery approach using overhead transparencies. Drawing, spreadsheet, and word–processing programs (with support for equations and Greek letters) were used to produce consistent laser output. Students were presented with projected overhead transparency images, as well as a copy of the “working textbooks”. The response to this initial shift was positive: Students noticeably listened in class, and moreover, participated in discussions. Class material was covered more efficiently, with time for extra examples. Material comprehension and examination performance improved subsequent to introducing this technique.

In the early 1990’s, personal computer platforms became powerful enough to support in–class presentation, and the next shift in technique took place. The word–processed notes were ported to presentation software format. This allowed for exhibition in color, the addition of some limited audio examples, as well as multi–tasking more than one program.

Whether the information is delivered to the student via a chalkboard, overhead transparencies or presentation software, all share a common textual base for information transfer. Having used all three of these presentation methods, it has been customary for this author to go beyond what the words alone could convey by bringing supplemental demonstrations into class in an effort to elucidate the acoustic concepts. Yet as helpful as these demonstrations were, they always seemed to be an “appendage” grafted onto the lecture, rather than part of an integrated approach.

THE SHIFT TO AN INFORMATION–RICH, STUDENT–CENTERED PEDAGOGY

The current approach evolving at the University of Hartford includes a hybrid approach of in–class presentations,
self-paced lessons, and collaborative report-generating. All three utilize multi-media computer methods for encouraging interactive learning environments between student-faculty and/or student-peers. Since lecture material can be reviewed by students at remote times, class sessions can evolve into periods of discussion, questions, and problem solving.

Four features of this approach are central to its educational usefulness: Interactivity, Multimedia, Simulations/Models and Assessment (4). An interactive-based approach includes the opportunity for student-centered learning in a non-linear manner; that is, the student may choose to interact with the material in-sequence or out-of-sequence. This hypertext metaphor fosters a sense of exploration and discovery, features that encourage greater participation on the part of the learner. The multimedia attributes directly addresses what acoustics instruction needs: sound examples, depictions of animated wave motion, video clips, etc. Students choose which emphasis helps them get the point across. Simulations and Models allow students to see, hear and experience virtual spaces, modes of vibration, and complex auditory phenomenon from an accessible platform. All the while, the course designer controls the possible story lines which can branch and fuse, providing opportunities for illustration, embellishment, and assessment of student progress.

These multimedia presentations are produced using certain authoring applications, draw and animation programs, sound manipulation software, as well as 3D CAD sound-engineering software and spectral analysis applets. Four examples are shown below in Figure 1 which typify the topics that can benefit from this approach: Sound Pressure Level Differences, Diffraction Geometry, Signal Processing Fundamentals, and Case Studies.

This author views multimedia’s information-rich delivery system of integrated sound, video, animation, and graphics as the next logical step towards empowering student-centered learning.

![Figure 1. Screen-Capture Examples of Multimedia Acoustic Topics](image)

**REFERENCES**


