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Using Multimedia in an Educational Setting to Teach Multiple Intelligences

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Abstract

Electrical engineering relies on students having a firm understanding of basic engineering concepts. Armed with these basics, they can then further investigate underlying principals as well as explore similar hypotheses. The electrical engineering graduate modules presented in this paper provide a dynamic visual representation of a complex topic: signal filtering. The purpose of these graduate modules is not only to develop a presentation aid to familiarize students with the overall concept in a dynamic medium, but also to serve as an interactive study aid for visual and physical learners, who might otherwise be lost in the static mathematical representation. This paper will present an overview of these modules and discuss the results obtained from their implementation.

Understanding Learning Styles

In general learners acquire and process information through various sensory means, and have a preferred method for learning. There are auditory, visual, and physical learners. These three categories can be broken down further into linguistic, logical-mathematical, bodily-kinesthetic (physical-kinesthetic), spatial (visual-spatial), musical, interpersonal, and intrapersonal[1]. Classroom teaching methods, such as lecture-only delivery, have focused on a minority of learners. Auditory learners tend to be in the minority. Occasionally, overhead transparencies and videos are incorporated to reach visual learners, but it is rare to incorporate physical interactivity into a lecture. For example when presenting signal filtering concepts to an auditorium full of students, the sheer number of students combined with equipment needs prohibits student experimentation with the equipment.

Since the advent of multimedia, laptop technology, and wireless connectivity, educators have more tools available to reach varied learning styles in a single forum. When multimedia is incorporated into the lecture, the information presented has the potential to reach a variety of learners. According to Grace-Martin "the more engaged the user is, the more likely they are to absorb some of the underlying content-related information[2]."

It is important that a learning environment is engaging for all students. The use of multimedia and instructional tools can assist with supporting multiple learning styles. The hurdle for non-auditory learners is processing verbal definitions and extrapolating a mental picture. Students taking a technical class may encounter complex engineering verbiage. For example a visual representation (see Figure 1) may assist some students of grasping the concept of a band pass filter which is defined as follows:

> A filter that blocks or attenuates signals at frequencies outside of the specified low pass and high pass cutoff frequencies. This is frequently done by combining or 'cascading' low-pass and high-pass filters.

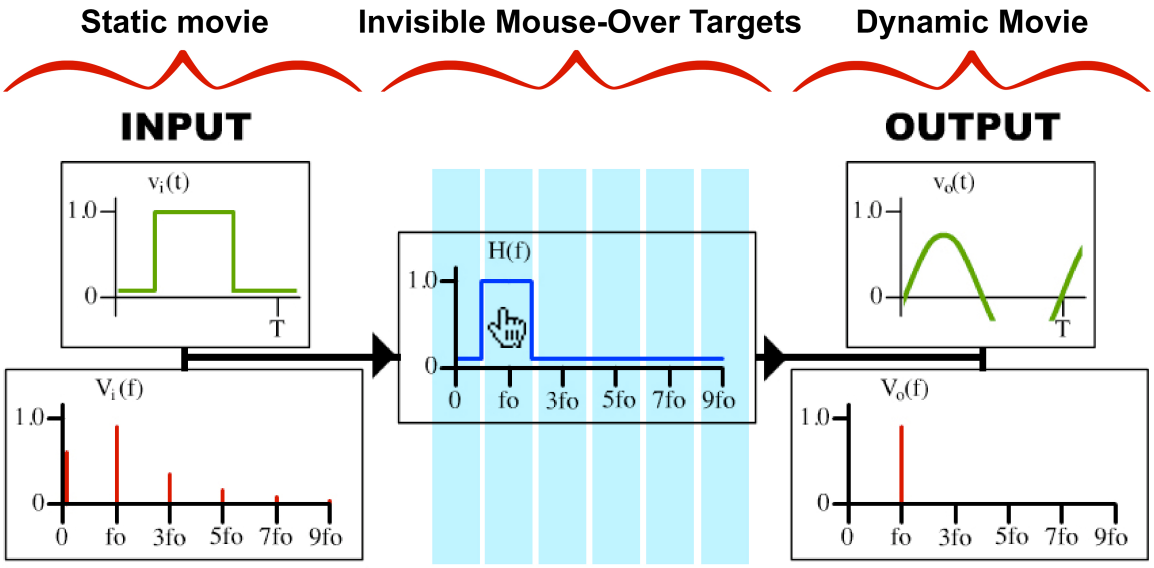

Figure 1: Band Pass Filter

Figure 1 shows how the signal filtering process works. It is divided into 3 sections: a static movie, mouse-over targets, and a dynamic movie. The left side of the process is the input signal represented as both a waveform and as a spectral plot, the center section shows how the filter is being applied, and the right side shows the filtered signal output as a waveform and as a spectral plot. The filter's frequency can be changed by scrolling a computer mouse over the 6 filtering frequencies (shown as blue rectangles), which changes the dynamic output movie on the right.

Interactive multimedia is an effective tool for demonstrating concepts that are:

- Dynamic processes, which require understanding of the relationships between moving objects.
- Materials which cover broad contexts, where a number of ideas need to be linked to form an understanding of the whole, not just the parts.
- Simulations of expensive or complex processes, where understanding may be hindered by the mechanical details of performing the process, or where there is no possibility of using the real equipment[3].

Inside and Outside the Classroom

The multimedia application described in Figure 1 was developed at the request of an electrical engineering professor. His goal was to create several web-based interactive multimedia modules to support non-traditional distance learning students working on advanced degrees. The students were able to access the modules as pre-assignments for a course and some students used the modules for remediation of the concepts.

A major hurdle encountered when teaching students from a distance or on campus is that students learn at different rates. No matter how you teach, the pace will either be too slow or too fast for various learners. Therefore, it is essential that students are easily able to revisit and refresh their knowledge of topics when they study. It is particularly beneficial to the students because all of the equipment needed for this experimentation is available to them any time, day or night, to anywhere that has an internet connection. Furthermore, multimedia is an extremely valuable learning tool because it allows students to self-test their knowledge of a concept by hypothesizing what the outcome of the signal filtering process will be, and then experimenting with the interactive module to determine if they were correct.

Prior to the implementation of the interactive simulation tool for signal filtering, expensive signal processing equipment was transported by faculty from the lab to the classroom in order to illustrate signal filtering topics. This process was inconvenient and students taking the class from a distance were not able to participate.

The integration of computer based presentation technologies into the classroom, along with every student having a laptop and wireless access to the internet, has allowed for two delivery modes for our signal filtering example. The first delivery mode is classroom lecture based in the form of a local copy of the material hyperlinked to a traditional classroom presentation tool. Topics are discussed in lecture format using a presentation computer tied to a digital projector and the interactive module is used to further illustrate the basic concepts. Students are then allowed to access the materials via the internet on their laptops for further remediation. Students can review the topics being illustrated in the multimedia materials via a web browser and the Flash plug-in. Review can be for class assignments, tests, or work beyond the class they are currently taking.

Conclusion

In conclusion, to accommodate both the visual and physical learners, two features are needed, namely, a diagram-like presentation and an interactive element. The signal filtering modules satisfy both of those requirements and have the added benefit of being an internet savvy format that can be integrated into the classroom environment as well as used as a study aid and remediation tool for distance learning students.

Bibliography

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[3] Phillips, R. Developers' Guide To Interactive Multimedia: A Methodology For Educational Applications. Curtin University: Perth, WA. 1996.

Biography

BRYAN HEY is the Director of Web Services for the College of Engineering. Bryan provides strategic planning and leadership of the web development team which collaborates with technical and creative groups, engineering faculty and staff, and off-site content providers to produce interactive and multimedia features for the College of Engineering's web presence. Bryan co-directs the Virginia Tech Multimedia Lab, along with Jason Lockhart, to provide support for faculty integrating technology into their research and instruction.

Bryan graduated in 2000 from the College of Arts and Sciences at Virginia Tech with a Bachelor's of Art and Art History, focusing on graphic design and multimedia.

Bryan has worked at the university and in the private sector developing award-winning multimedia and video projects for the last eight years. He presented Macromedia Flash, Macromedia Director, Macromedia Dreamweaver, Adobe Photoshop, Adobe Acrobat (PDF), and QTVR authoring for the Faculty Development Institute (FDI) from 1997 to 2001. Bryan is also an accomplished artist and photographer, and has had gallery showings of his artwork in Blacksburg, Virginia and Chicago, Illinois.

JASON LOCKHART is the Director of High Performance Computing and Technology Innovation for the College of Engineering at Virginia Tech as well as the Associate Director of the Virginia Tech Terascale Computing Facility. He has worked for the College for eight years developing instructional and research tools, developing and facilitating faculty training workshops on multimedia, web, and research computing topics, and providing strategic direction for and implementation of computational science and engineering resources within the College and the University. His most recent accomplishment of note was the conceptualization, design, and building of *System X*, the world's first academic supercomputer to break 10 teraflops of sustained performance.

Jason obtained his Bachelor of Architecture in 1995 from the College of Architecture and Urban Studies at Virginia Tech. He has been involved with several startup companies, done consulting, and worked for Virginia Tech since his graduation.

http://www.eng.vt.edu/overview/highperfcomp.php
http://www.tcf.vt.edu

GLENDA SCALES is the Associate Dean for Distance Learning and Computing, College of Engineering and Director for the Commonwealth Graduate Engineering Program. Dr. Scales earned her Doctor of Philosophy degree in Curriculum and Instruction in 1995from Virginia Tech, her Master of Science degree in Applied Behavioral Science in 1992 from Johns Hopkins University and her Bachelor of Science in Computer Science in 1985 from Old Dominion University.