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So, You Want to Be a Loudspeaker Engineer?

By Steve Mowry

I was recently asked a simple question by a client: "Where can one study to learn loudspeaker engineering?" Although somewhat embarrassed, I replied that the only places that I knew were within the graduate school of the University of Sydney in Australia with Neville Thiele or at Bradford University or the University of Southampton, both in the United Kingdom.

Engineering is considered one of the most challenging but also rewarding of all professions. Academic institutions within the US must conform to ABET (Accreditation Board for Engineering and Technology), http://www.abet.org/, standards to have accreditation status. ABET periodically reviews courses and their content, examinations, assignments, laboratory exercises, and students' GPA (grade point average). This is not a "rubber stamp" audit. If a college or university fails to configure their respective engineering curriculums to ABET standards, then no accreditation is given and most likely no research money from the government and/or the private sector will flow to that institution. Furthermore, what caliber of students and faculty can a non-accredited institution attract?

In my home state of Rhode Island, only the University of Rhode Island (URI) and Brown University offer accredited engineering programs of study. People such as Spike Lee, Wendy Carlos, the late JFK Jr. and Amy Carter, to name a few, attended the Ivy League university. Brown was the most expensive University within the US in 1990!

The challenge of reaching the academic standard for a Bachelor of Science in Electrical or Mechanical Engineering is high, and the average successful candidate in the US takes 4.5 years to complete the BS degree requirements—not 4 years or 8 semesters, but 4.5 years or 9 semesters. Many students are asked to leave by the Academic Dean or change majors. For example, URI accepted 100 freshmen into the Department of Electrical Engineering in 1989 and graduated 32 seniors in 1993. Another challenge is that the undergraduate cannot study what he/she wants, but must choose courses from within ABET guidelines.

Engineering disciplines typically include the following:
Electrical
Mechanical
Structural (Civil)
Chemical (Material Science)
Industrial (Manufacturing)
Computer

Here's the paradox: the loudspeaker engineer needs all of these! Where's acoustic engineering? Sorry, acoustics is a branch of physics. The problems the loudspeaker engineer encounters are perhaps not as difficult or sophisticated as in the other respective disciplines, but the loudspeaker engineers' problems

PHOTO 1: Steve Mowry and the staff at Advanced Sound exchanging information.

PHOTO 2: The author presenting Electromechanical Theory to the staff of Advanced Sound in Malaysia.

cover extremely broad-based physical and virtual concepts. Obviously, to study all the engineering disciplines at the university as an undergraduate is not practical. Most loudspeaker engineers study electrical or mechanical engineering; however, perhaps the single best academic match is the most dreaded of all—"physics" or physical science.

Advanced degrees such as MS and PhD are not closely monitored by ABET. His advisor or major professor typically dictates the candidate's program of study. Unfortunately, there are few, if any, professors conducting funded research concerning loudspeaker technology.

With respect to my experiences, I was extremely fortunate to study under Dr. Leland Jackson at URI. Dr. Jackson is one of the "fathers of DSP," a gentleman with high academic standards and an IEEE Fellow. His textbooks are used at several prestigious universities, including Stanford. He took a sabbatical leave from URI in the 1980s to teach signal processing to the technical staff at Bose Corporation in neighboring Framingham, Mass. So Dr. Jackson was no stranger to loudspeakers.

When I approached him regarding a program of study that focused on vibrations, electromagnetics, and electroacoustics, his reply was, "If that is what you want, fine, and maybe I will learn something too." This was truly good news at the time because URI had been heavily involved in underwater acoustic research for the Department of Defense—the Trident and 688 class submarines were being designed and developed by General Dynamics and Raytheon, and built in North Kingston, RI, and Groton, CT. This funded research included sonar and piezoelectric transducer investigations.

However, my project to earn an MS degree in electrical engineering was a ribbon loudspeaker. Dr. Jackson was impressed and awarded me an A; however, a few of my fellow students actually ridiculed my work/project. Studying about loudspeakers can be a "Rodney Dangerfield"—no respect experience.

An alternative and perhaps the most practical solution is to learn from colleagues within the workplace. Everyone does this to some extent, but a good way to enhance the learning experience is to concurrently pursue an MS degree by attending a local university on a part-time basis. This assumes that you have found a position at a loudspeaker company that is cooperative, and the local university is receptive to a loudspeaker-engineering-oriented curriculum.

Additionally, for those who have the passion to learn, there is a steady flow of papers and conferences from organizations, such as the Audio Engineering Society (AES) http://www.aes.org/, the American Loudspeaker Manufacturers and Acoustics (ALMA International) http://www.almainternational.org/, and the Loudspeaker University, that provide a format for loudspeaker information and technology. Ironically but sincerely, the best source for loudspeaker and acoustic theory books that I could find was at Old Colony Sound Lab, http://www.audioxpress.com/bksprods/.

Dick Small captured it very well: "Most people have to assemble it from a mix of physics, engineering, and acoustics." My advice is much simpler. "Take a 5-day course in design of experiments (DOE)."

Seriously, if you want to be a loudspeaker engineer, go for it—but the truth is that it will not be easy. If you want to design amplifiers, just study electrical engineering and you can start designing the day after graduation. If you want to write code, it's essentially the same. If you want to design a septic system for that dream home, then a new graduate of civil engineering can handle that design and documentation. The path to loudspeaker engineering is not so clear and direct.

There is yet another alternative that requires implementing a "Dr. Deming" type of commitment to improving employee skills. This approach brings an independent transducer engineer in-house for the purpose of conducting training courses and seminars, while ideally working concurrently with the technical staff designing and developing new products in real-time. There is a high degree of excitement within Advanced Sound Technology, http://www.asp.com.my/, an approved Malaysian Multimedia Super Corridor company, http://www.msc.com.my/.

Our joint concurrent training and new product development efforts are underway and going very well. This is also great for team building and TQM. "Actions speak louder [pun intended] than words." This clearly demonstrates that Advanced Sound is committed to preserving/producing jobs and plans to stay in the business of developing innovative A/V solutions.

It is no wonder that the chairman, S.L. Hui, a citizen and resident of Penang, Malaysia, has an advanced degree, a Masters in Business Administration (MBA) from the University of Michigan. Just about everyone in Malaysia speaks English and you never need a jacket—just an umbrella and a bottle of water. The non-English language and cultural barriers significantly limit this training/seminar option within China and even Thailand. Kindly make sure Malaysia is on your radar screens. Malaysia recognizes the intense competition for foreign capital investment.

In larger companies, seminars and training courses are not uncommon. Cross-training is typically encouraged among development team members but this typically lacks structure and organization. Not all competent engineers are willing to divulge their techniques or maybe their lack thereof. Companies are reluctant to pressure a productive engineer to teach when he is not receptive to teaching or he may be an introvert, sometimes referred to as an individual contributor.

Up to this point the article has focused on how to obtain the necessary training to become a loudspeaker engineer. Please don't misunderstand—this is not enough. Engineering as a profession is a life-long commitment to learning and growing technical skills and the understanding of physical and virtual concepts. How is that ongoing training obtained? Frankly, with only a little more than ten years of working experience, I will leave that question to the more qualified industry veterans such as Neville Thiele and Dick Small.

With all this education and knowledge that has been acquired by the aspiring or junior loudspeaker engineer comes the realization that without the engineering simulation and measurements tools, the loudspeaker engineer can do nothing. Engineers depend on hardware and software to a very high degree. A cliché seems to apply here: "An engineer's tools are only as good as his head."

Another often overlooked characteristic of a productive loudspeaker engineer is that he must be a risk taker. As in finance, sometimes the greater the risk the greater the potential is for

reward. This is also affected by the fact that loudspeakers and transducers are mature disciplines. It is not advisable to sit back and relax. An engineer's performance is typically reviewed annually or semiannually. The more productive the engineer, the more the pay increases.

Free agency is fair game but best left to the strong at heart and/or thick of head. However, to quote the Director of the Department of Electrical Engineering at URI in 1995, Dr. William Olney, "The time to look for your second job is as soon as you find your first job."

Engineering is inherently competitive. It's really quite elementary—make money for your employer or client and you're styling. However, I have seen more than one colleague escorted to the employee exit, never to return. If this sounds objective, that's because it is.

In retrospect and in closing, there is nothing that I would rather do than think, talk, dream about, simulate, design, document, and test transducers and systems. A loudspeaker engineer has the most rewarding job on the planet! One final warning—the politics can be hazardous to your health. ***VC***

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