

DSPS Education: An Industry Leader's Experiences and Expectations

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ABSTRACT

Texas Instruments is the industry leader in providing digital signal processing solutions to a variety of system applications including wireless communications, modems, hard disk drives, and many others. In this paper, the key roles of university research and education are described. The relationship of TI to the university community is reviewed. TI's expectations from university programs are also outlined.

1. INTRODUCTION

Texas Instruments (TI) is the industry leader in providing digital signal processing solutions (DSPS) to a wide variety of applications including wireless communication, voice band and digital modems, networking and storage. DSPS can be defined as a combination of a digital signal processor (DSP), analog and mixed signal circuits and software to meet the needs of an application. To be successful, multi-disciplinary expertise consisting of DSP, signal processing software and systems engineering knowledge is essential. Graduates with these multiple talents are valuable not only to TI, but are essential at TI customer organizations that ultimately provide the applications to the consumers. The potential of growing the DSPS industry depends on the DSPS provider as well as the SP-knowledgeable applications development companies. Today, cell phones, modems and hard disk drives dominate the DSP market, but in the future a variety of new communications applications will appear. There is no doubt that a student's career in DSP will go through much evolution as new applications emerge. DSL modems, and new high speed wireless LANs are likely candidates for DSPS. Connectivity is a fundamental need or desire from a large segment of the population. This is the reason for the spectacular growth of cell phones and the Internet. Undoubtedly, there are many new communications applications not yet recognized that will become the drivers for DSPS in the future.

2. University Relationship

TI has created a multi-faceted approach to establishing university relationships. It can be roughly categorized into three areas: (1) educational initiatives, (2) research sponsorship and interaction, and (3) summer internship.

TI has developed a DSP laboratory for instructional help at the universities. Using a mixture of theory and laboratory work, the DSP Teaching Kit enables students to grasp the fundamentals of DSP. The key features of the Teaching Kit consists of comprehensive instructor and student guides, demonstration programs including source code, test questions and marking sheets, fixed or floating point DSP starter kit with accessories, and a textbook, "A Simple Approach to DSP" by Ewers and Marven. The kit is available at a nominal cost to the universities and is widely adopted for laboratory work. More details may be found on the TI web site <http://www.ti.com/sc/university>.

As one of several initiatives to increase the DSP awareness and enhance the creative skills of students, TI had created the program "The DSP Solutions Challenge." The program was open to students from any university in the world. The requirements were creating and submitting to Texas Instruments, an original design, which employs a TI digital signal processor (DSP) and includes an original software program (if applicable). The design was expected to operate as a functional application. The contestants were judged regionally with three winners in each region (Americas, Europe and Asia), with the first place winner from each group making to the final round. The winning team of students is also afforded the opportunity to intern at TI, and the advising faculty member is encouraged to spend a sabbatical term at TI. This highly successful program has helped students to deal with real-world problems requiring them to handle hardware, software, algorithm and system level issues. Some of the winning projects include digital video broadcasting over varying channel conditions, Virtual 5.1 channel audio from only two speakers and smart antennas for wireless communication. TI is currently investigating several programs that will meet similar goals.

TI Educators Conference is an annual event hosted by TI, and the participants consist of educators, students, TI staff, and third party DSP tool vendors who provide software tools for TI DSPs. It is a forum that allows for DSPS research results and DSP education issues are discussed. Focused training programs and technology demonstrations (from universities as well as TI) are part of the conference activities.

TI has been involved in sponsoring several research programs at various universities for a number of years. Evolving from this eclectic approach, TI recently established a university research fund program focused on the development of DSP technologies and applications such as wireless and wireline communication, networking, multimedia, digital motor control and biomedical instrumentation. Many leading research and engineering staff interact with the universities by serving on research advisory panels, doctoral committees and as industrial co-advisors for doctoral and master's theses. There are many occasions when these research has been carried out at TI at least in part. The best benefits of the university research have occurred when TI has had the students working on the TI-sponsored project hired in as a summer intern or a regular employee.

Summer DSP internship program spans many TI activities and the students hired into the program range from advanced undergraduates to doctoral students. These students work on a variety of projects ranging from research to some product development activities. Most of the students find the experience to be a highly valuable part of their educational pursuit.

3. Expectations from DSP Education Efforts

What does a DSP-industry leader expect from the education efforts? Obviously TI needs graduates who have DSP knowledge for it to succeed and meet customer needs. However, equally important is for TI's customers to have such graduates on their staff. Such a situation will make DSP applications pervasive; the TI customer will make educated decisions and will exploit the full potential of the DSP in creating new applications. Of course, we like having the best students join us as permanent employees, but the phrase "all boats rise with the tide" does apply. We believe that having more DSP knowledgeable engineers in the industry does benefit our whole industry including TI.

The world of DSP applications is dominated by connectivity, be it a cellular phone, a personal computer or a handheld device. Many analysts believe that the electronics industry will be driven in the future by communications applications rather than by the personal computer that has dominated that last 15 years of the

electronics industry. The applications demand knowledge of communication systems including estimation and detection theory, filtering, spectral analysis, compression technology, and adaptive techniques. However, the implementation of many signal processing algorithms require much more than the above theories. The better DSP systems engineer is well prepared in a number of topics that not all DSP curricula cover. TI appreciates the need for DSP engineers well trained in the following: computer architecture, data structures, fixed/floating point issues, software engineering, networking, computational techniques, numerical methods, etc. We believe that a good DSP education involves good computer engineering education as well. DSP projects that require the understanding of the above areas will be key to training engineers to be well prepared to meet the demands of the real world. Systems engineering will be the key to many of the successful new applications of DSPs. Attendance at conferences and workshops and interaction with key industry leaders will be helpful. Summer internships, an important program at TI, will expose the students to real-world considerations and we would strongly encourage students to participate in summer engineering internships or coop programs.

4. Conclusions

In summary, TI would like to see the DSP engineer trained not only in the traditional DSP theoretical curriculum, but augment it with formal training in the computer engineering fields and a good non-trivial DSP project. The potential of the DSP career field has never been brighter, and it offers challenging technical problems, exciting applications, and rapidly growing markets with outstanding job opportunities.