EXPANDING TEAM EXPERIENCES IN DSP EDUCATION

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ABSTRACT

Since practicing engineers work in multidisciplinary teams, it is important that universities provide as many teaming experiences as possible. In this paper, we present some of the advantages and disadvantages of traditional teaming approaches. We then present issues related to virtual teaming - the teaming of students from geographically distributed locations. Virtual teaming adds a new dimension to the teaming experiences that universities can provide to students to better equip them for the environment in which they will work in research positions and in industry. Experiences with a three-year program in virtual teaming between the University of Colorado and George Mason University will be presented.

1. MOTIVATION

The most successful teams for the design, analysis, and manufacturing of engineering systems are often formed from a geographically distributed pool of talent [1,2]. To help prepare our students for this new reality, we have developed a two-course undergraduate sequence in digital signal processing [3] in which students from the University of Colorado (CU) form virtual teams with students from George Mason University (GMU). In the first course, basic concepts in distributed teaming are introduced through a sequence of three group projects. Additional group projects are the focus of a second course in multimedia signal processing.

Through an NSF equipment grant, we have established identical laboratories at CU and at GMU that contain Silicon Graphics Indy workstations. These systems support asynchronous communications via advanced electronic mail which can include video, audio, text and data. The equipment also allows synchronous communications between remote team members via full teleconferencing capabilities that include two-way audio/video, a shared whiteboard for document preparation, and transparent data transmission. Additional software allows students to rapidly develop WWW documents containing text, images, software, and data - thus allowing for truly multimedia based project reports.

2. TRADITIONAL TEAMING APPROACHES

Team projects are a part of many courses in an engineering curriculum. These projects are an important part of the preparation of a student for the team-oriented workplace in engineering jobs. However, these projects lack some of the important characteristics of engineering teams, such as different backgrounds and different physical locations. We felt that it was important to extend the traditional teaming approaches so that they could better model the engineering teams of today and of the 21st century.

3. VIRTUAL TEAMING

Virtual teaming, in its simplest form, is the extension of traditional teaming to include geographically remote partners through the use of advanced technology. The advantages are clear: removing proximity as a constraint in forming teams allows one to include the best talent available within work groups irrespective of location. However, along with these new possibilities, this natural evolution in teaming brings with it a whole host of new issues.

Scheduling and a division of labor are always critical issues in any large project. Virtual teaming necessarily requires a greater reliance on an accurate and realistic schedule since changes in work assignments/dates are much more difficult to coordinate across distance and time. Because of this, it is imperative that virtual groups establish a detailed schedule with a clear division of labor that is uniformly accepted by all members. It has been our experience that groups who have not clearly identified responsibilities and deadlines in advance inevitably run into potentially contentious situations resulting in a

significant decrease in the success of the project. However, those groups with good communication and a well understood working schedule often submit work which is much more creative than teams composed of regionally connected members.

Because team members can not rely on traditional means to maintain cohesion, the constant documenting of procedures and preliminary results becomes critical. This is a particularly daunting task when cultural diversity within the group can mean no common primary language exists. However, the use of a fully integrated WWW site as an evolving document source allows all members instantaneous access to the full measure of documentation, resulting in a much closer coordination of all the source material.

One of the greatest advantages of virtual teaming is the inclusion of diversity within the groups. This diversity allows for a greater variety of points of view and expertise, thus resulting in a level of creativity rarely seen in traditional teaming. (As an example of this creativity, see Figure 1 for a graphic of an entire virtual team.) In addition, the significantly increased potential for student-to-student learning has elevated the performance of our students.

4. CURRENT EXPERIENCES

We are now finishing the third year of virtual teaming projects associated with senior-level digital signal processing courses at CU and GMU [4, 5]. The advanced capabilities of virtual student teams is best observed by examining the group pages on the WWW. (For a list of current student teams and projects, see http://www.spec.gmu.edu/~gorsak/courses/ece410/teams.html.) However, to offer an example of the level of work of these students we supply the following figures from our second group project in our Introduction to Signal Processing course. In this project, students were supplied with both a clean and a noisy version of a signal that in this case, is the synchronization signal from a computer modem. In Figures 2 and 3 you can see the variety of ways in which the students attempted to identify the nature of the corruption and remove its ill-effects on the signal.

5. FUTURE EFFORTS

In the Spring 1997 semester, we will be adding a practicing engineer to each virtual team. This person will not be a formal team member, but will provide advise, suggestions, and mentoring to the team. The engineer will, in general, also be a virtual member and may not

physically reside near any of the students on the team. This link to the real world is an important link that is best provided by practicing engineers.

As described earlier in this paper, one of the most significant dimensions of virtual teaming is the ability to allow for diversity within project groups. To enhance and further the regional diversity which occurs by teaming students from CU and GMU, we have been actively pursuing the inclusion of students from a coalition of Historically Black Colleges and Universities (HBCU's) within the future activities. These institutions are Howard University, Morgan State University, and Hampton University. The mutual benefits this partnership promises has engendered a significant amount of enthusiasm from faculty and administrators at all of the participating institutions. Moreover, this partnership has been endorsed by the Executive Board of AMIE (Advancing Minorities' Interest in Engineering). It is expected that the initial teaming experiences with the HBCU's will begin during the 1997-98 academic year.

6. REFERENCES

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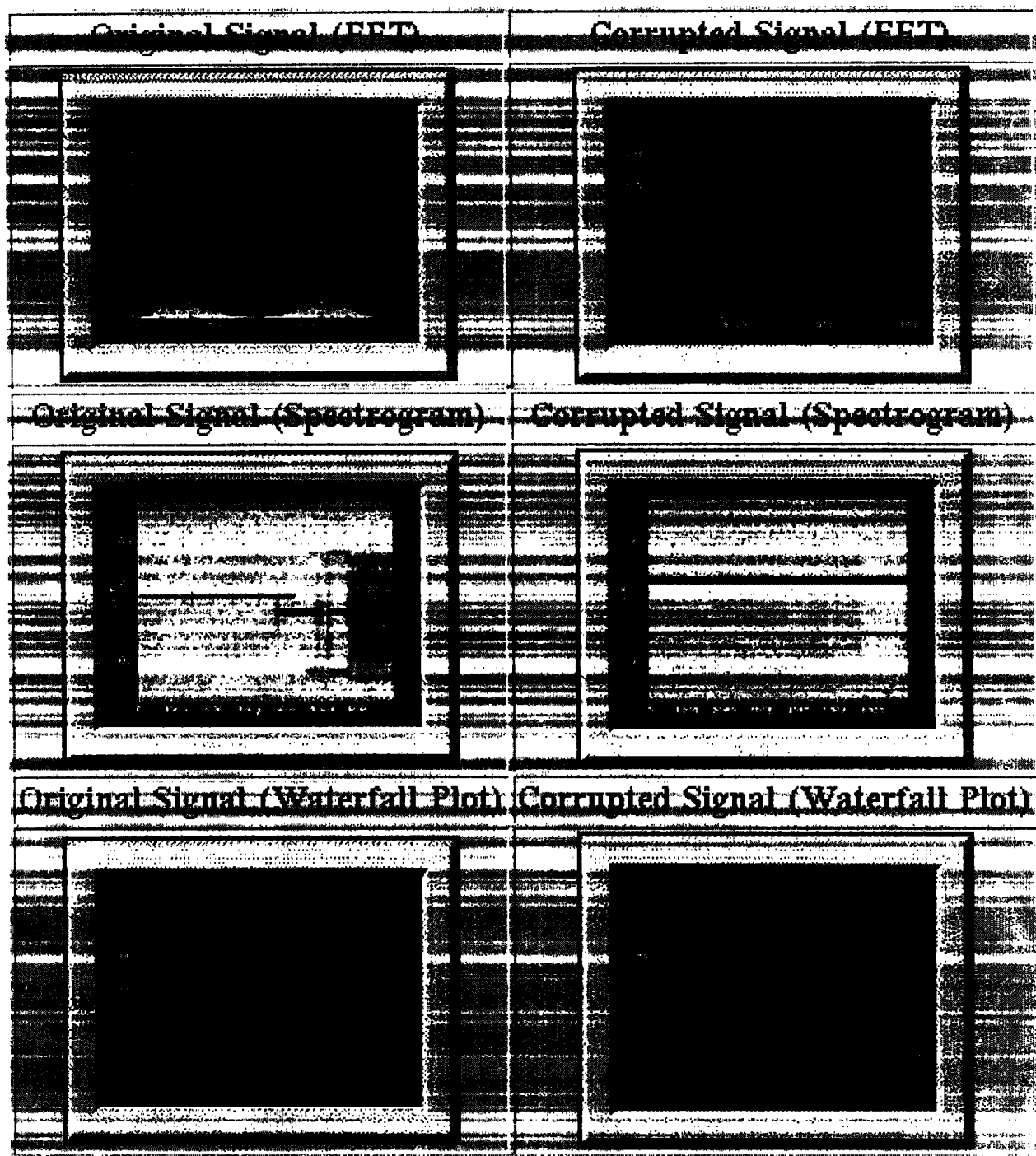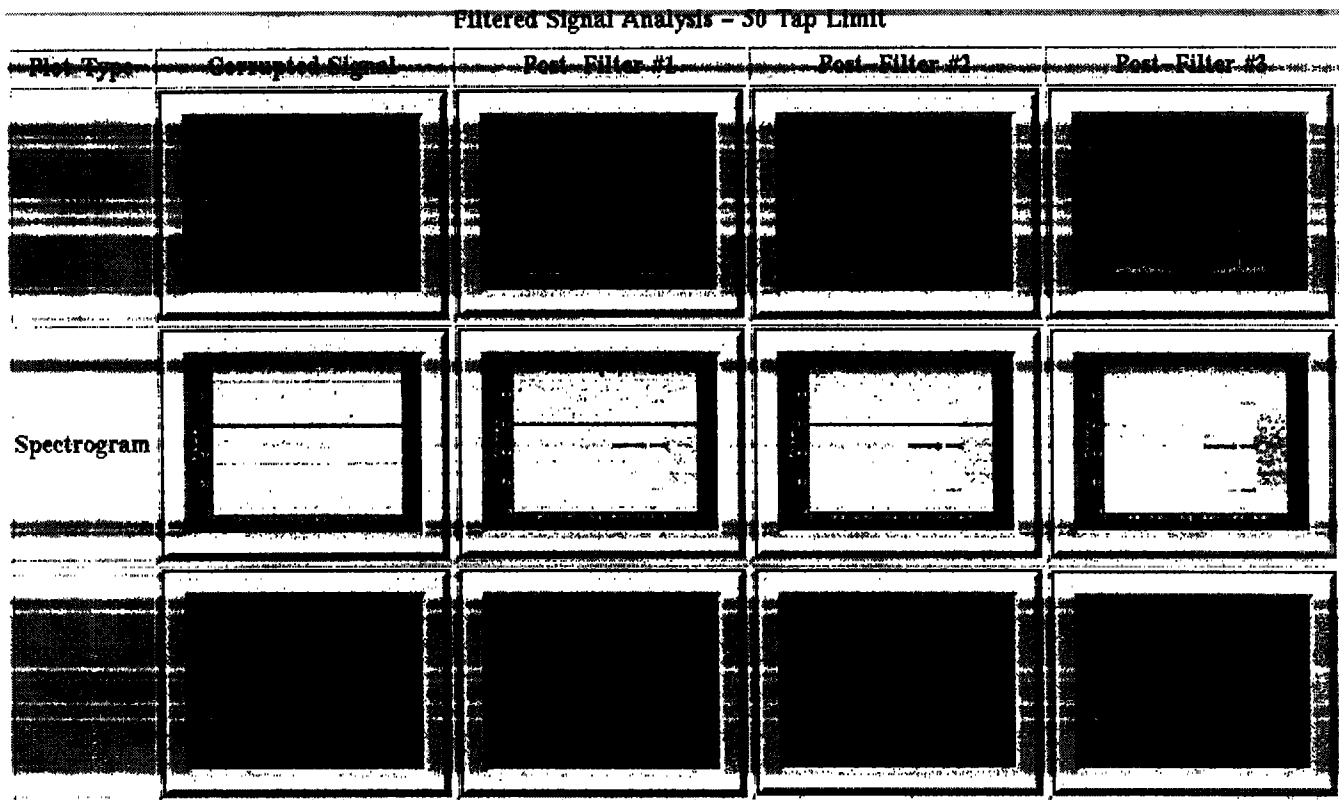
Figure 1. Virtual Team "Shaking Hands"

Figure 2. Project Signal Analysis

Figure 3. Project Filter Analysis