Work in Progress - Collaborative Multi-Disciplinary J-DSP Software Project

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Abstract - **This NSF Phase 3 CCLI multidisciplinary project consists of a collaborative implementation and national dissemination effort that involves Arizona State University (ASU), Johns Hopkins University (JHU), Prairie View A&M University, University of Washington-Bothell (UWB), Rose-Hulman Institute of Technology, University of New Mexico (UNM), and the University of Cyprus (UCY). The project involves significant educational technology innovations and software extensions that will enable the online software J-DSP to be used in multiple disciplines including digital signal processing, earth systems, renewable energy, biologically-inspired sensors, and arts and media. Problems addressed include the delivery of technology-enhanced laboratory experiences to undergraduate students using novel Java tools and the requirement of a broad assessment of these practices at several universities.**

Index Terms – DSP, Java, online labs, multidisciplinary.

INTRODUCTION

Java-DSP (J-DSP) (http://jdsp.asu.edu) is an educational program that enables on-line simulations and web-based computer laboratories [1]. J-DSP provides an object-oriented programming environment that enables students to establish and run DSP simulations on the internet. The initial version of J-DSP has been developed in the ASU Java lab and tested in a senior-level Electrical Engineering Digital Signal Processing (DSP) course (EEE 407). The J-DSP Version 1 (CD-ROM ISBN 0-9724984-0-0) is approximately 42,000 lines of Java code. Original J-DSP functionality included algorithms for signal processing [2], imaging [3], controls [4], time-frequency analysis [5] and communications applications [6]. A DSP book that uses the software has also been published [7].

The objectives of the NSF CCLI phase 3 project are to develop: a) new educational technology, b) functionality extensions enabling J-DSP to support new disciplines and modules in the collaborating universities, c) a dissemination process for the software and all materials, d) workshops for training faculty, e) new online laboratory exercises for all courses by the Co-PIs at the different universities, e) a geographically diverse assessment plan that involves the faculty specialists at all universities, and f) national dissemination of a book developed from a previous CCLI EMD and publication of all results in a new J-DSP lectures book with a commercial publisher.

MULTIDISCIPLINARY EXTENSIONS TO J-DSP

Several significant multidisciplinary extensions to J-DSP are being developed for the phase 3 project. By involving several universities, the project aims to expand the scope and applicability of J-DSP beyond Electrical engineering. As part of the multidisciplinary collaboration with Johns Hopkins University, J–DSP/Earth Systems Edition (J-DSP/ESE), a customized version of J-DSP for Earth science and geology systems is developed. J-DSP/ESE includes functions for generating the Earth systems data, performing depth to time transformation, interpolation/re-sampling, filter design, windowing, fast Fourier transforms (FFT/IFFT), and time-frequency analysis [8]. An example of using J-DSP/ESE to analyze earth systems data is given in Figure 2. Earth system signals consist of Eccentricity, Tilt and Precession (ETP) frequencies and extracting them from the signal is a significant problem. Functionality for computing the multiple prolate taper spectrum will be developed and existing functions such as spectrogram will also be used in order to extract the ETP frequencies.

J-DSP will be extended as a part of a multimedia computing course in UWB. The focus will be on connecting students' knowledge of data-structures, algorithms, system analysis and design. In a collaborative activity with RHIT, J-DSP modules will be embedded in a music synthesis course. In collaboration with the Arts, Media and Engineering (AME) program [9] at ASU, extensions for J-DSP will be developed to provide artists with creative web-based DSP software tools. Functions have been developed in J-DSP for ion-channel signal processing in collaboration with ASU Institute of Nanoelectronics [10]. J-DSP will be extended to renewable energy areas at ASU and used in power engineering courses, where a solid working knowledge of DSP concepts is essential. At UNM, digital filter concepts will be introduced to students using J-DSP and will be integrated with the FPGA implementation of digital filters. In collaboration with the ASU SenSIP center, J-DSP will be used to explain the basics of nucleotide sequences and its relation to signal analysis. The existing functions for displaying DNA data [11] will be used and new functions

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FIGURE 1
MULTIDISCIPLINARY AND MULTIUNIVERSITY
COLLABORATIVE J-DSP MODULES FOR PHASE 3 PROJECT.

will also be developed. Other collaborative efforts include creating educational modules using J-DSP for DSP courses at PVAMU and injecting J-DSP in signal and image processing courses at UCY.

Assessment of student learning will be performed individually for each multidisciplinary module. The set of online assessment tools that are already available will be adapted and improved to measure student learning.

CONCLUSIONS

Multidisciplinary extensions form the core of the NSF CCLI J-DSP phase 3 project. Innovative assessment techniques and worldwide dissemination efforts are also planned as a part of the effort. The learning of DSP concepts will be simplified using modules tailored for each discipline and this will help the students explore the applicability of signal processing concepts in their own area. The learning process promoted by the laboratories and assessments developed as a part of the project will stimulate the critical thinking of students and provide them with a positive attitude towards the subject.

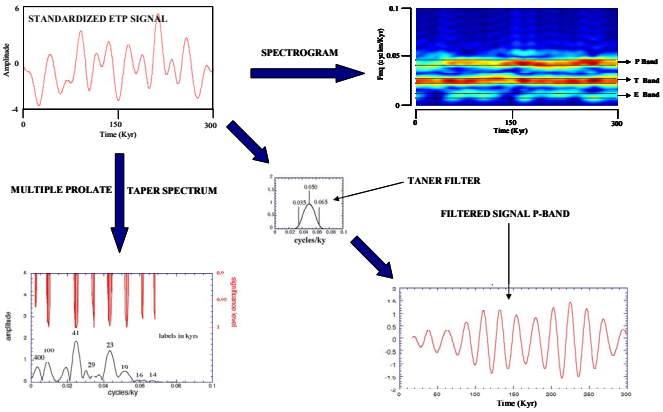

FIGURE 2
EARTH SIGNAL ANALYSIS USING J-DSP/ESE.

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