Java-DSP – Online Virtual Laboratories

DSP Simulations

Extensions to other Disciplines

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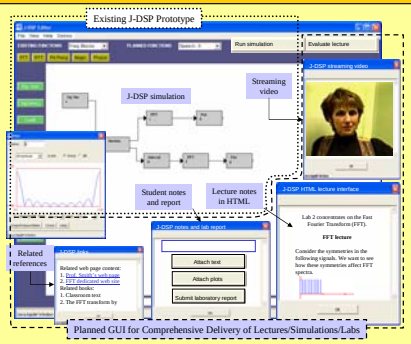
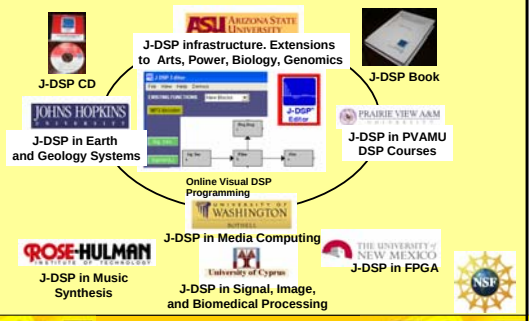
NSF Program CCLI Phase 3 Award Started Apr. 2008 – Apr. 2013 involves 8 universities

Also core software used in an NSF CRCD 2004-2006

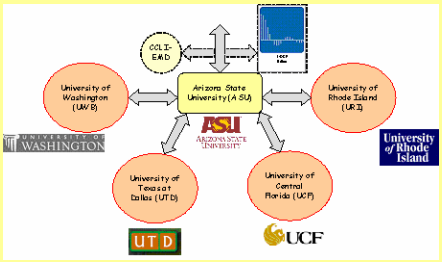
J-DSP: A Distance Learning Paradigm



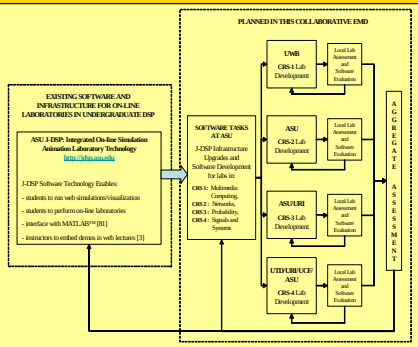
5 year Collaborative Multidisciplinary NSF Phase 3 Project on J-DSP - Lead by ASU



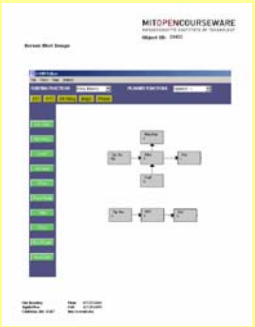
Collaborative Project



Collaborative EMD Overview



J DSP and MIT Open Courseware



Why J-DSP / Objectives

- Develop an on-line simulation tool for use in Linear Systems courses.
- Motivate Students to take Systems electives
- Provide hands-on experiences to undergraduate/ graduate DSP students and distance learners.
- Accelerate leaning by exposing students to hands-on manipulation of signals and DSP systems.
- Expose High School Students to Electrical Engineering

TOOLS FOR INSTRUCTORS

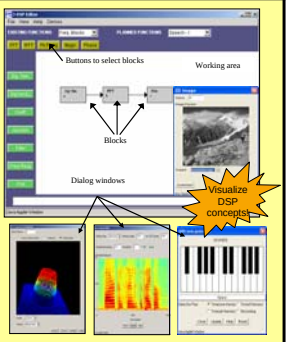
- Seamlessly embed J-DSP simulations in web lectures;
- Demos for use in High-School Environments

J-DSP Overview

BASIC FUNCTIONALITY IN J-DSP

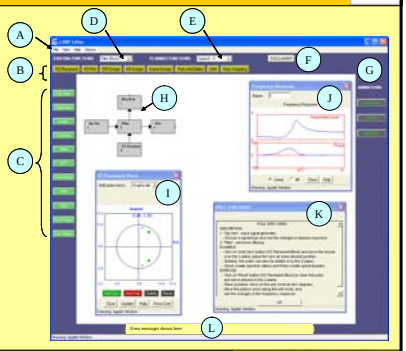
- Fundamental DSP Functions (FFT, IFFT, Windowing etc.)
- Basic Arithmetic Functionality,
- Multi-rate DSP
- Pole-Zero z-domain diagrams
- Frequency Response,
- Visualization Blocks,
- Digital Filtering,
- FIR/IIR Filter Design
- Spectral Estimation
- 3D Animations,

Pole-Zero fie-net\fe-031\Prof_SPANIAS\ASSESSMENT\AV11\PoleZeroPlacement1.avi\Animation



The J-DSP Editor

A. Menu items
B. Filter Blocks Section
C. Permanent Blocks
D. List Menu Selection (Existing)
E. List Menu Selection (Planned)
F. Disclaimer
G. Interactive Visual Demos
H. Simulation Flowgram
I. Dialog window (PZ Placement)
J. Plot Window to View Results
K. Help Information
L. Error messages



On-line J-DSP Labs

LAB – Intro: Signals And Systems Introductory Exercise

How to use J-DSP, Step by Step Procedure

Generating and Analyzing Signals

Sampling Issues

Simple Filters, Sine plus noise simulation

Simple IIR Design (Butterworth, Chebychev), Shelving Filters

MIDI and DTMF examples and spectral estimation

Prior Work: J-DSP Labs

LAB – 1: *Difference Equations and the Z-Transform*

LAB – 2: *Pole-Zero Plots and Frequency Responses*

LAB – 3: *FIR and IIR Filter Design*

LAB – 4: *The Fast Fourier Transform (FFT)*

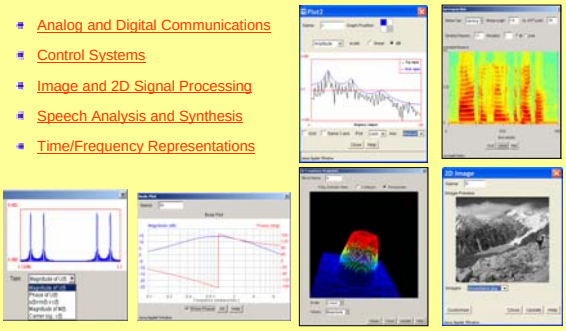
LAB – 5: *Multi-rate Signal Processing and QMF Banks*

LAB – 6: *Random Signal Processing – Spectral Estimation*

Lab Submission Procedure

Extensions from DSP to other Systems Courses

- Analog and Digital Communications
- Control Systems
- Image and 2D Signal Processing
- Speech Analysis and Synthesis
- Time/Frequency Representations

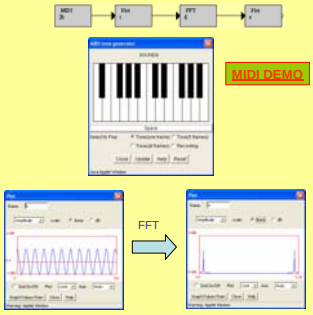


MIDI Functionality

- Simulates a piano keyboard and generates MIDI sounds at the frequencies described by the MIDI standard.
- Generate a sequence of pre-recorded tones.
- The MIDI block can generate a single tone of length: 256 (1 frame), 1280 (5 frames) and 8192 (32 frames) samples.

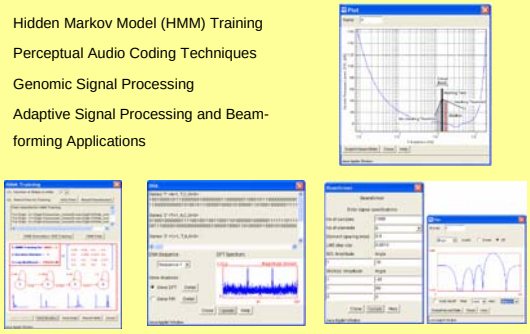
$$y = \cos(2\pi\, fnT)$$

where f is taken from a MIDI standard table [www.midi.org]



Advanced Functionality

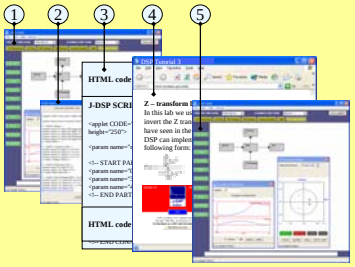
- Hidden Markov Model (HMM) Training
- Perceptual Audio Coding Techniques
- Genomic Signal Processing
- Adaptive Signal Processing and Beam-forming Applications



Seamlessly Embed J-DSP Simulations in Web Content

FIVE SIMPLE STEPS

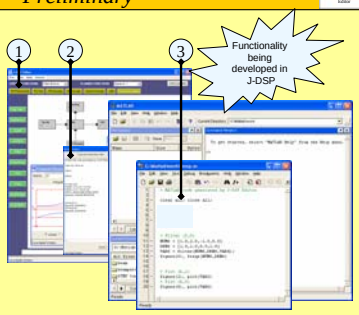
1. Prepare demonstration in J-DSP.
2. Export simulation in J-DSP script.
3. Copy and paste script into an HTML file.
4. Add your own educational content
5. Deliver to students.



J-DSP Interface with MATLAB Preliminary

THREE SIMPLE STEPS

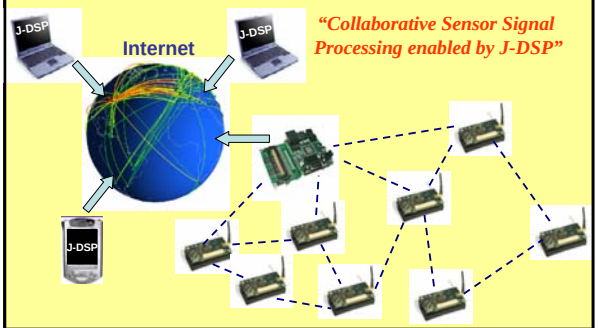
1. Prepare demonstration in J-DSP.
2. Export simulation in MATLAB script.
3. Copy and paste into MATLAB editor window.



J-DSP for use in High Schools

- Developed a series of J-DSP functions that are high school friendly.
  - These functions are categorized as:
    - Tone-generators,
    - MIDI,
    - DTMF
    - Echo and Reverberation Effects.
- These functions are complemented with simple exercises (tone, echo, echo, etc) as well as advanced simulations (vocoders, MP3, etc).
- Developed pilot materials a for dissemination to high-school students.

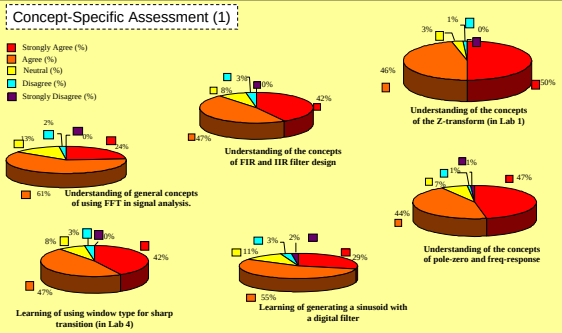
Java-DSP and the Motes



"Collaborative Sensor Signal Processing enabled by J-DSP"

J-DSP Assessment

Concept-Specific Assessment (1)



Remarks

- Developed several functions in J-DSP
- Performed Assessment.
- Collaborative Labs using Java Scripting Capabilities
- Obtain Feedback and use for Continuous Improvement

Preliminary Dissemination at IEEE FIE, ICASSP, and ASEE Conferences

Universities that received materials include:

Georgia Tech
University of Southern California
University of Maryland
University of Minnesota
University of New Mexico
University of Texas-Austin
University of Texas-Dallas
University of Central Florida
Northeastern University
University of Kent
Marquette University
Stevens Institute of Technology
Georgia Institute of Technology
Blekinge Institute of Technology
Drexel University
University of Nebraska
Cal Poly Pomona
University of Detroit-Mercy
University of Pennsylvania
Rice University
Massachusetts Institute of Technology
University of Akron
University of Connecticut
University of Puerto Rico
Clemson University
North Carolina State University
Ecole Nationale
Polytechnique-Algeria
Bogazici University-Turkey

Book that Features J-DSP Exercises

- The J-DSP book for use in an undergraduate DSP class to complement the theory of signal processing.
- Every chapter starts with a compact description of the theory and continues with experiments and computer exercises
- Topics: Review of linear signals and systems, basics of digital filters,z transforms,FIR and IIR filter design,multi-rate signal processing, FFT in signal processing, discrete-time random signal analysis, speech processing, adaptive filters

Workshop at FIE 05

Includes tutorials and examples to demonstrate how instructors can use J-DSP in their classes both as a demonstration tool and as a computer laboratory software

Objectives are:

- to learn how to use Java-DSP.
- to learn how to use the signal generator and filter design functions
- to learn how to use the FFT to compute spectra of signals
- to learn how to use other pre-canned signal functions
- to learn how to use J-DSP scripts to embed demonstrations from web course content
- to enable participants to design their own J-DSP laboratory exercises
- to demonstrate how to carry an assessment of the exercises and practices with J-DSP

Publications

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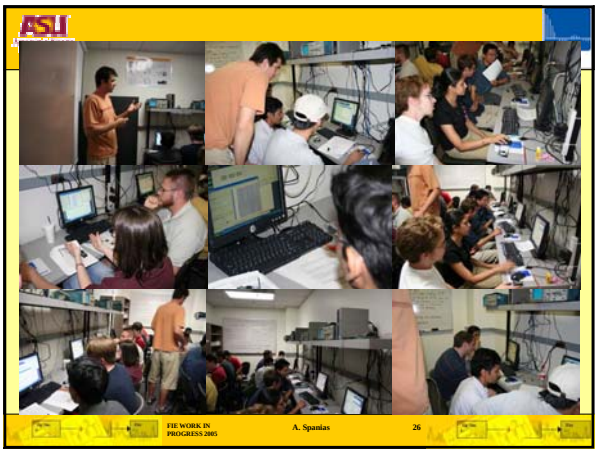

Questions …

Visit http://jdsp.asu.edu

for more information on J-DSP