

J-DSP
Signal
Remote Sensing
Simulations
Interface
Processing
Object-Oriented
Education
Programming
Functions
MP3
Frequency
Visualization
Communications
JAVA
Innovation
Multidisciplinary
Visualization
System
Mapping
Spectrum
Monitoring
Tracking
Localization
Implementation
Reverberation
GUI
On-line
Research
Algorithms
Generators

Become a test site for J-DSP

- Host a mirror site at your university.
- Include J-DSP in your simulations and class notes.
- Use J-DSP in research.
- Collaborate with ASU and embed J-DSP in your dissemination plans.

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Awards

J-DSP Awards

Feb 2007: J-DSP Team Award: For developing the outstanding non-commercial software J-DSP for Education and Research, IEEE Phoenix section

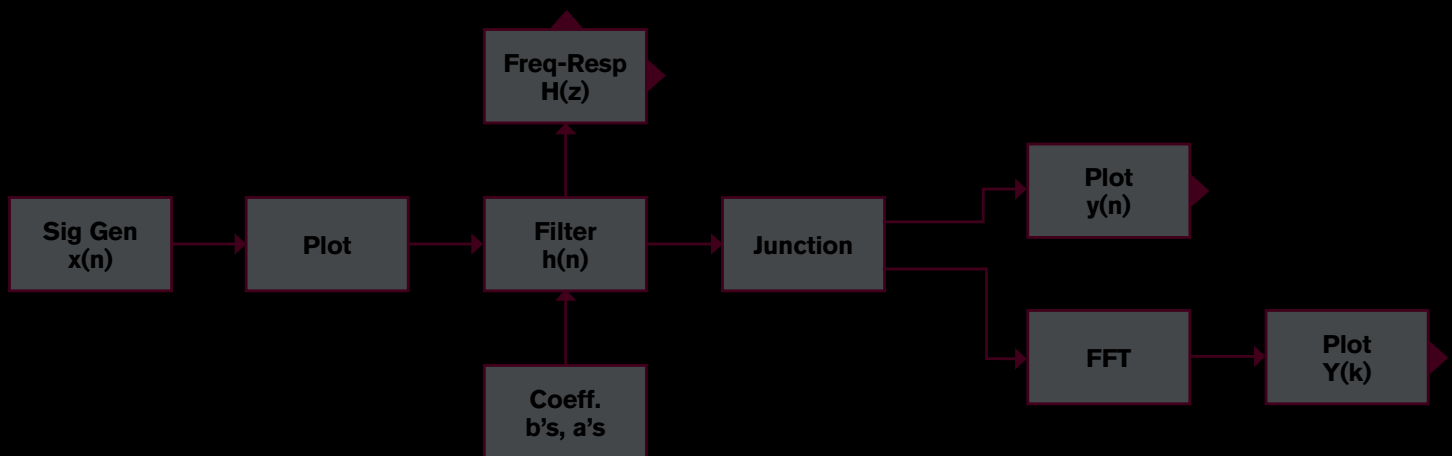
Oct 2003: J-DSP voted as one of the top three learning resources for 2003 by the National Engineering Education Delivery System (NEEDS) which holds an annual competition to recognize high-quality, non-commercial courseware designed to enhance engineering education. The NSF-funded J-DSP package was recognized at the 2003 IEEE/ASEE Frontiers in Education (FIE) Conference in Boulder, Colorado.





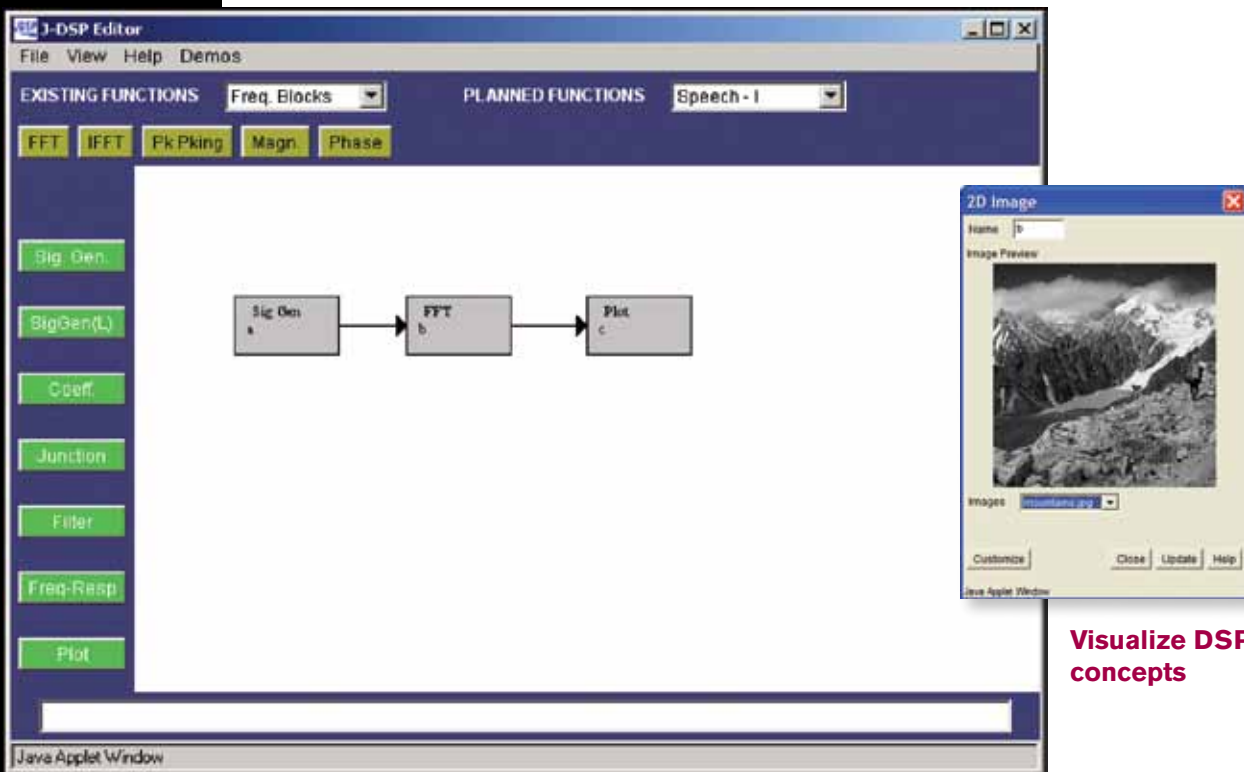
Java - Digital Signal Processing

An Online Signal Processing Simulation Tool



About the J-DSP Editor

Java-DSP (J-DSP) is an educational software package for online simulations and web-based computer laboratories. J-DSP is based on an object-oriented visual programming environment that enables students to establish and run DSP simulations on the Internet. This universally accessible tool is based on an intuitive “block diagram” programming approach. J-DSP has been developed specifically for education; several functions have been inspired by interactions with students to explain concepts that were not evident with blackboard-type explanations. The functions that J-DSP supports are suitable for basic DSP tutoring as well as for demonstrating advanced algorithms. Basic functions include signal generators, arithmetic functions, convolution, filtering, the FFT, impulse and frequency response plots, etc. Advanced functions include statistical and multirate DSP, fixed-point and PCM quantization blocks, select MPEG-Layer 3 functions, and hidden Markov model (HMM) estimation. More on J-DSP functions and their assessment can be found in: A. Spanias, V. Atti, “Interactive online undergraduate laboratories using “J-DSP,” IEEE Transactions on Education, vol. 48, no. 4, pp. 735- 749, Nov. 2005.



The screenshot displays the J-DSP Editor interface. At the top, there is a menu bar with 'File', 'View', 'Help', and 'Demos'. Below the menu bar, there are two dropdown menus: 'EXISTING FUNCTIONS' set to 'Freq. Blocks' and 'PLANNED FUNCTIONS' set to 'Speech - I'. A row of buttons includes 'FFT', 'IFFT', 'Pk Pking', 'Magn.', and 'Phase'. On the left side, a vertical toolbar contains buttons for 'Sig. Gen.', 'BigGen(L)', 'Coeff.', 'Junction', 'Filter', 'Freq-Resp.', and 'Plot'. The main workspace shows a block diagram with three blocks: 'Sig. Gen.' (labeled 'a'), 'FFT' (labeled 'b'), and 'Plot' (labeled 'c'), connected by arrows from left to right. To the right of the main workspace, a '2D Image' window is open, displaying a grayscale image of a mountain range. The window has a title bar, a close button, and a 'Java Applet Window' label at the bottom.

Visualize DSP concepts

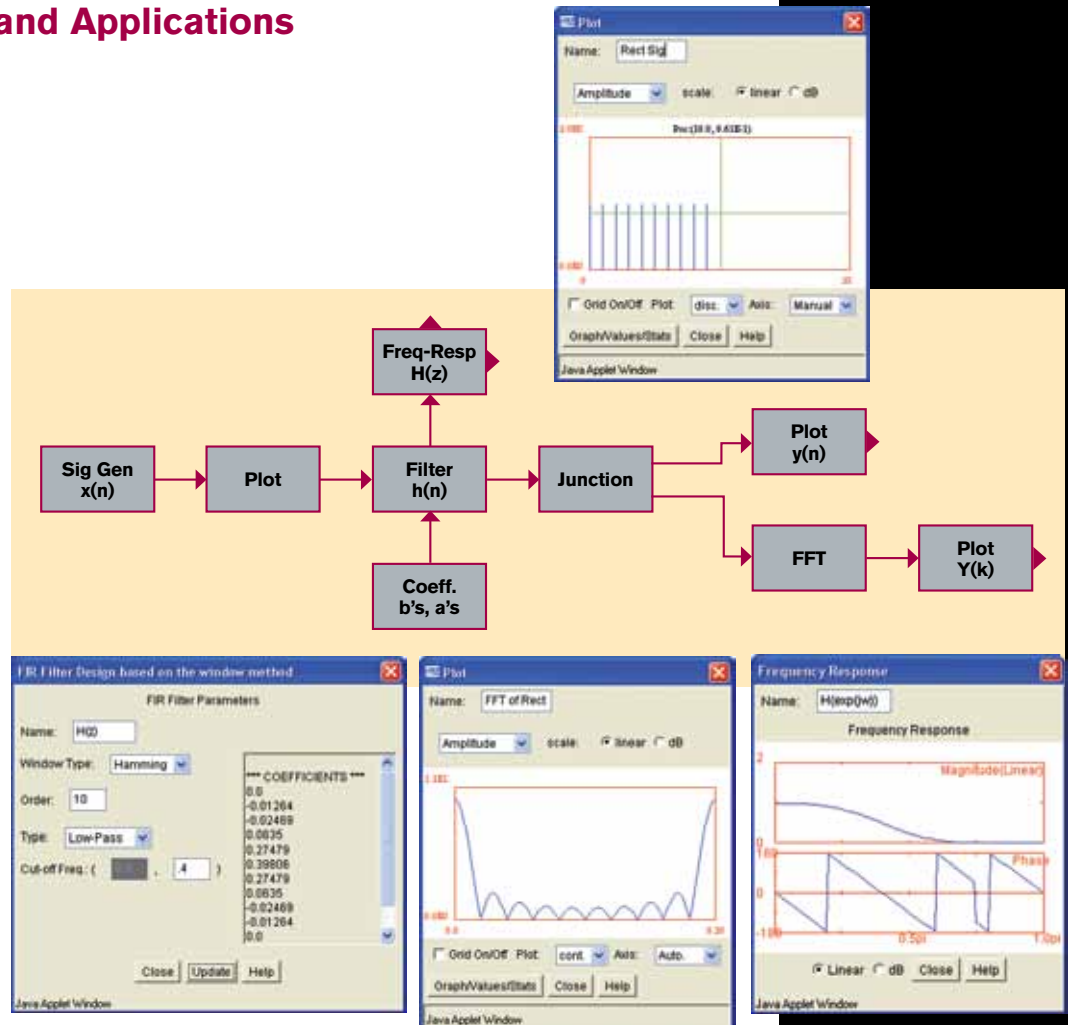
J-DSP is universally and freely accessible

- J-DSP is an on-line graphical DSP simulator written as a Java applet.
- Users can obtain graphical or numerical results at any point of the simulation.
- Provides a simple graphical and user-friendly interface.
- J-DSP has won national awards and ranked as one of the top 3 non-commercial education software resources by NEEDS in 2003.
- J-DSP is also being used in sensor networks research.
- J-DSP is used in earth systems and geology.
- A J-DSP arts and media functions suite is being developed.
- J-DSP interfaces with DSP hardware have been established.
- A functional MP3 decoder in J-DSP has been tested.
- Ion-channel models in J-DSP for sensor applications have been formed.

J-DSP Functionality and Applications

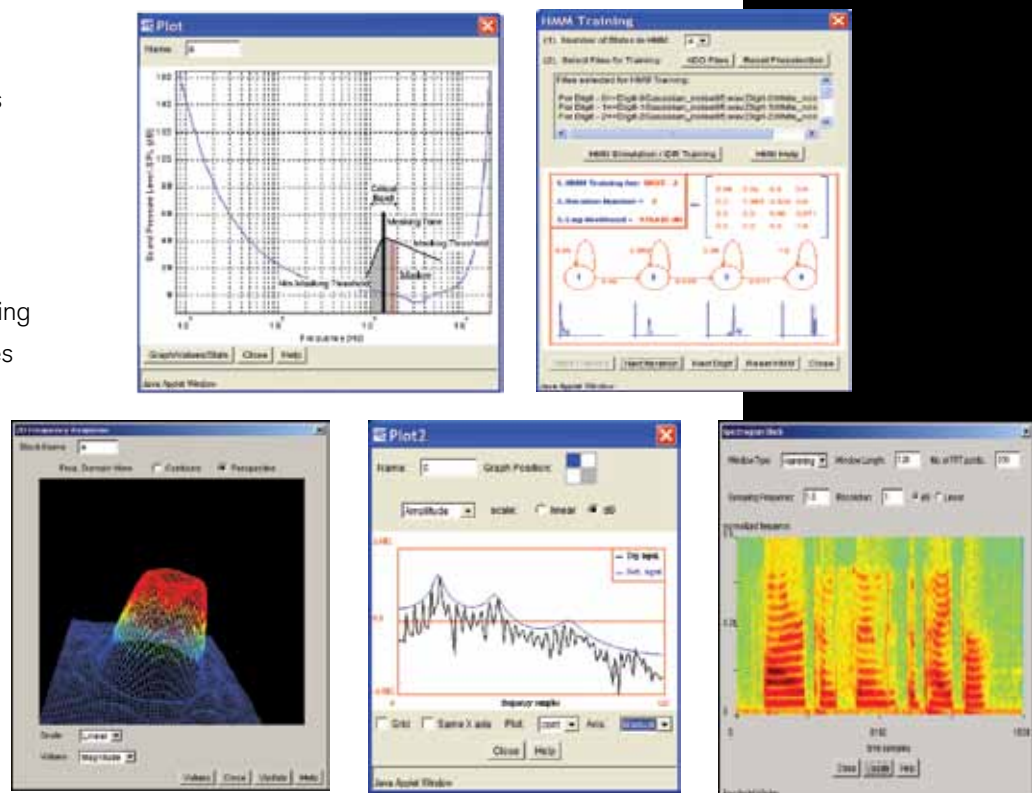
Basic Functions

- 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
- Signal to noise ratio
- Spectrogram
- Visual impulse response design
- Quantization functions
- Parametric methods



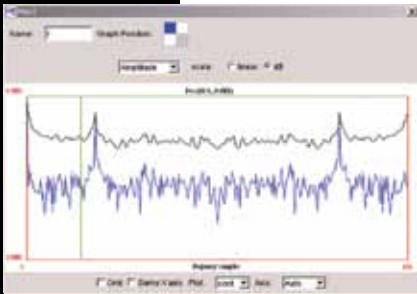
Advanced Functions

- Analog and Digital Communications
- Control Systems
- Image and 2D Signal Processing
- Speech Analysis and Synthesis
- Time/Frequency Representations
- Hidden Markov Model (HMM) Training
- Perceptual Audio Coding Techniques
- Genomic Signal Processing
- Adaptive Signal Processing
- Beamforming Applications

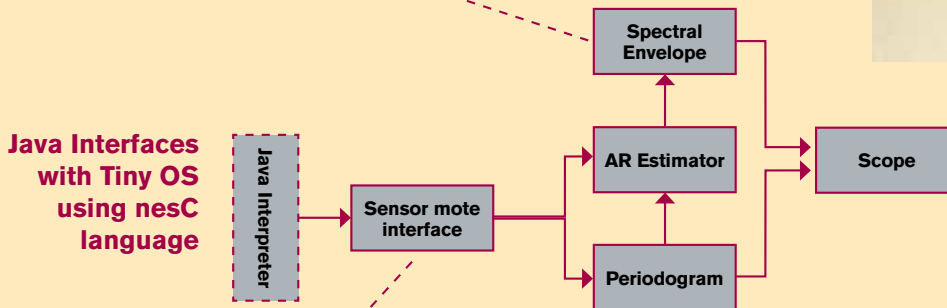


J-DSP and Sensor Networks

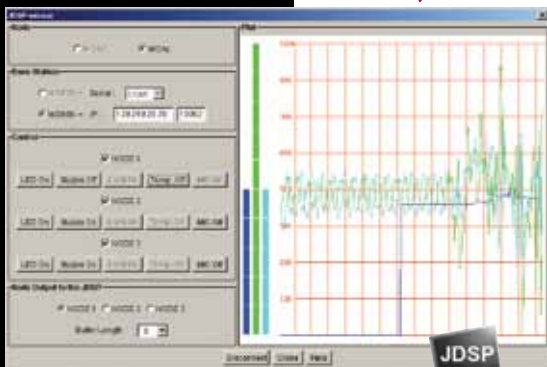
Remote sensing enabled by J-DSP



Remote sensing hardware set-up



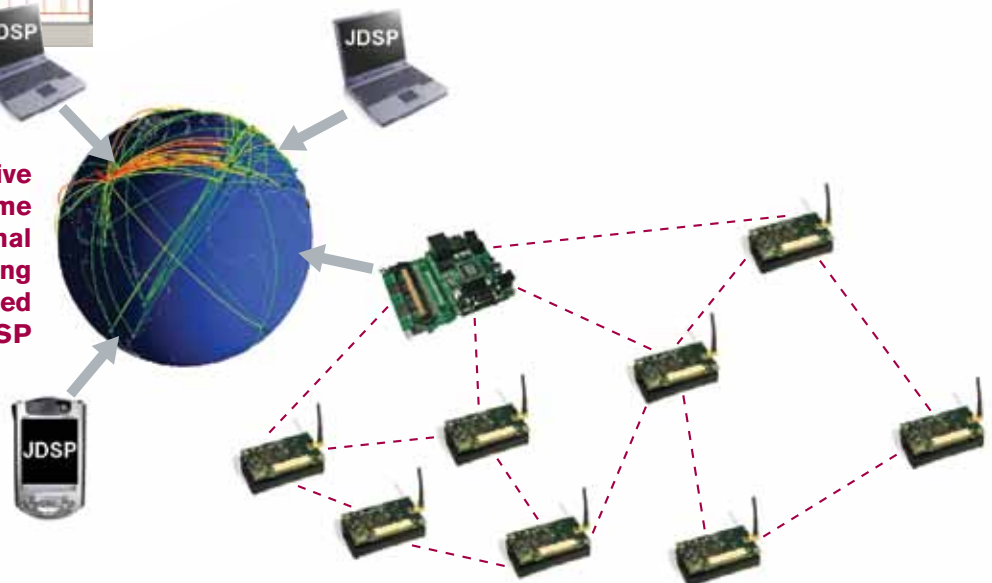
Java Interfaces with Tiny OS using nesC language



Applications

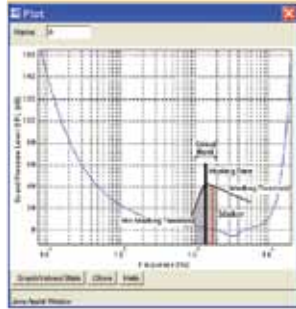
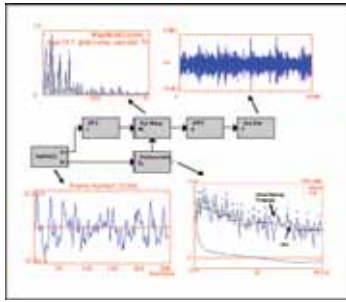
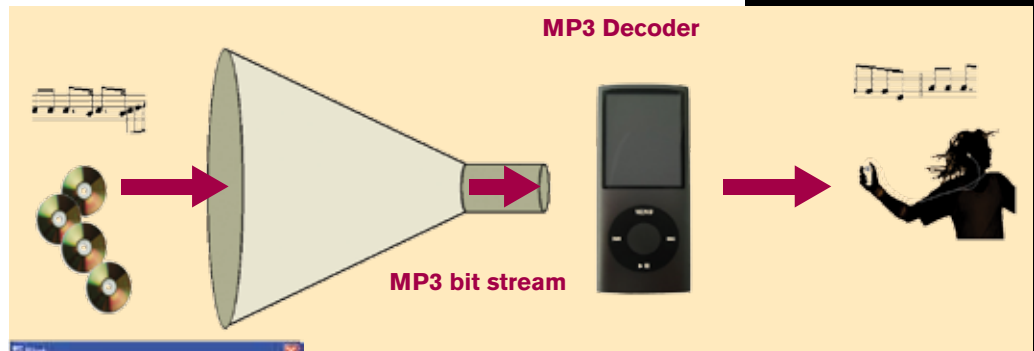
- Environmental Monitoring
- Acoustic Monitoring
- Security
- Source Localization
- Tracking
- Biological Applications

Collaborative Real-Time Sensor Signal Processing Enabled by J-DSP



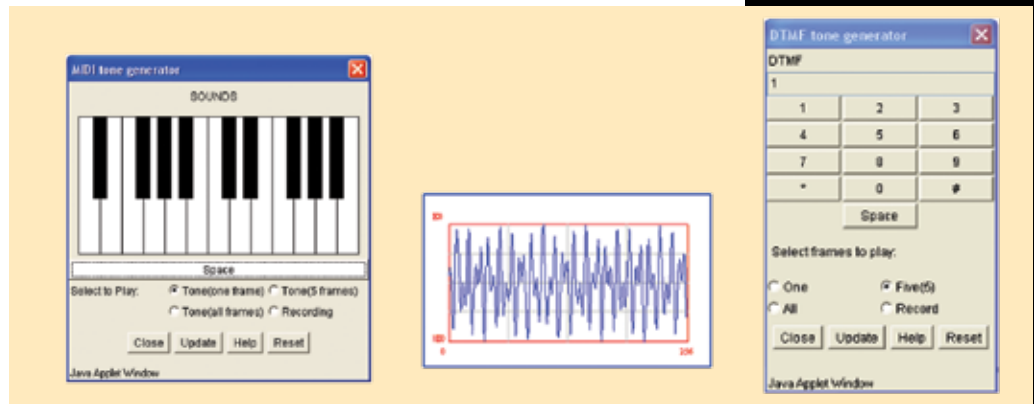
Learning the basics of MP3 compression using J-DSP

- Critical band analysis
- Tonal and noise making experiments
- MPEG-1 psychoacoustics model-1 implementation



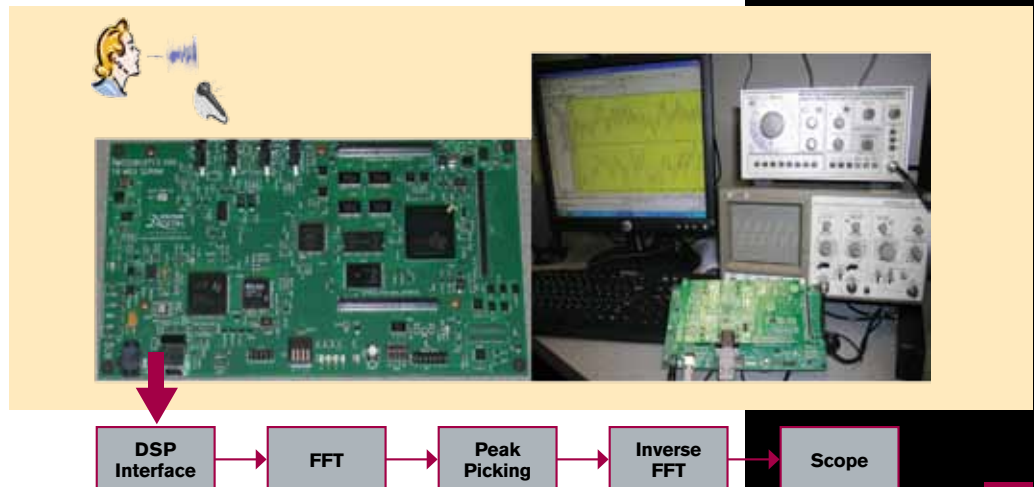
J-DSP piano player and phone dialing functions

- J-DSP can be used to introduce signals and systems in freshman and senior high school classes.
- Tone-generators
- MIDI encoder
- DTMF encoder
- Echo and Reverberation Effects



J-DSP Interface with DSP Boards

- Real-time experiments with J-DSP
- GUI enabled programming of DSP chips
- Interface with Texas Instruments boards
- Sound processing and compression with J-DSP



J-DSP External Software Interfaces

- Seamlessly embed J-DSP Simulations in Web Content using J-DSP Scripts
 - Generate MathScript™ code from J-DSP and integrate with LabVIEW
 - Export J-DSP functions as a MATLAB script



J-DSP

MATLAB™

- Export J-DSP simulation in MATLAB.
- Copy and paste into MATLAB window.
- Extend functionality in Matlab as needed.

HTML

- Export J-DSP simulation in HTML.
- Copy and paste script into an HTML file.
- Add your own educational content
- Deliver to students.

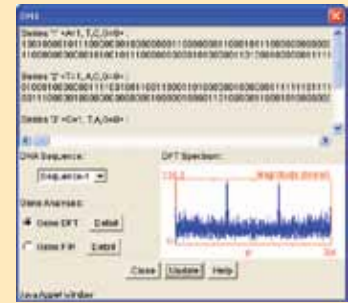
LabVIEW™

- Export J-DSP simulation in MathScript™.
- Copy and paste into an m-file.
- Supply the file path to LabVIEW model.
- Run the model and open *JDSP_Labview_Interface* to visualize the block diagram.

MATLAB and LabVIEW are registered trademarks of The Mathworks and National Instruments, respectively.

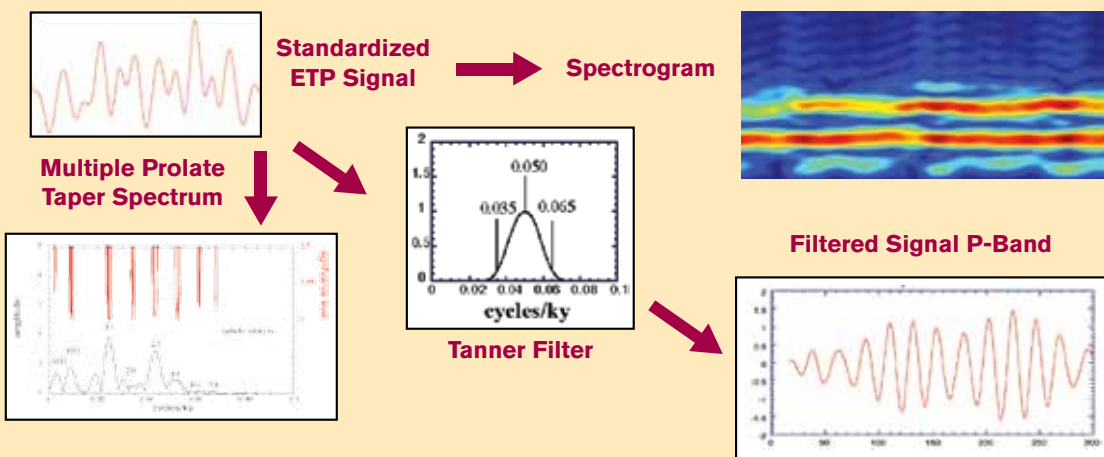
Multi-Disciplinary Applications of J-DSP

- Genomics
 - Analyze the DNA sequences using numerical mapping, FFT power spectrum, and correlations.
 - Visualize the $2\pi/3$ periodicity



Earth-Systems

- A collaborative project between ASU, Johns Hopkins University and Purdue University.
- Functions tailored to perform analysis and visualization of earth system signals.
- Geophysicists are introduced to basic DSP concepts and get hands-on experience with analysis of Earth Systems data.



A DSP book with J-DSP simulations and experiments

Digital Signal Processing

An Interactive Approach

by Andreas Spanias

The book provides theoretical treatments and Java simulations of the following topics:

- Extensive review of continuous-time signals and systems concepts; Java simulation of sampling.
- Introduction to discrete-time systems and applications; J-DSP experiments on digital filters.
- DTFT, FFT, and z-transforms; pole zero diagrams and FFT spectra with Java.
- Filter design; Kaiser, Parks-McClellan, Butterworth/Chebyshev; Interactive J-DSP FIR/IIR design.
- Multirate systems, downsampling / upsampling, QMF subband coding, A/D Σ - Δ concepts.
- Discrete-time random signals; correlation; channel estimation. J-DSP and spectral estimation.
- Adaptive filters; LMS and RLS, Noise Cancellation. LMS convergence simulation with J-DSP.
- Quantization effects, fixed-point processing, PCM, roundoff errors, J-DSP Quantization functions.
- Speech processing algorithms. Linear prediction with Java. LPC and CELP standards.
- Audio coding, Filter banks, the MP3 algorithm; Step-by-step Java visualization of Psychoacoustics.



Computer exercises in J-DSP complement the theory and reinforce concept learning. A chapter-by-chapter comprehensive bibliography is provided with more than 100 references to additional sources of information to explore topics in greater depth.

The textbook includes all the appropriate contents and topics for undergraduate or graduate courses in digital signal processing.

The Digital Signal Processing book can be found at:

<http://www.lulu.com/content/2581497>

ISBN 978-1-4243-2524-5



J-DSP in the classroom.

<http://jdsp.asu.edu>

NSF Multi-University Project on J-DSP Software Development

NSF CCLI Phase 2:

Development and Dissemination of On-Line Laboratories in Networks, Probability Theory, Signals And Systems, And Multimedia Computing

PI : Andreas Spanias (ASU)

Co-PIs: A. Papandreou-Suppappola (ASU), C. Tepedelenioglu (ASU), J. Zhang (ASU),
F. Bodreaux-Bartels (University of Rhode Island),
M. Stiber (University of Washington-Bothell),
T. Kasparis (University of Central Florida), and
P. Loizou (UT Dallas)



NSF award
number 0443137



The CCLI-EMD collaborative effort involves five universities, namely, Arizona State University (ASU), the University of Washington-Bothell (UWB), the University of Texas at Dallas (UTD), the University of Rhode Island (URI), and the University of Central Florida (UCF). This project addresses significant educational technology innovations and software extensions that enable the online software Java-DSP (J-DSP) to be used in three courses at these five universities. The Collaborative NSF EMD involves:

- Educational innovation achieved by generating a large volume of new Java software that upgrades considerably the J-DSP graphical user interface (GUI).
- A software development task that extends the mathematical and signal processing functionality of J-DSP so that it can support online computer laboratories in four courses. This task engages five faculty and several students.
- A dissemination and assessment plan that involves five universities in order to test and provide feedback on the new J-DSP GUI and all exercises and content.
- A comprehensive pilot test of a new multi-site laboratory concept that allows students in the five universities to run real-time distributed online simulations.

NSF CCLI Phase 3:

Collaborative Research: Design and Dissemination of Multidisciplinary Digital Signal Processing Software and Content

PI and Project Director: A. Spanias,
Co-PI at Johns Hopkins University: L. Hinnov, Co-PI at University of Washington:
M. Stiber, Co-PI at Prairie View A&M: C. Akujuobi.
Directors of Test Sites at Rose-Hulman (E. Doering),
University of Cyprus (C. Pattichis), University of New Mexico (M. Pattichis).
Co-PIs at ASU: C. Tepedelenioglu, A. Papandreou-Suppappola,
H. Thornburg, R. Ayyanar



J-DSP CD

ASU ARIZONA STATE UNIVERSITY
J-DSP Infrastructure Extensions to Arts, Power, Biology, Genomics



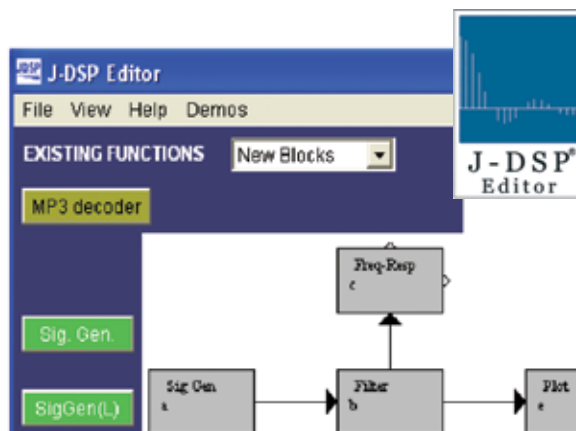
J-DSP Book

JOHNS HOPKINS UNIVERSITY

J-DSP in Earth and Geology Systems

ROSE-HULMAN INSTITUTE OF TECHNOLOGY

J-DSP in Music Synthesis



Online Visual DSP Programming



J-DSP in PVAMU DSP Courses



THE UNIVERSITY OF NEW MEXICO

J-DSP in PVAMU DSP Courses

UNIVERSITY OF WASHINGTON BOTHELL

J-DSP in Media Computing



J-DSP in Signal, Image and Biomedical Processing



NSF award number 0817596

The CCLI Phase 3 proposal builds on several products and outcomes of two previous Phase 2 CCLI EMDs and revolves around our online software technology J-DSP. This Phase 3 proposed comprehensive project expands the scope of J-DSP beyond Electrical Engineering to other fields associate with multidisciplinary applications that are central to the nations' security and economic welfare. Our first multidisciplinary activity with Johns Hopkins University and two other partners is to create a J-DSP/Earth Systems version which will be customized for earth system sciences and geology, and will also embrace issues of sustainability. The software and associated module will be used in classes at JHU. Our second multidisciplinary activity has to do with extensions of J-DSP to arts and media (with the ASU AME) providing artists with creative web-based DSP software tools and embedding and assessing J-DSP modules in AME courses. A companion activity will embed J-DSP modules in a music synthesis course at the Rose-Hulman Institute of Technology (RHIT). Our third inter-technology activity provides J-DSP and J-DSP-C modules for power engineering courses and embraces issues of renewable energy (with ASU Power Systems). A series of equally important activities with our partners target interdisciplinary and inter-technology areas including: interpreting biological signals from ion-channel sensors with J-DSP (with the Arizona Institute of Nanoelectronics), using J-DSP to expose students to the importance of signal analysis in sensing and genomics (with the ASU SenSIP; <http://sensip.asu.edu>), embedding J-DSP in FPGA systems courses (with UNM), embedding J-DSP in computing and programming applications (UWB), and embedding J-DSP in DSP courses (with PVAMU).

J-DSP Assessment
<http://jdsp.asu.edu>

The assessment results were collected from students of EEE 407 (DSP) class.

General Assessment:

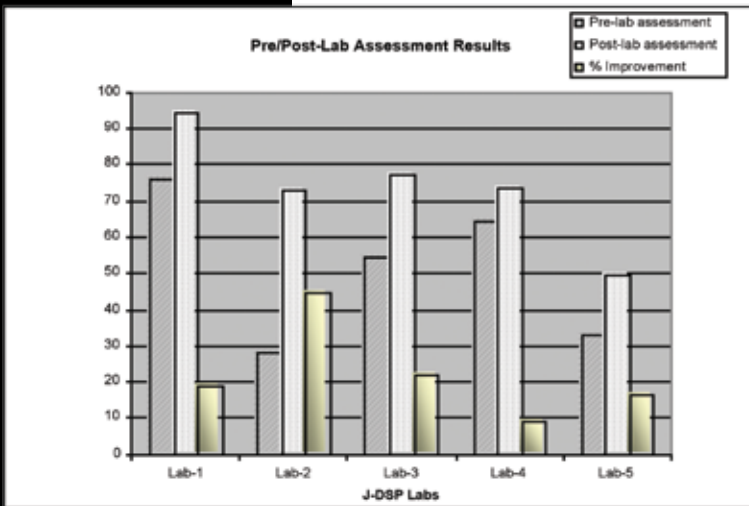
Subjective opinion about J-DSP was collected.

- 95% liked the concept of Internet-based simulations.
- 70% responded that it took them less than 30 minutes to learn how to use J-DSP.
- 85.5% are likely to consider using J-DSP to construct their own educational simulations.

Concept-Specific Assessment:

Laboratory evaluations, both before using J-DSP (pre-lab) and after (post-lab), were carried out.

- 87% agreed that with the J-DSP filter design exercise they understood which window is suitable for sharp transitions.
- 88% understood better the signal symmetries in the FFT spectra using of J-DSP visualization.
- 91% reported that with J-DSP they understood the relation between the Pole-Zero locations and the frequency response.



- Lab – 1:** Difference Equations and 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

Publications

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 - Andreas Spanias, Linda Hinnov, Michael Stiber, Cajetan Akujuobi, Marios Pattichis, Costas Pattichis, Ed Doering, Karthikeyan Ramamurthy, Shalin Mehta, Raja Ayyanar, Harvey Thornburg “The Java-DSP Phase 3 Project: An Interdisciplinary Multiuniversity Effort”, *Proc. FIE 2009*, vol. 1, San Antonio, TX, October 2009.
 - Andreas Spanias, Linda Hinnov, Michael Stiber, Cajetan Akujuobi, Marios Pattichis, Costas Pattichis, Ed Doering, Karthikeyan Ramamurthy, Shalin Mehta, Raja Ayyanar, Harvey Thornburg “The Java-DSP Phase 3 Project: An Interdisciplinary Multiuniversity Effort”, *Proceedings of ASEE Annual Conference and Exposition*, Austin, TX, June 2009.

J-DSP

Andreas Spanias is the director of the J-DSP GUI design and software development team and the PI on the three NSF projects that supported portions of this project. Several ASU graduate students helped with the development of J-DSP functions including Venkatraman Atti, Costas Panayiotou, Thrassos Thrassyvoulou, Yu Song, Argyris Constantinou, Axel Clausen, Harish Krishnamoorthi, Chih-Wei Huang, Jayaraman Thiagarajan, Karthikeyan Ramamurthy, Ashwin Natarajan, Moushumi Zaman, Khawza Ahmed, Fikre Bizuneh, Ted Painter, Ho-Min Kwon, Mahesh Banavar, Shibani Misra, Visar Berisha, Ravi Chilumula, Maya Tampi, Mohit Shah, Shalin Mehta, and Georgos Stylianou. Certain specialized functions were designed by consulting with several colleagues including: Antonia Papandreou-Suppappola, Michael Stiber, Tolga Duman, Linda Hinnov, Lina Karam, and Kostas Tsakalis. J-DSP concept by A. Spanias.



J-DSP development team in 2007.