Java-DSP: Recent Developments and Extensions

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J-DSP Cyprus Workshop

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Agenda

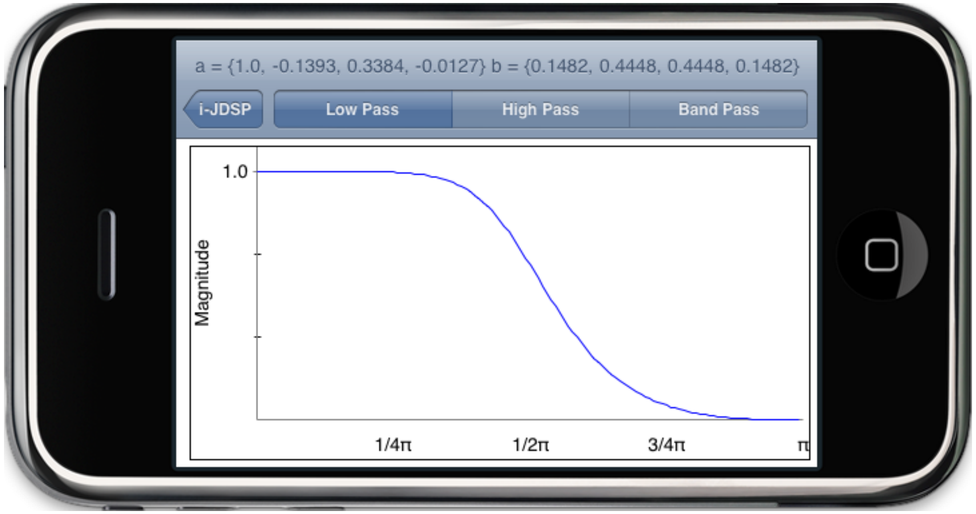
- i-JDSP : Interactive iPhone/iPad based tool based on Java-DSP.
- Java-DSP Quiz Version : Interface to enhance student learning.
- Interfacing Java-DSP to MATLAB and LabVIEW.
- User-defined Java Code.
- Java-DSP and Sensor Motes.
- Java-DSP Earth Systems Edition.

i-JDSP : Interactive Signal Processing Tool

for iPhone/iPad

i-JDSP

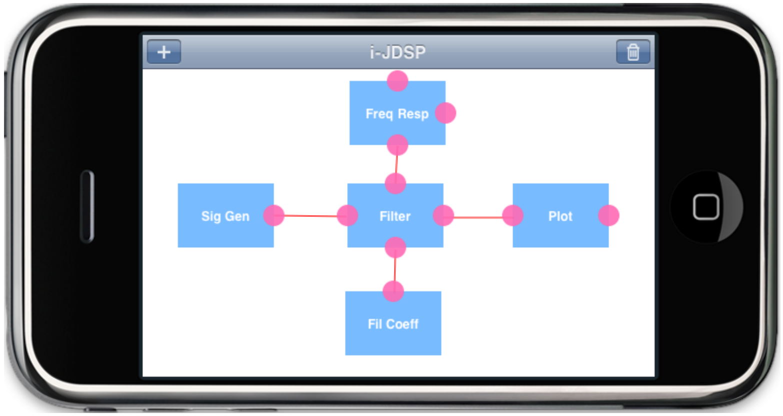
- An interactive iPhone/iPad based signal processing tool based on Java-DSP.
- Implemented in Objective-C and C as a native Cocoa Touch application that can be run on any iOS device.
- Offers basic signal processing simulation functions on the new compact and convenient iPhone/iPad graphical user interface (GUI).
- Provides a very compelling multi-touch programming experience.

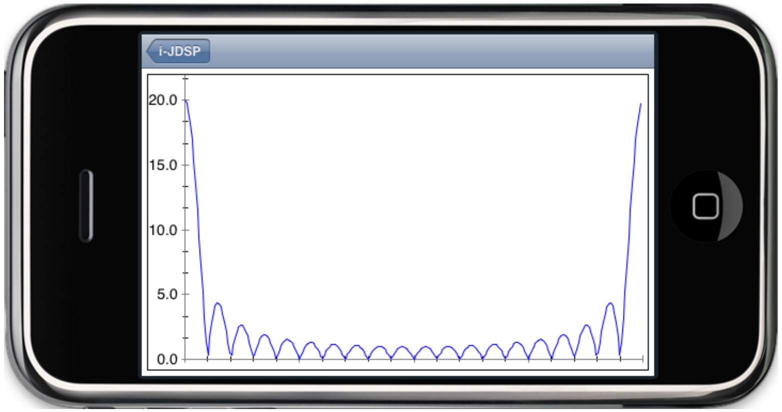


Using the Tool

- All simulations can be visually established by forming interactive block diagrams through multi-touch and drag-and-drop.

- List of existing function blocks:
  a. signal generator
  b. Filter
  c. Filter coefficient
  d. Frequency response
  e. FFT
  f. Plot
  g. Frequency response demo



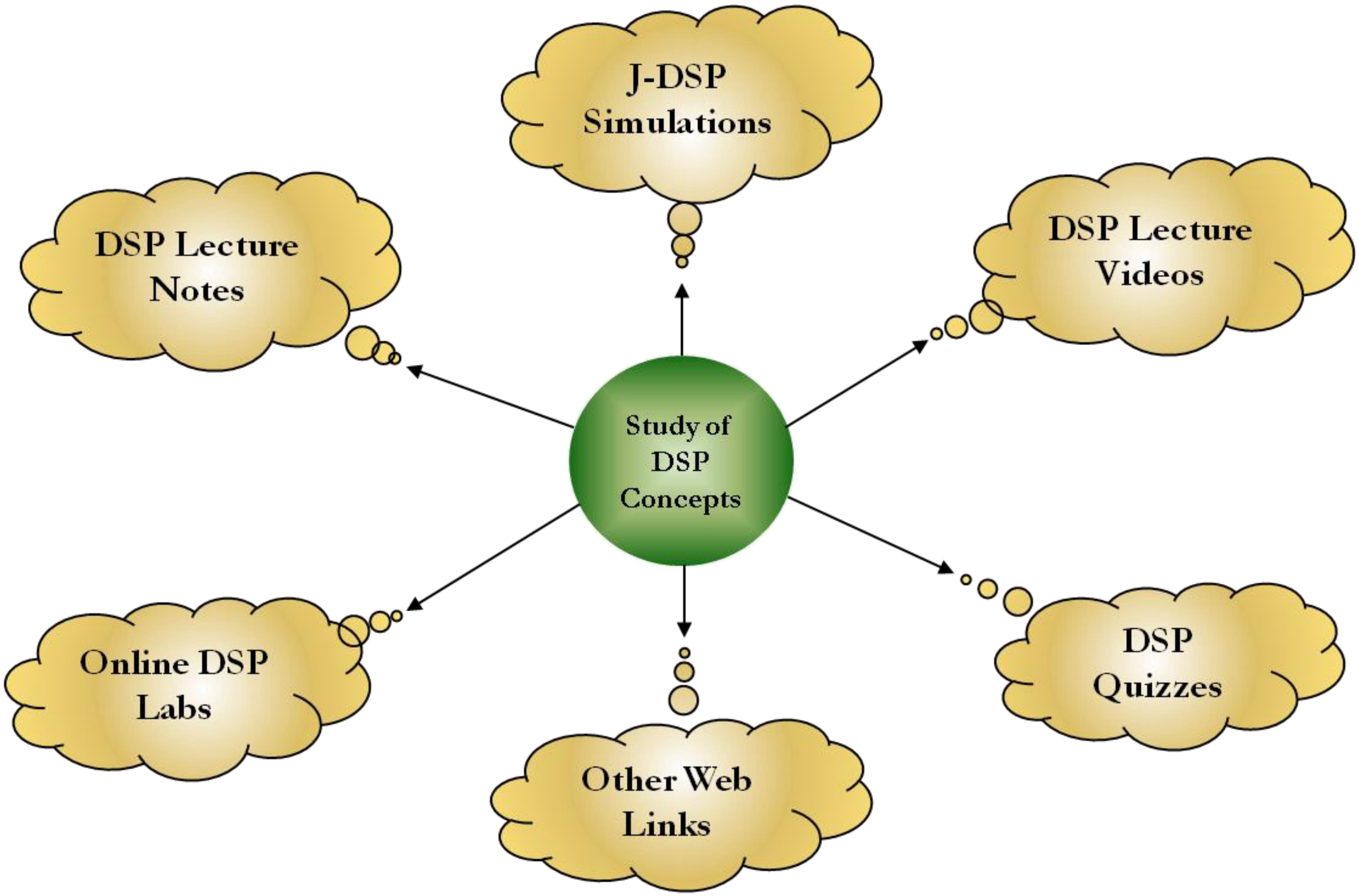


Key Features

- Graphical programming experience.
- Easy to use (multi-touch and drag-and-drop).
- Portability and accessibility through online app store.
- Small footprint/efficiency.
- Scalability.
- **Future Work**
    - i. Adding more function blocks.
    - ii. Extension to other mobile platforms.
    - iii. Release to online app store.
    - iv. Bug fixing and Testing.

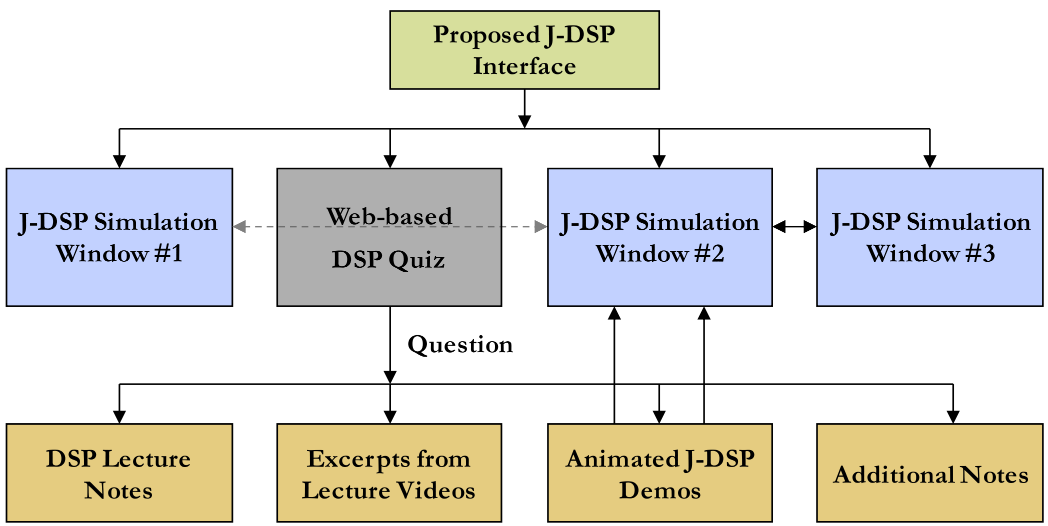
Java-DSP Quiz Version for Enhanced Student Learning

Motivation


J-DSP Simulations
DSP Lecture Notes
DSP Lecture Videos
Study of DSP Concepts
Online DSP Labs
DSP Quizzes
Other Web Links

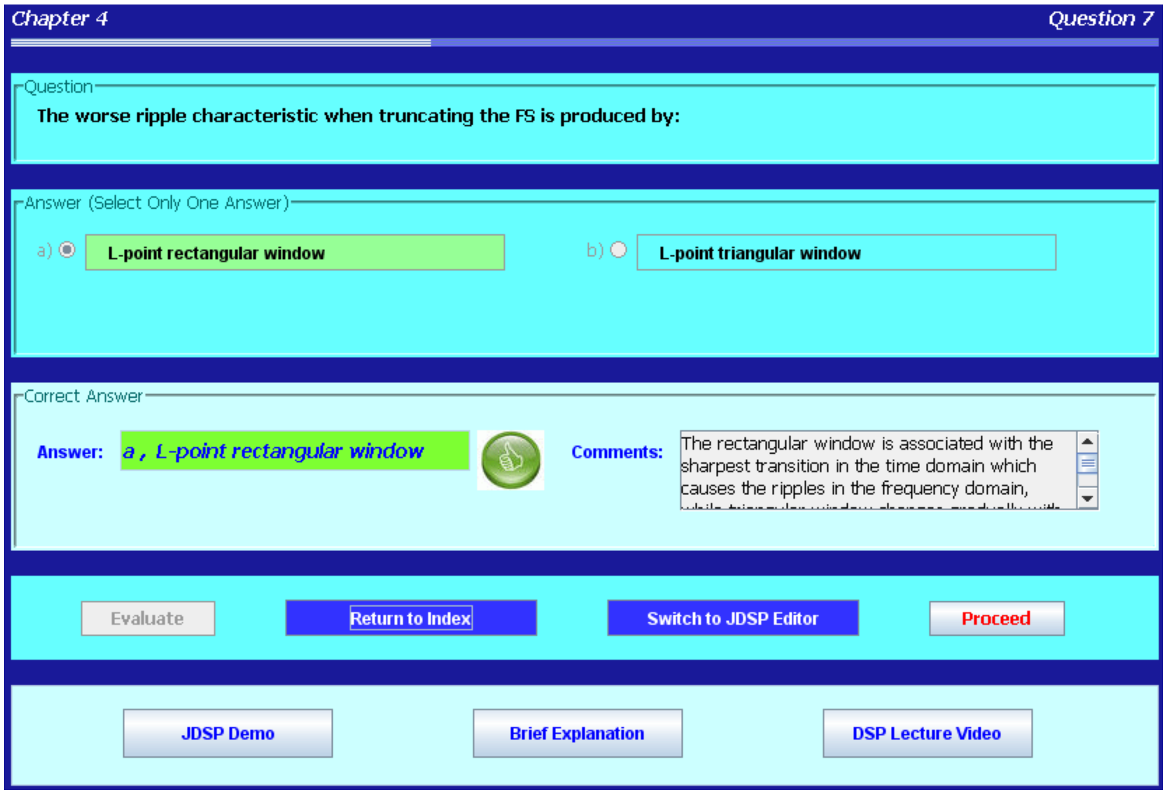
Proposed Interface

- Existing Java-DSP framework – Rich palette of signal processing functions.
- Integration of several discrete learning components to Java-DSP.
- Access to three simulations in a single Java-DSP window.
- Allows implementation of large simulations that cannot be accommodated in a single window.



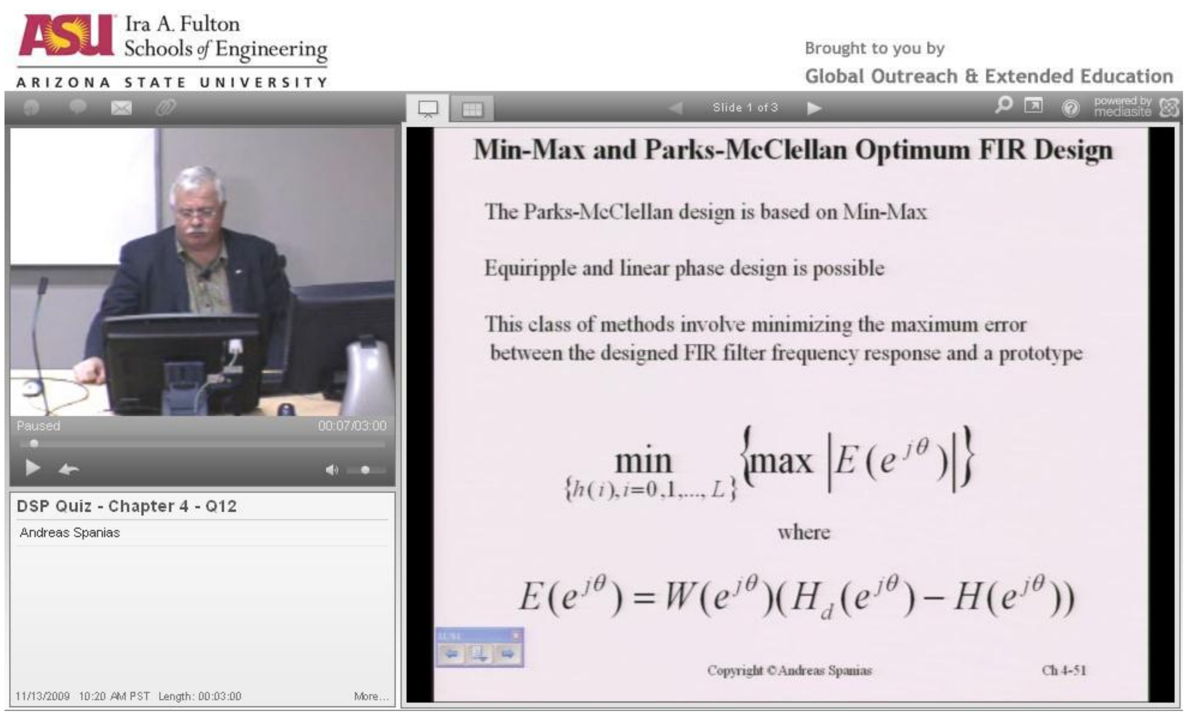
Web-Based Quiz

- Connecting link between DSP questions, J-DSP simulations and other learning components.



Links to Relevant Material

- Links to all relevant materials and demos are activated after the student attempts a question.
- Includes animated Java-DSP demos, lecture notes, lecture videos.

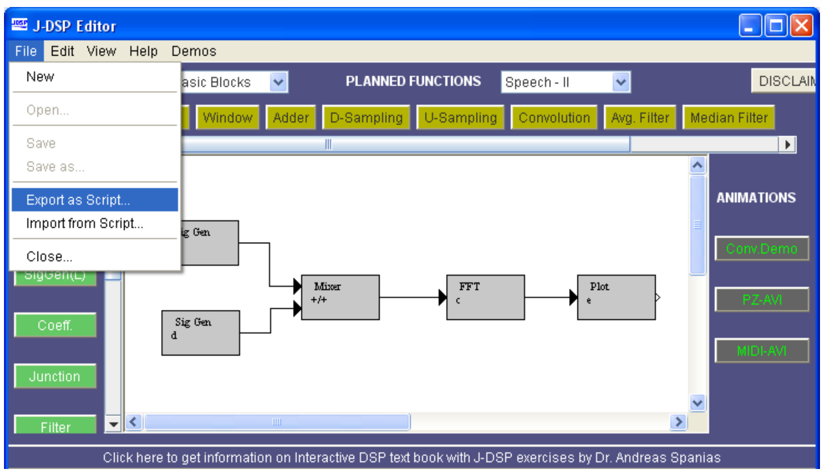


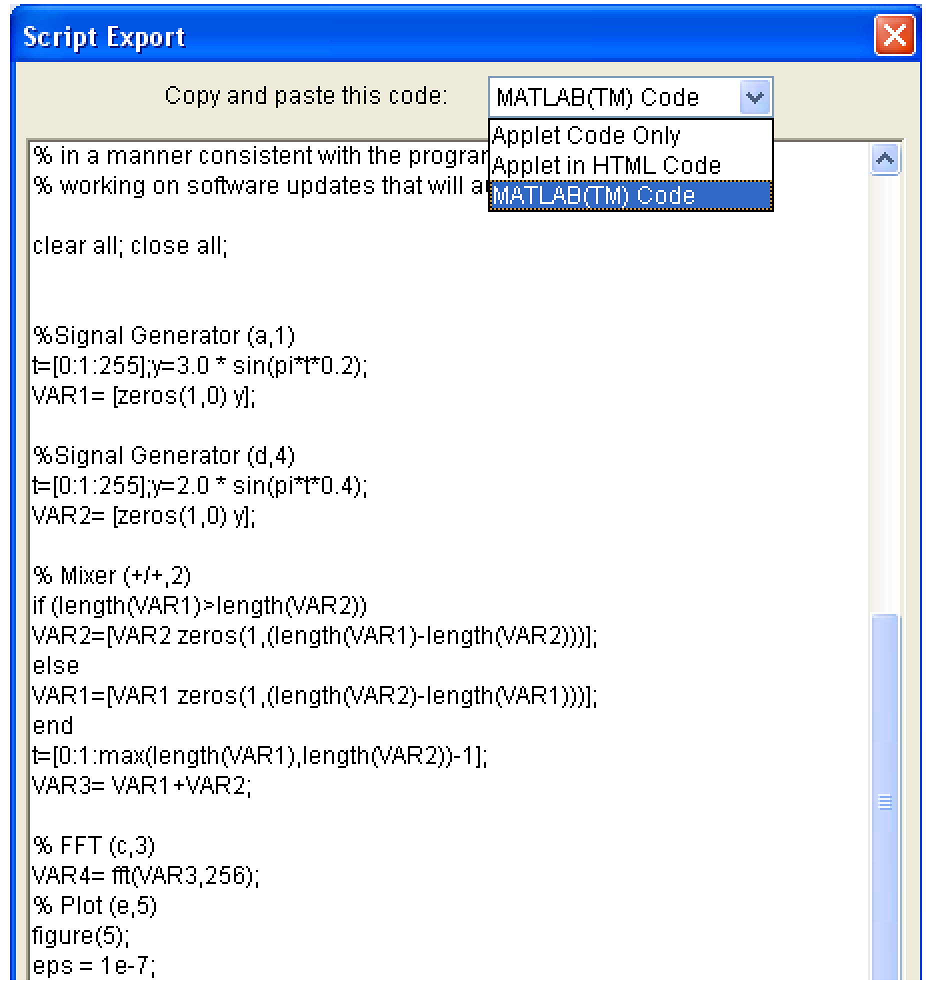
Interfacing Java-DSP to MATLAB and LabVIEW

Overview

- Enables students and instructors to exchange data and perform simulations on both the platforms.
- Allows to translate the block diagram from Java-DSP into MATLAB code.
- Enables users to repeat, verify and expand simulations in the MATLAB environment.
- Conversely, MATLAB programs can mapped to flowchart like diagrams and run in Java-DSP.

MATLAB Interface





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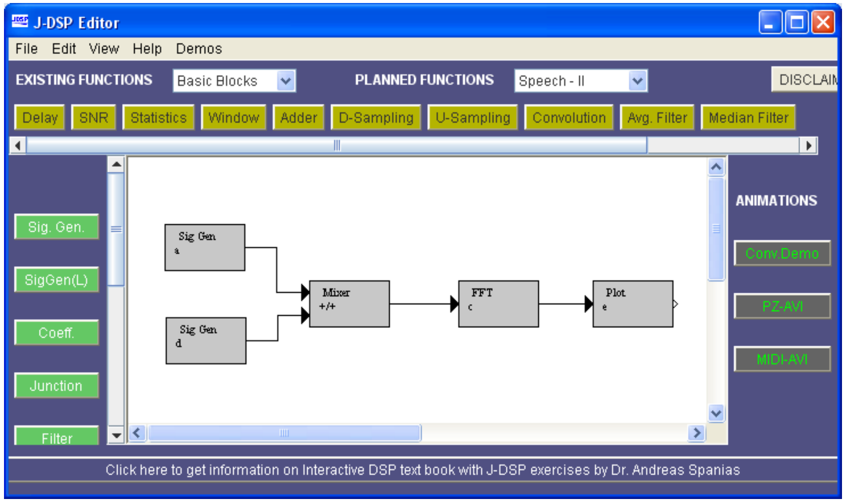
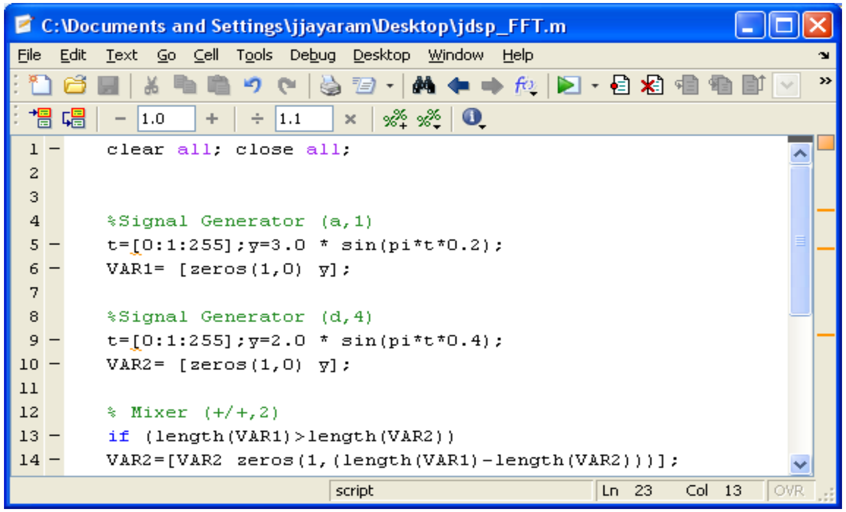
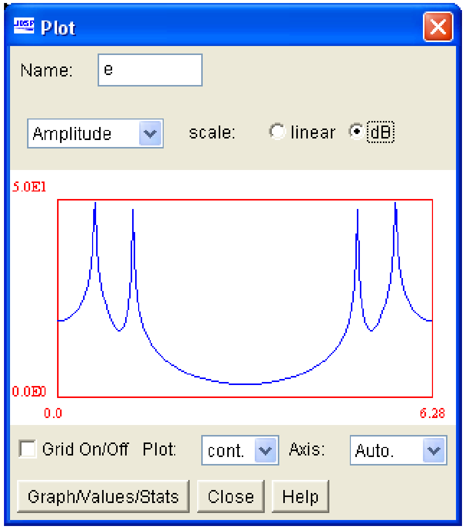
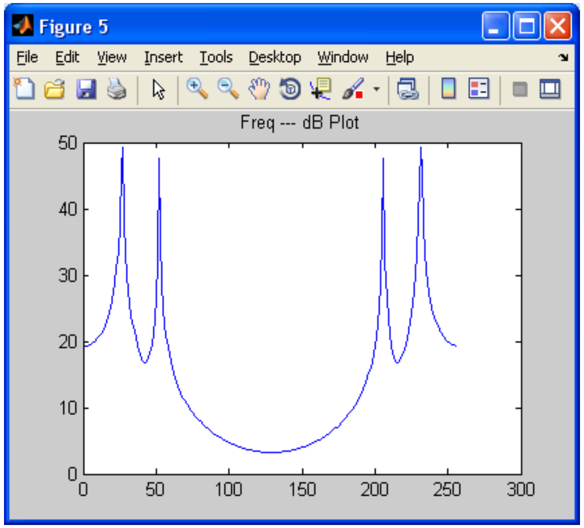
MATLAB Interface









http://jdsp.asu.edu

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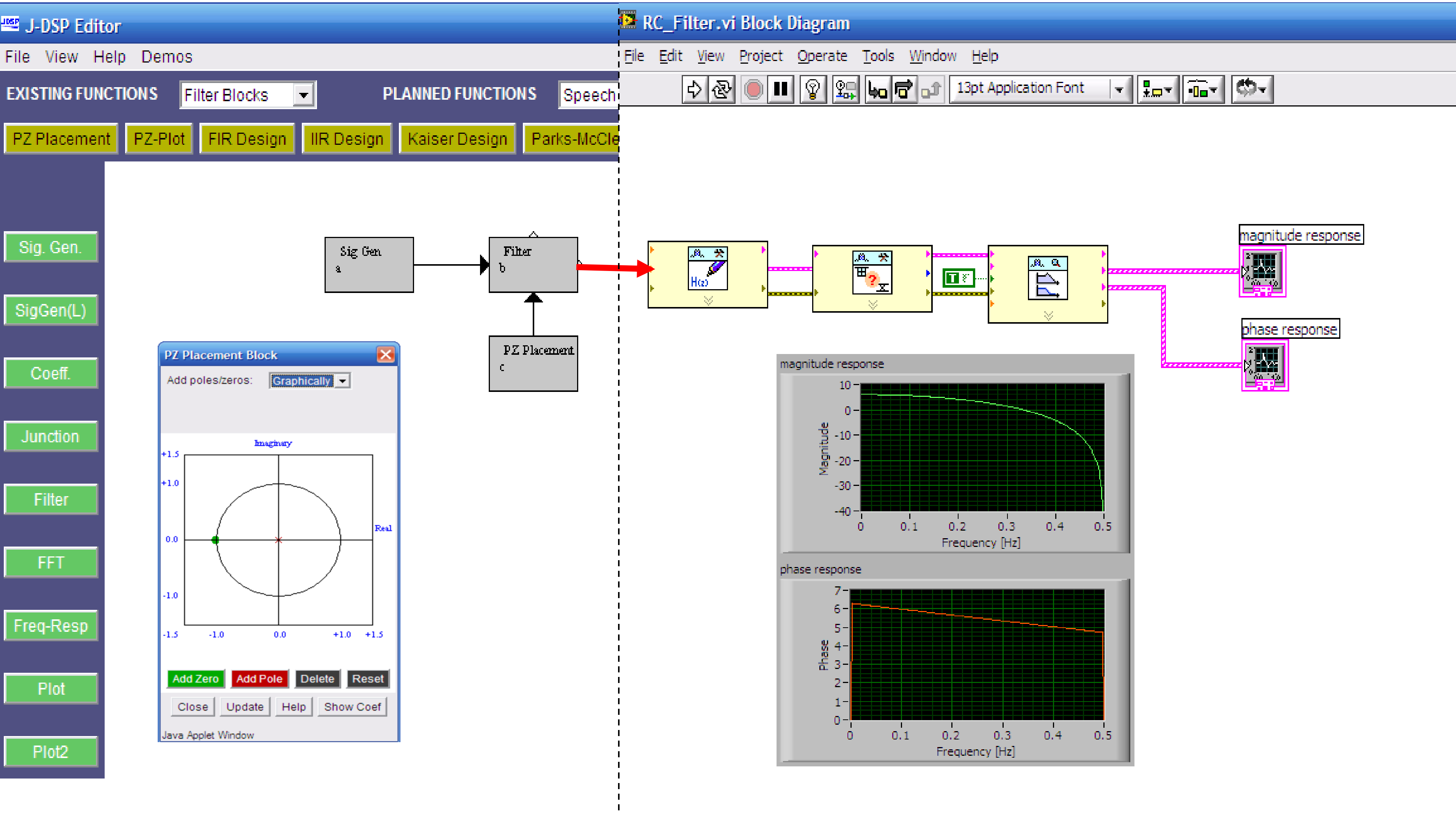
Java-DSP LabVIEW Interface



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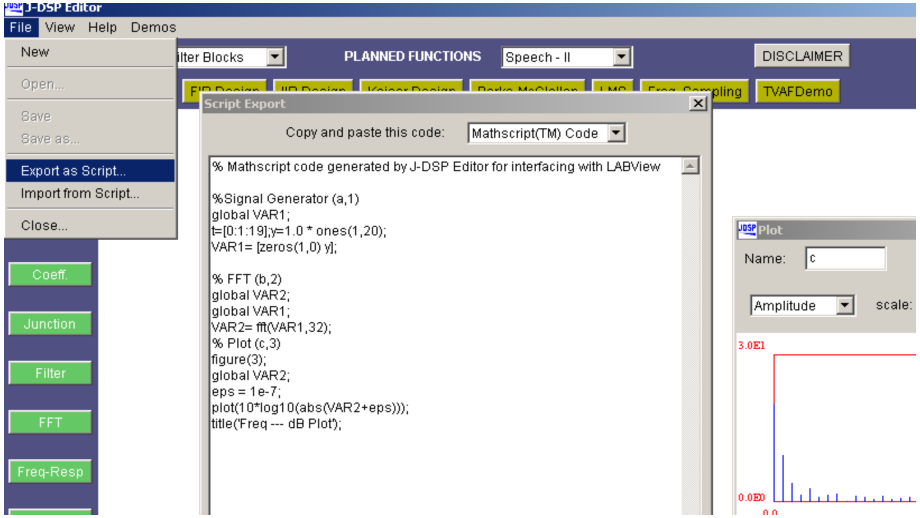
Mathscript Code from Java-DSP

J-DSP Editor

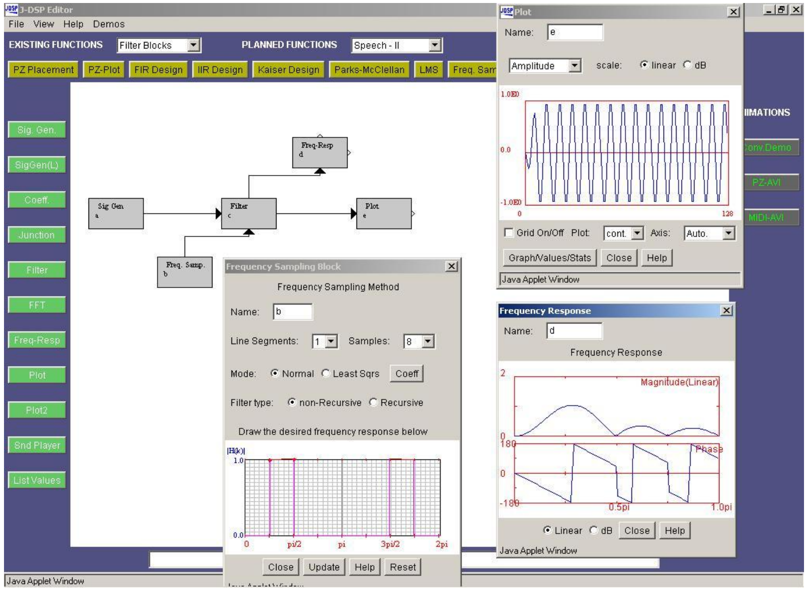
- Uses the script generation capabilities of J-DSP to generate Mathscript code.
- Most J-DSP simulations can be translated to Mathscript code.
- "Export Script" from file menu and select "Mathscript(TM) Code".
- Copy paste code into m-file.
- Signed Applet – will eliminate copy-paste process.

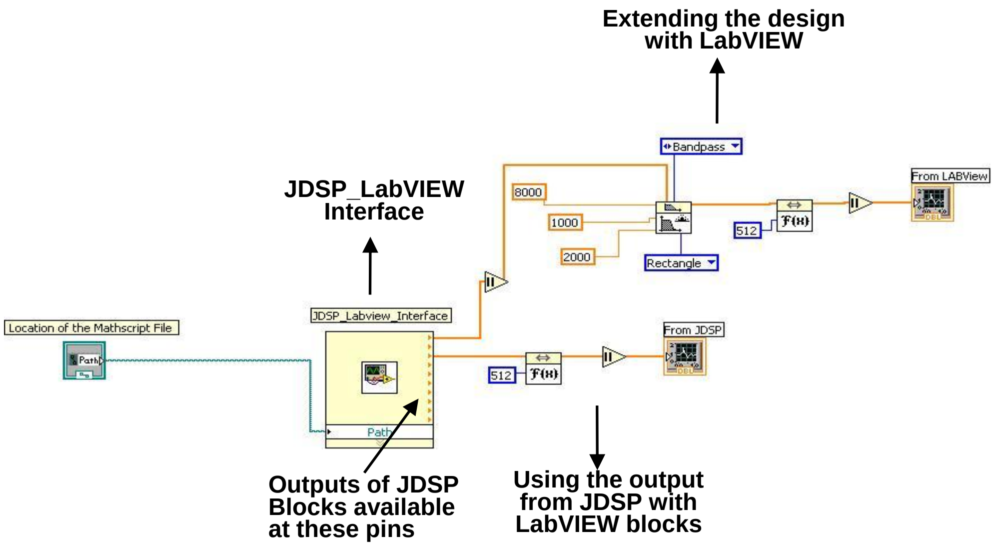


Simulation Example

J-DSP Editor

- Uses the script generation capabilities of J-DSP to generate Mathscript code.
- The design is extended in LabVIEW with native blocks

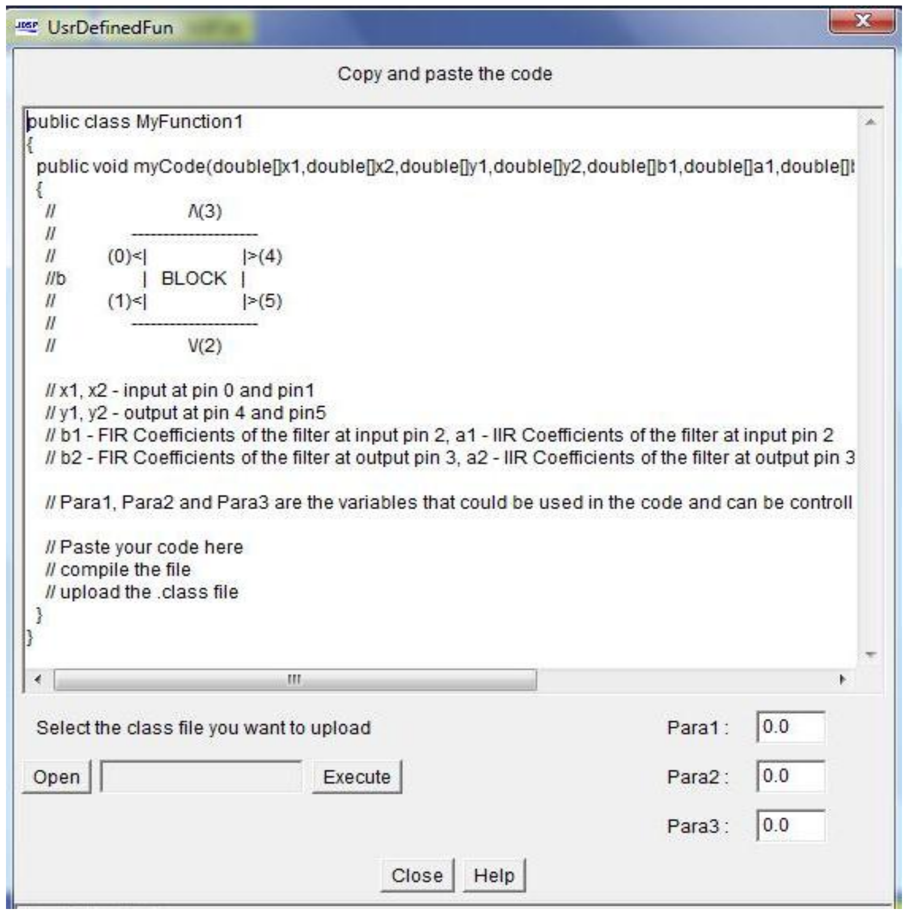




Including Custom Java Code

User-defined Block

- The user-defined block allows custom java code to be interfaced with other J-DSP blocks.

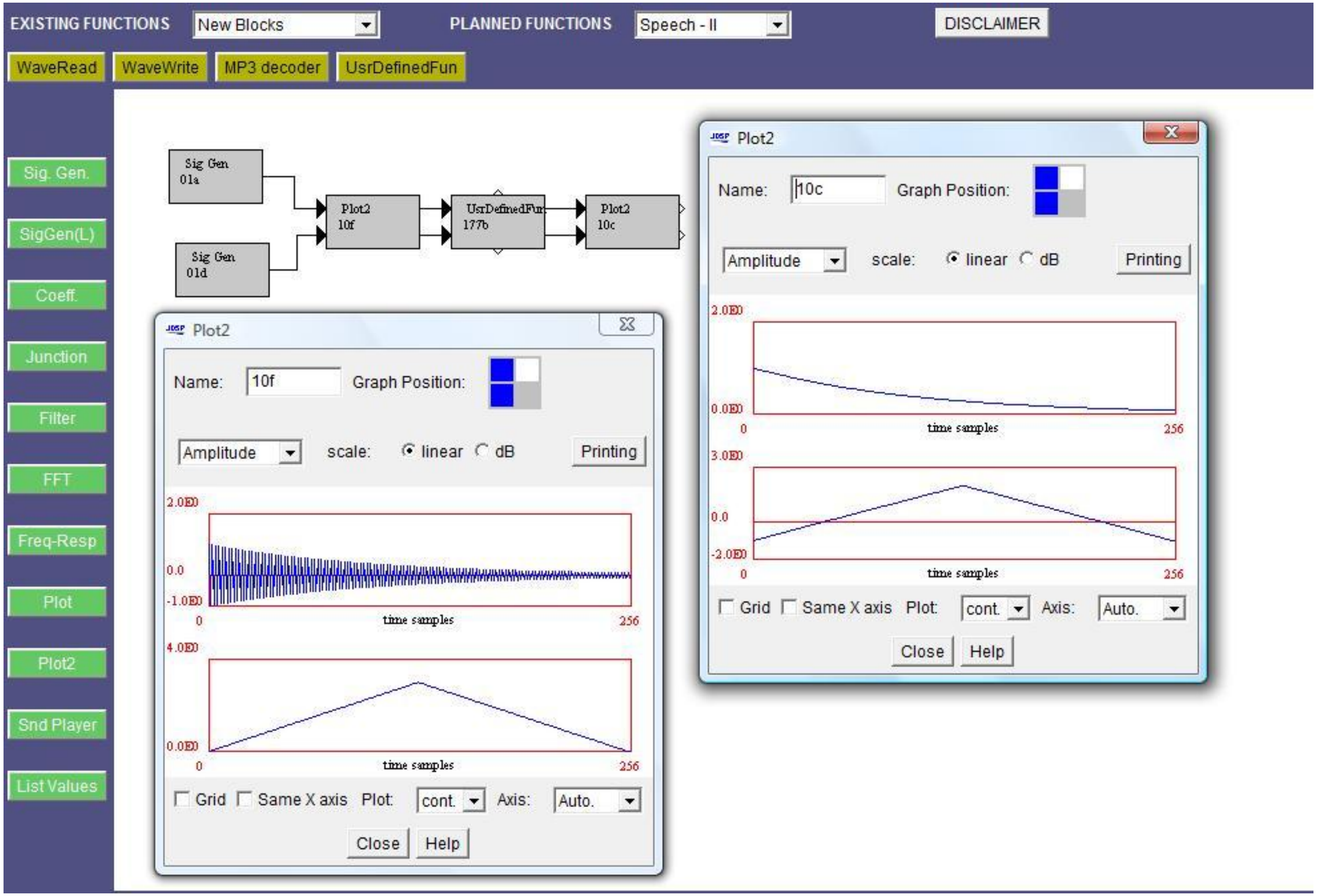


Example

Sample Java Code for the User Defined Block

```
public class MyFunction1
{
  public void myCode(double[]x1,double[]x2,double[]y1,double[]y2
   {
/*
                 /\(3)
             -----------
        (0)<|           |>(4)
            |   BLOCK   |              //BASIC BLOCK MODEL
        (1)<|           |>(5)
             -----------
                 \/(2)
*/

//  x1 - input at pin 0, exponential signal
//  check the top portion of the plot on the Left side

//  y1 - output at pin 4, absolute value of input signal
//  check the top portion of the plot on Right side

    for(int i=0; i<256; i++)
    {
        y1[i] = Math.abs(x1[i]);
    }

//  x2 - input at pin 1, triangular signal
//  check the bottom portion of the plot on the Left side

//  y2 - output at pin 5, input-Para1 (Para1 = 1)
//  check the bottom portion of the plot on Right side


    for(int i=0; i<256; i++)
    {
        y2[i] = x2[i] - para1;
    }

   }
}
```

Example



EXISTING FUNCTIONS
New Blocks
PLANNED FUNCTIONS
Speech - II
DISCLAIMER
WaveRead
WaveWrite
MP3 decoder
UsrDefinedFun
Sig. Gen.
SigGen(L)
Coeff.
Junction
Filter
FFT
Freq-Resp
Plot
Plot2
Snd Player
List Values
Sig Gen 01a
Sig Gen 01d
Plot2 10f
UsrDefinedFun 177b
Plot2 10c
Plot2
Name: 10f
Graph Position:
Amplitude
scale: linear dB
Printing
2.0E0
0.0
-1.0E0
0
time samples
256
4.0E0
0.0E0
Grid
Same X axis
Plot: cont.
Axis: Auto.
Close
Help
Plot2
Name: 10c
Graph Position:
Amplitude
scale: linear dB
Printing
2.0E0
0.0E0
3.0E0
0.0
-2.0E0
Grid
Same X axis
Plot: cont.
Axis: Auto.
Close
Help

Java-DSP and Sensor Motes

Overview

Java-DSP

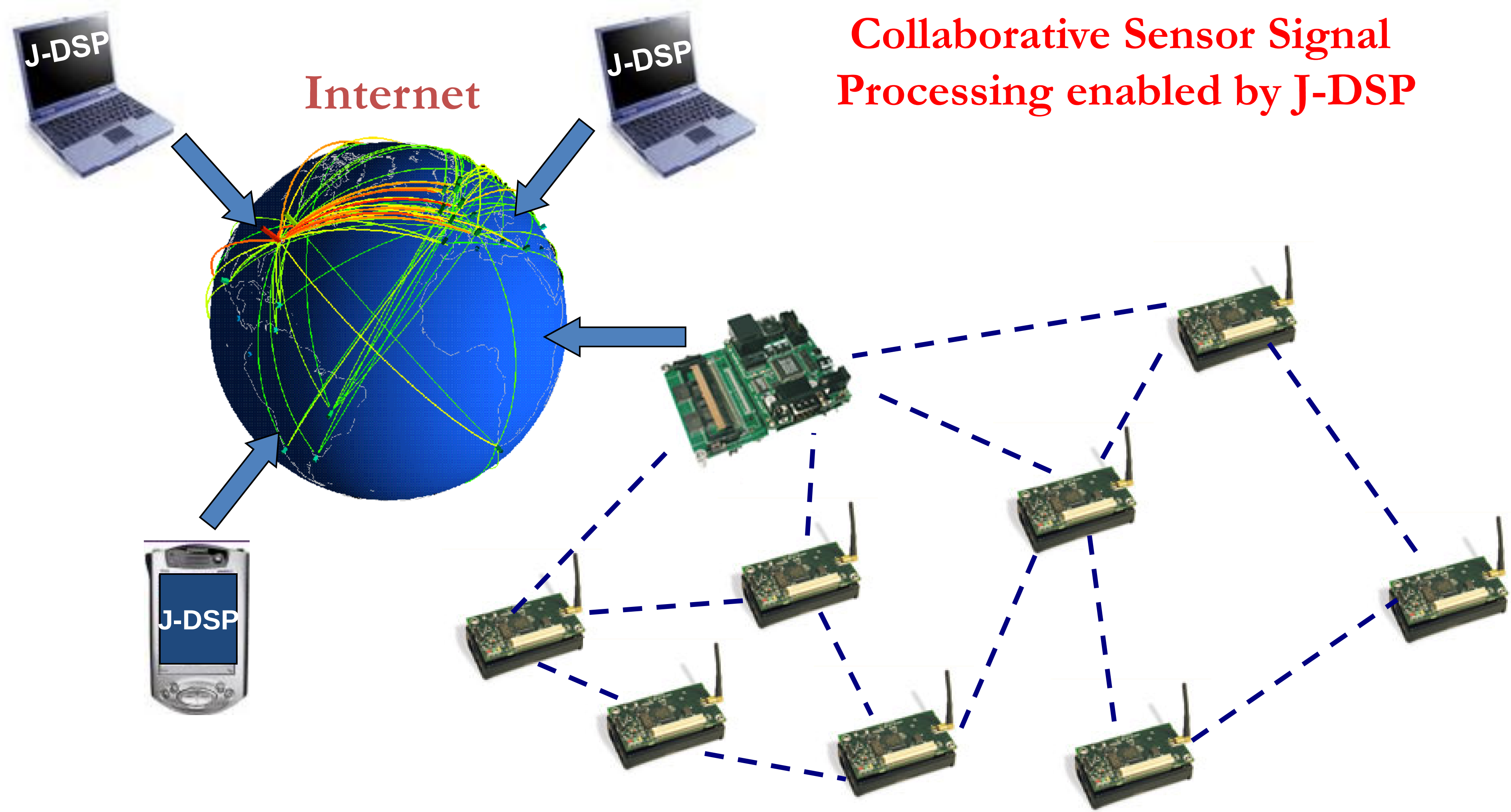
- A Web-based DSP Simulation Tool
- Universally accessible DSP functions
- Embeds Interactive Simulations in Web pages
- Seamlessly Integrates Animated Demos

Wireless Sensor Motes

- Integration enables real-time sensor signal analysis
- Java interface natural for remote sensing
- User-friendly GUI for computation/graphics using the J-DSP-Mote interface
- Hardware: *Mica2* from *Crossbow*

Java-DSP and the Motes

Collaborative Sensor Signal Processing enabled by J-DSP



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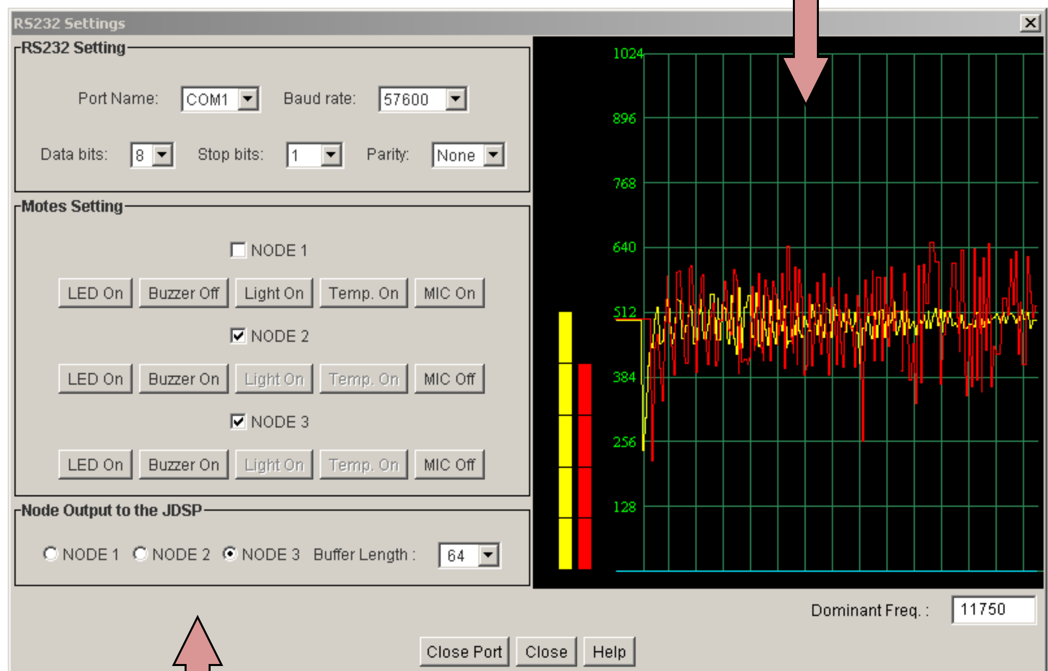
MOTE Block

J-DSP Editor

- GUI for the motes
- Control panel is used to control the individual motes and the RS232 settings
- MOTE block in J-DSP allows users to control individual motes
- Real-time graph plots data as it comes

Plot Area



Control Panel

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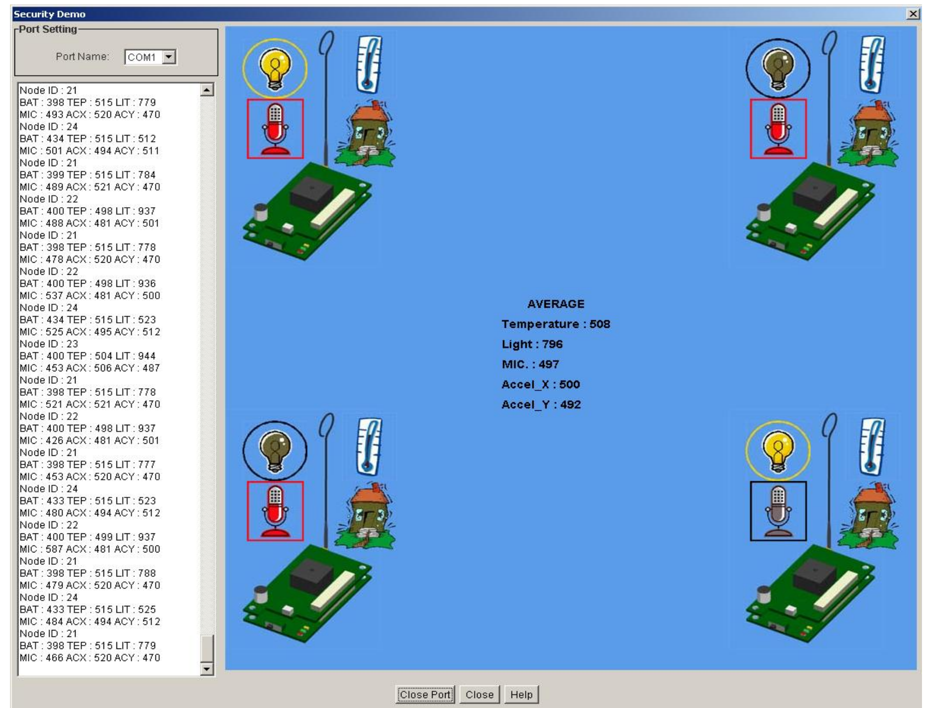
Remote Sensing Example

J-DSP Editor

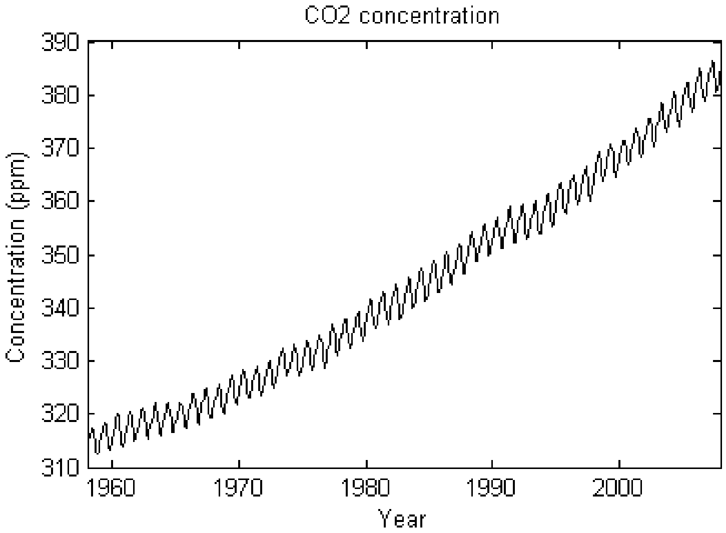
- Preliminary example shows possibilities for sensing and security applications.
- Display panel shows which sensors are active
  a. Active Sensors:
  b. Light
  c. Sound
  d. Temperature
  e. Accelerometer



Java-DSP Earth Systems Edition

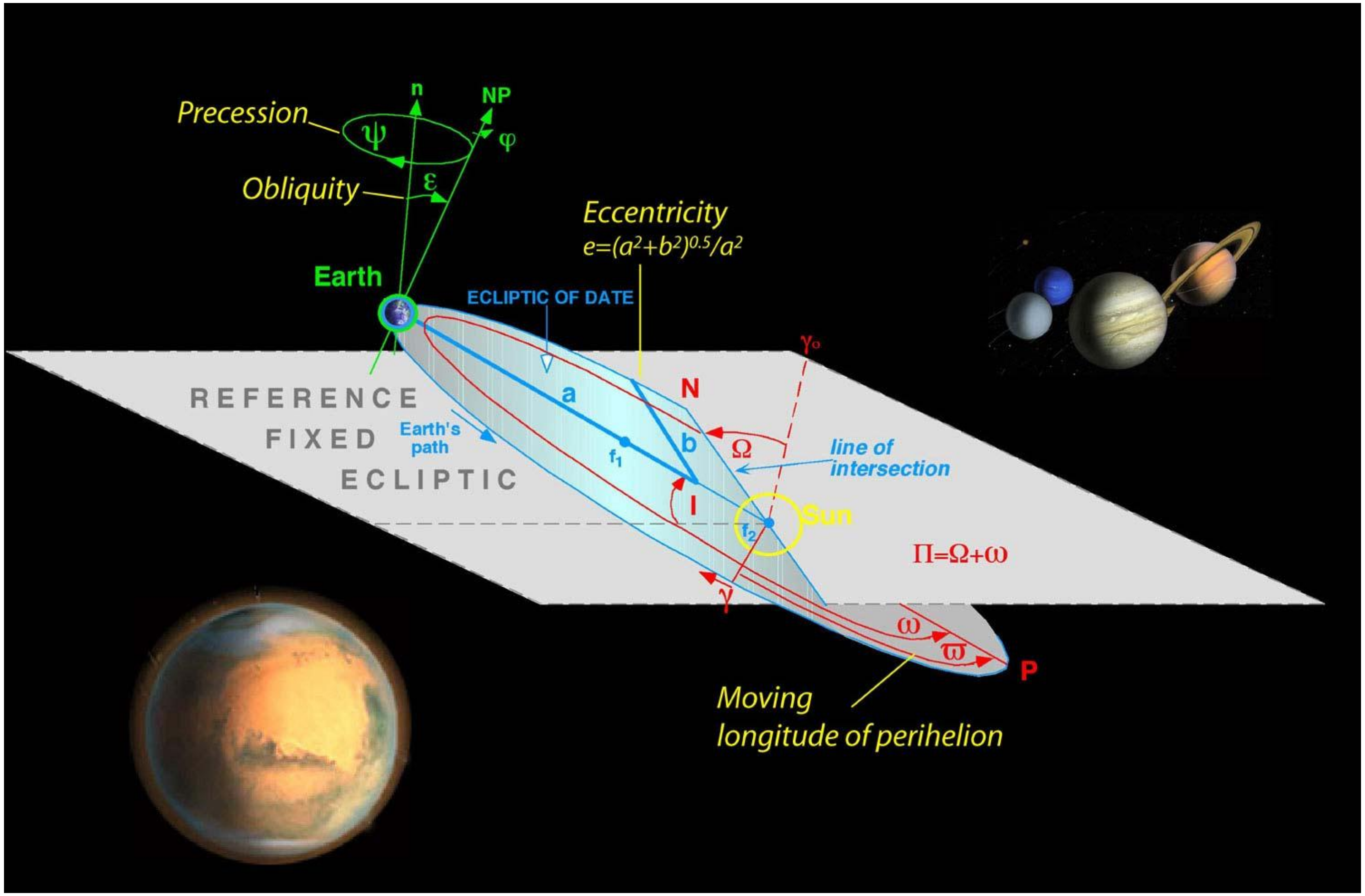
Earth Systems Signals

- **“Real-Time” monitoring**
  - Global temperature, Concentration of greenhouse gases, River flow, atmospheric pressure, earth orientation.
- **“Deep-Time” proxy data**
  - Proxy data that are representative of past Earth system behaviour.
  - Ice sheet isotopes (air temperatures), tree ring thicknesses (hydrology), magnetic intensity of ancient sediment (geomagnetic field).



Late Miocene (9.3 to 8.4 Ma) sapropel cycles from the Gibliscemi A section, south-central Sicily. Photo courtesy of F. Hilgen, University of Utrecht.

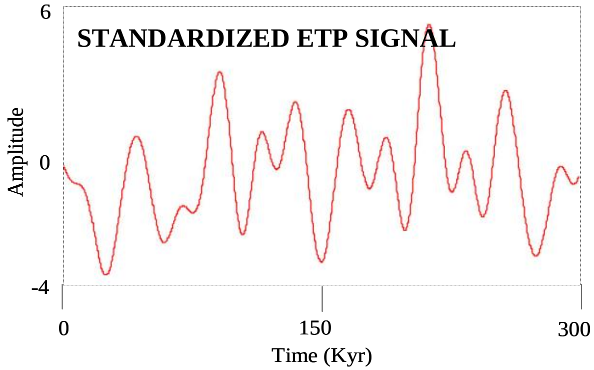
Expected Astronomical Frequencies



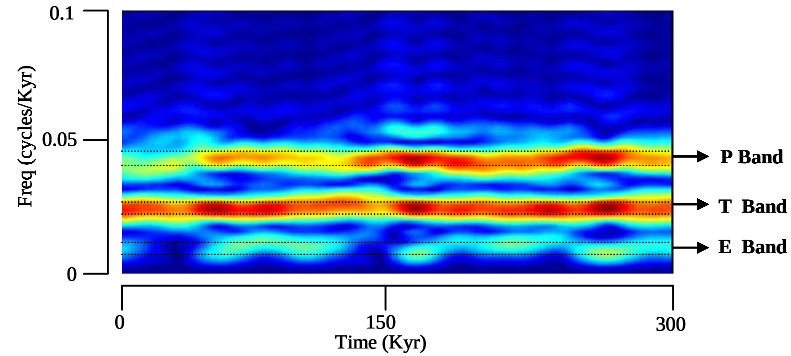
Earth's orbital parameters

E - periods 400,000 and 100,000 years, T - period 41,000 years,
P - periods of 23,000 and 19,000 years.

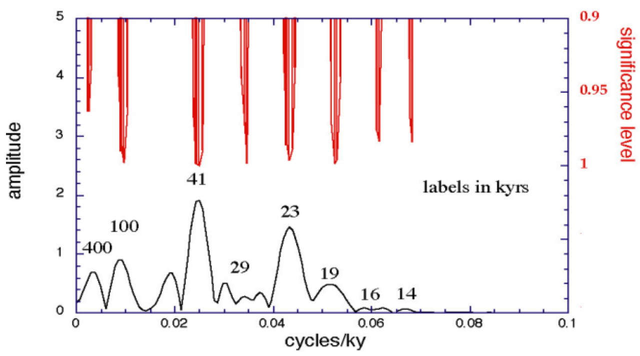
ETP Model Analysis



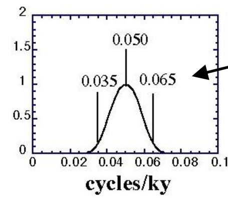
SPECTROGRAM



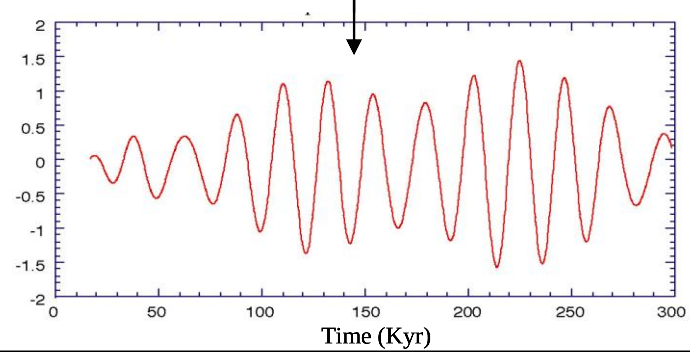
MULTIPLE PROLATE TAPER SPECTRUM



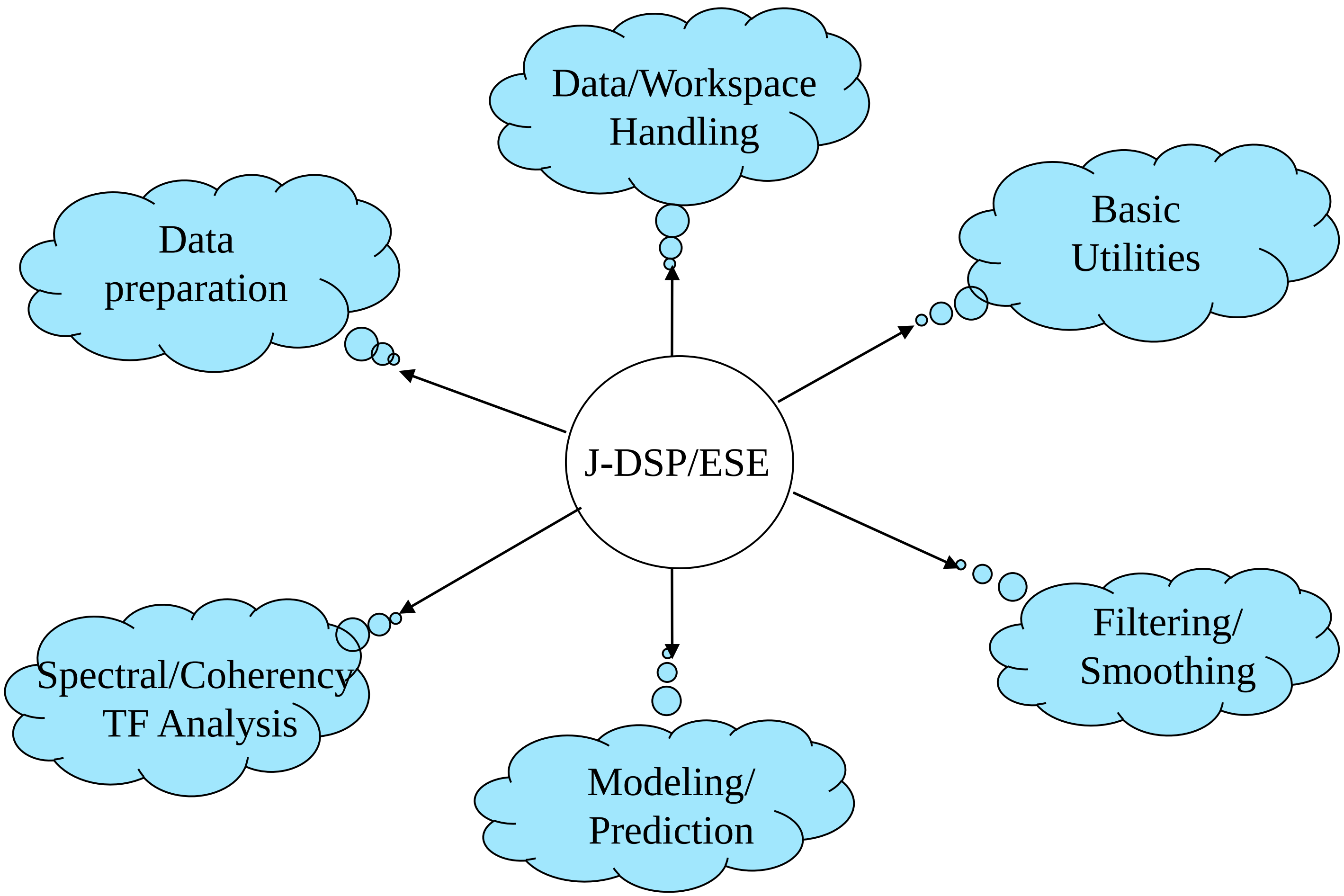
TANER FILTER



FILTERED SIGNAL P-BAND

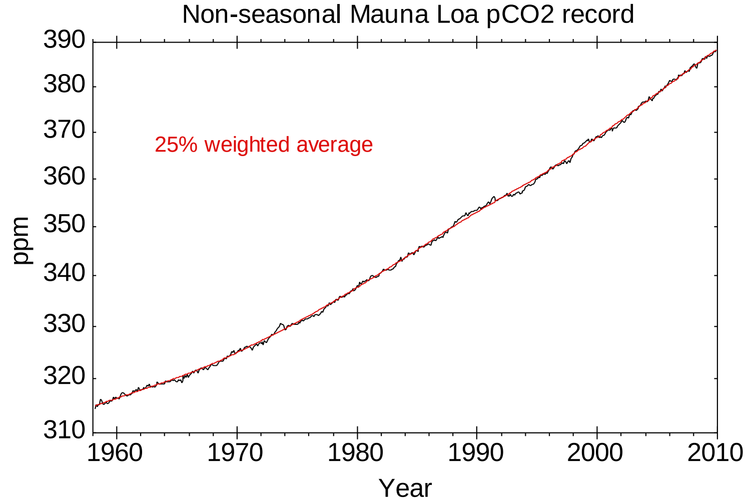


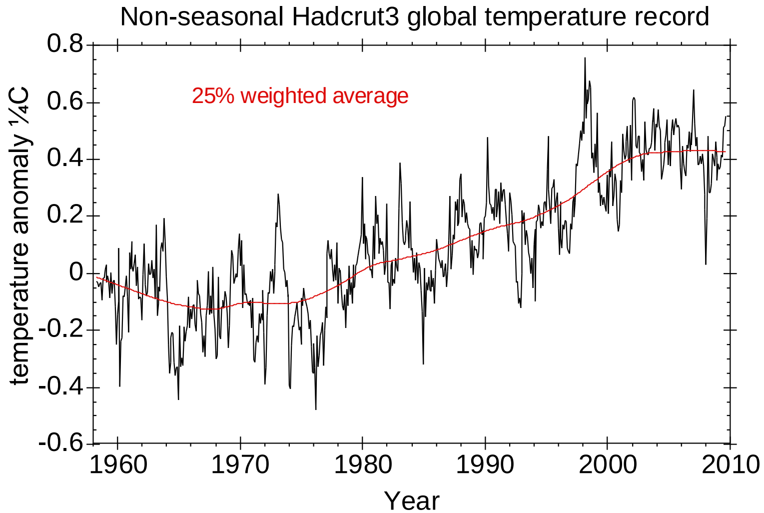
Functions Available and Planned



Example – Global Warming in 20th Century

How is pCO_2 correlated with global climate change?





Mauna Loa atmospheric pCO_2 (ppm) mid-monthly values, with the seasonal cycle removed by subtracting "a 4-harmonic fit with a linear gain factor."

http://scrippsco2.ucsd.edu/

Monthly global temperature record averaged over 5°x5° areal grids, from more than 3000 stations temperature time series, preprocessed to remove the seasonal cycle and biases from stations at different elevations and different averaging formulae.

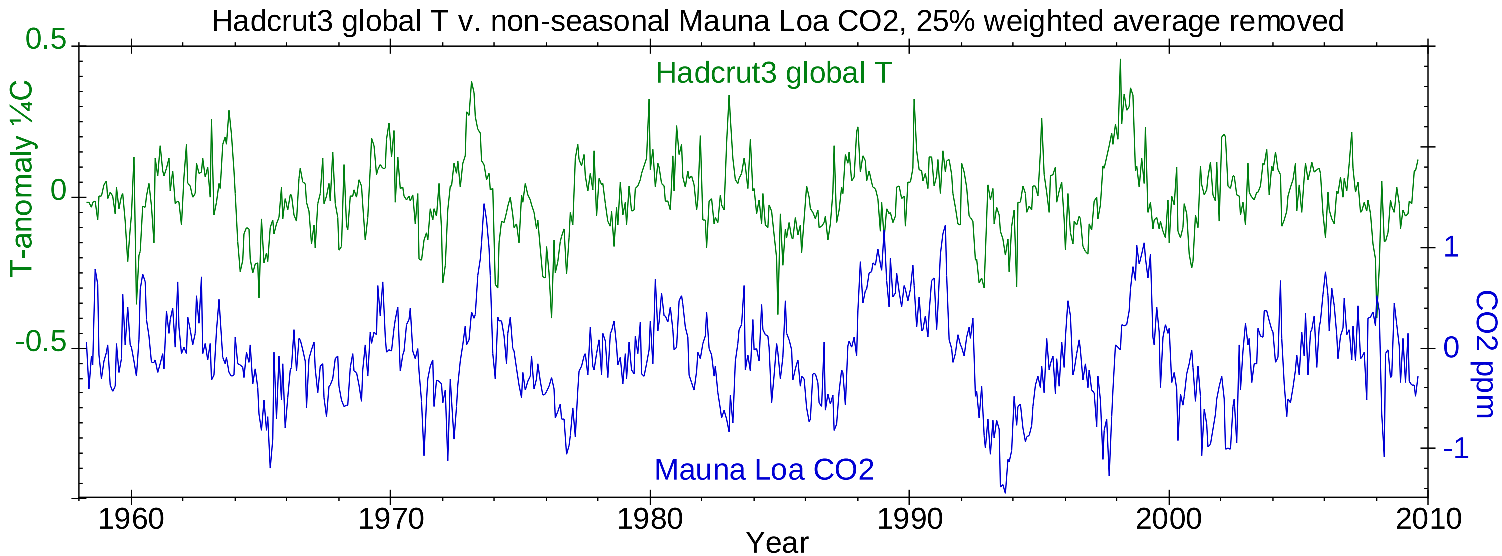
http://www.cru.uea.ac.uk/cru/data/temperature

Global Warming in 20th Century

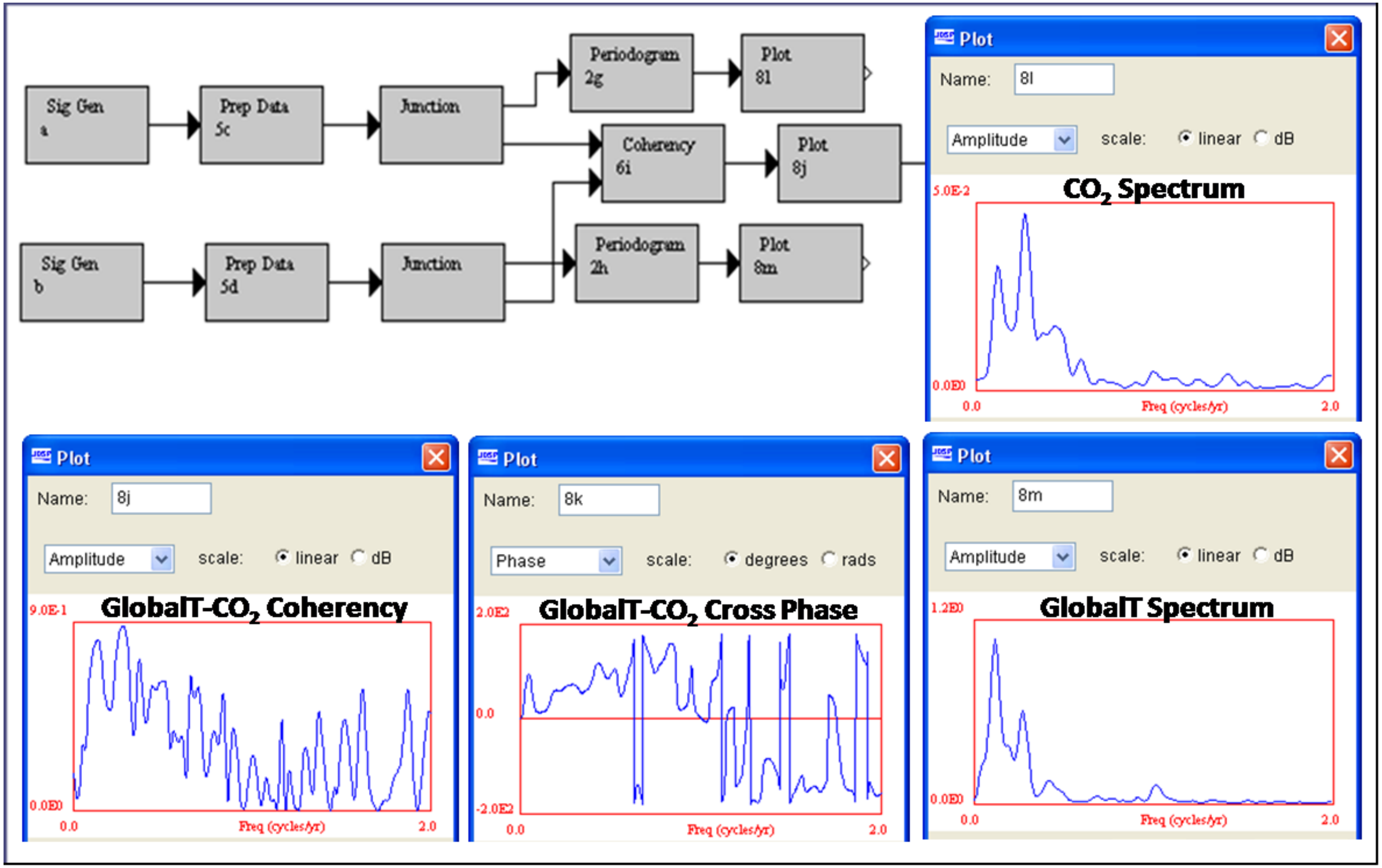
INTERANNUAL VARIATIONS ?

The "interannual" variations in global temperature and their relationship to those in pCO_2 provide additional important information, and are best assessed statistically, through signal processing and time series analysis.

The interannual variations of global temperature v. pCO_2 at Mauna Loa shown below (seasonal cycles and long-term trends removed) appear to share cyclic variations -- are these cycles significant and are they correlated?



Global Warming in 20th Century



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  School of ECEE

  Arizona State University

SenSIP
Sensor, Signal and Information Processing Center