Introduction to J-DSPC and Control blocks

J-DSP is an object-oriented Java™ tool, where J-DSP stands for Java Digital Signal Processing. J-DSP has been developed at Arizona State University (ASU) and is written as a platform-independent Java applet that resides either on a server or on a local hard-drive. It is accessible through the use of a web browser at http://jdsp.asu.edu. J-DSP has a rich suite of signal processing functions that facilitate interactive on-line simulations of modern statistical signal and spectral analysis algorithms, filter design tools, QMF banks, and state-of-the-art vocoders. J-DSP has recently been modified to allow control system simulations which are presented in this text. Due to the nature of control simulations however, the J-DSP blocks have been developed in a stand alone J-DSP version called J-DSPControl (J-DSPC).

J-DSPC provides a user-friendly environment through Java’s graphical capabilities. Its highly intuitive graphical user interface (GUI) is easy to understand and use. All functions in J-DSPC appear as graphical blocks that are divided into groups according to their functionality. Selecting and establishing individual blocks can be done by a drag-and-drop-process. Connecting the blocks can also be done easily by dragging the mouse from one output pin to an input one. Figure 1 shows the J-DSPC editor’s graphical environment.

Each J-DSPC block is linked to a control function. By connecting blocks together, a variety of control systems can be simulated while at the same time signals at any point of a simulation can be examined through the appropriate blocks. Blocks can be edited through dialog windows, allowing the user to change the corresponding function’s parameters to desired values and/or to view results. Dialog windows appear when the user double clicks on the center of a block. Blocks can easily be manipulated (i.e. edit, move, delete and connect) within the specified drawing area, using the mouse.

For the original J-DSP version, all system execution is dynamic, which means that any change at any point of a system will automatically take effect in all related blocks. Any number of block dialog windows can be left open to enable viewing results at more than one point in the system. However, due to the nature of control simulations which most often requires feedback, all J-DSPC control blocks have been designed not to execute dynamically. Instead, the simulation can only be executed if the user places the distinct Control block shown in figure 2 on the workspace. By double-clicking on the Control block its dialog window appears along with the [Start Simulation] button. The user needs to press the button, after he/she has correctly created the control system to be simulated in J-DSPC. Once the button is pressed, the simulation executes and results can be viewed by means of blocks like the Plot block. Remember, the Plot block has to be connected prior to running the simulation otherwise it will not display anything. In addition, the user needs to make sure to always press the update button (present in all dialog windows) every time he/she modifies the simulation parameters so that these can take effect.
Here is the suggested process for creating and running a control simulation:

1. Place all the blocks on the workspace and arrange them to facilitate the connection process in step 2.
2. Connect all blocks as necessary. Modify the connections as needed in order to achieve a nice diagram.
3. Open the dialog boxes of the blocks where necessary and enter the required parameters. Press the [Update] button to enable them!
4. Create a Control block and double click on it in order to open its dialog window. Setup the simulation parameters as needed.
5. Press on the [Start Simulation] button to start the simulation.
6. Observe the simulation results, usually through the Plot block.
7. If needed to run a new simulation, simply change the block parameters or add/remove blocks and connections in the system. Repeat from step 5.
**Figure 1:** J-DSP Editor environment
In the new J-DSPC environment, the user has more access on manipulating blocks and connections, specifically developed with systems and controls in mind. Blocks can now be rotated by pressing the Ctrl-R combination of keys. Blocks can be flipped vertically by pressing Ctrl-T and horizontally by pressing Ctrl-E. A connection can be modified simply by dragging a part of it with the mouse. In order to create better looking diagrams, it is suggested that you first place the blocks at the correct location, rotate or flip them as needed while leaving the connections for last. J-DSP editor performs better if the diagrams are created in this order. In case a connection becomes messy during your attempt to modify it, it is also suggested that you delete it and create it again from scratch. Figure 3 shows a case where modifying a connection results in an improved diagram.

Figure 2: The Control block
Figure 3: (a) Prior to modifying a connection (b) After modification

For more information on the basics of J-DSP, the student is invited to read the “Introduction to J-DSP” manual located at the J-DSP Editor’s web site at http://jdsp.asu.edu/jdsp_manual.html.