

A Real Time DSP Learning Module

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EXTENDED ABSTRACT

Purpose

Typically, digital signal processing (DSP) or signals and systems classes use text based programming languages (e.g. MATLAB), which do not use real time examples, as a lab type component for teaching difficult concepts that are vital parts of the course. Using this type of approach can result in students not grasping the materials as well as they possibly could. A real time, interactive approach could lead to achieving a better understanding of these difficult concepts. This project designs and creates a real time learning module to assist students in learning DSP.

Project

In order to create a real time environment, this project uses National Instruments LabVIEW 8.5 (a graphical programming environment) with DSP Module 2.5 and the National Instruments SPEEDY-33 external DSP board. This version of LabVIEW introduces a MIDI (Musical Instrument Digital Interface) read function. MIDI is a standard file type for digitalized music. The MIDI read function will instantaneously read in data from a MIDI file as an array of five frequency values. A program is constructed using the MIDI read function and implemented on top of the SPEEDY-33 board. This program splits the array of five frequency values into five separate arrays of frequencies, and plots each onto amplitude vs. time graph and amplitude vs. frequency graphs. The program then adds the separate arrays back into one array, recreating the original wave, and plots this array onto amplitude vs. time and amplitude vs. frequency graphs. This allows a visual representation of each voice that is being read from the MIDI file as well as a visual representation of the MIDI as a whole. With a reconstructed signal, the program then implements DSP including equalization, delay, reverberation, and synthesis. The program then outputs the signal with any, all, or none of the aforementioned effects to speakers. This provides a real time, interactive learning module to accompany coursework and math concepts, which can assist students in learning DSP or signals and systems concepts.

Results

Graphical programming languages (e.g. LabVIEW) are easier than text based languages to implement complex programs on, because they make use of function blocks wired to other functions, outputs, or graphs. Using the MIDI read function allows for a real time environment to work with. This real time environment makes learning concepts easier for students, because it appeals to senses. This immediate feedback in the form of seeing and hearing helps students in grasping the concepts of DSP.