Rapid Prototyping: Controller to DSP/Embedded Systems

VisSim/DSP™

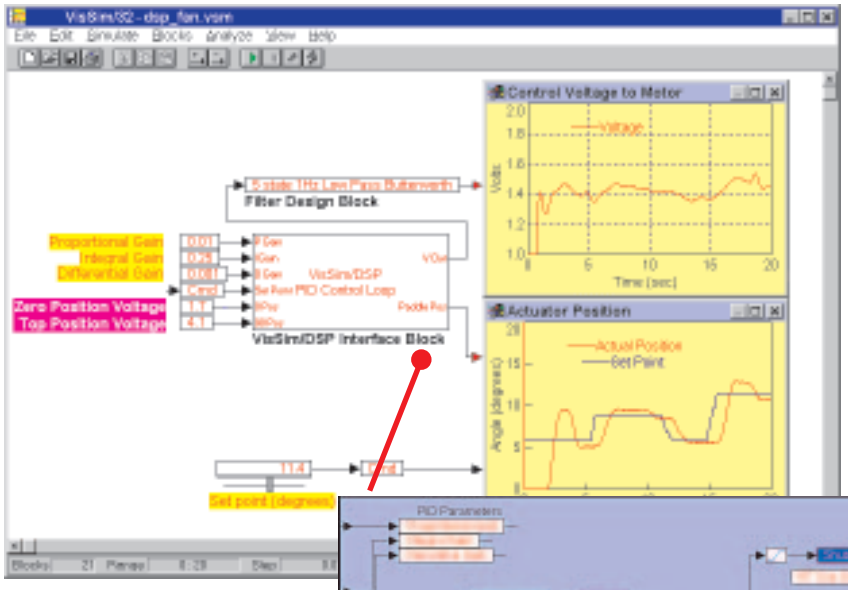
VERSION 3.0

VisSim/DSP is a completely integrated, native Windows program for the rapid prototyping of control systems targeted at digital signal processors (DSPs) and embedded systems. VisSim/DSP includes integrated modules for control system design and simulation, automatic C code generation, and real-time DSP validation and optimization. All of the following tasks can be completed quickly without writing a line of code.

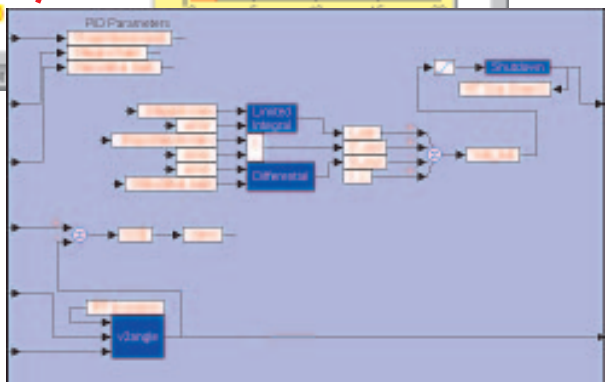
Control System Design: Design and simulate a control system using any or all of VisSim's standard blocks; then validate the controller against the simulated plant.

Automatic C Code Generation, Compilation, and Downloading: Select all or part of a block diagram (e.g., a controller), and VisSim/DSP automatically generates ANSI C code, compiles and links the code, and downloads the resulting executable to the target DSP.

Real-Time Hardware-in-the Loop DSP Validation and Optimization: Use I/O port blocks to access real-time analog and digital data from the DSP in both interactive and compiled modes. Validate the system by comparing DSP controller performance with the design goals. Make refinements to the control algorithm in the block diagram quickly and easily, and eliminate lengthy hand-coding and debugging. Repeat the automatic code generation, compilation, linking, and downloading process by a single push of a button to make fast design iterations. Then perform final-phase hardware-in-the-loop validation to ensure that the DSP-based controller performs properly with the actual product or test stand.



Closed-loop control system developed in VisSim/DSP. The DSP code is compiled and downloaded to the DSP card. Inputs to the VisSim/DSP Interface Block are sent to the DSP card; DSP results are presented to the output ports on the VisSim/DSP Interface Block.



Drill into the PID controller subdiagram by simply clicking on the VisSim/DSP Interface Block.

Highlights

- 40 KHz closed-loop sampling rate for PID SISO systems with full analog and digital I/O support
- User-configurable continuous, discrete, SISO, MIMO, control systems, and filters block set
- 50+ signal processing blocks, including arithmetic, Boolean, linear, nonlinear, random generator, transcendental, signal producer/consumer
- Fixed and floating point simulations
- Spectral analysis
- FIR and IIR filter design and implementation
- Multi-rate signal processing
- Matrix math operations
- Fixed and adaptive filter simulation
- Portable C code generation
- Automatic code comments
- Automatic use of VisSim variables in DSP code
- Source code to support library for custom or proprietary DSP cards (opt.)
- Use same diagram for PC control and DSP control
- Asynchronous DSP communication
- 32-bit Windows host interface to DSP card
- Open-ended DSP run mode

Real-Time Graphical Interface

An engineer retains the standard interactive real-time interface of VisSim while the DSP algorithm executes on the DSP platform. The results of the algorithm can be used immediately or viewed dynamically in VisSim through plots, strip charts, bar graphs or any other VisSim block. In addition, modifications can be made to DSP parameters "on-the-fly" directly from VisSim using standard blocks, such as constants, buttons, sliders, and gains. This means no regeneration of C code is necessary in order to make these changes to the algorithm as it runs on the DSP platform.

Asynchronous DSP Communication

VisSim/DSP communicates to the target DSP through dual ported memory. This results in asynchronous, bi-directional communication (ABC) between VisSim/DSP and the target DSP. The ABC guarantees that the selected DSP sampling rate will not be affected by PC disk activity or other PC-generated disturbances. A simple dialog box selection in VisSim/DSP automatically creates the ABC.

Matrix Math Operations

The Matrix Operation blocks are vector-based blocks that facilitate the design of FIR and IIR filters, adaptive control, and other real-time applications. The Matrix Operation blocks include buffer, dotProduct, fft, ifft, invert, multiply, transpose, and vsum.

Fixed and Floating Point Simulations

Features including multiple data types, color-coded data types, and propagation of ANSI C data types are built into VisSim/DSP to facilitate prototyping and development of fixed and mixed system simulations and C code generation for DSP and embedded systems.

Modeling DSP Performance Degradation

The convert block provides a convenient method for converting data types from the host PC to the target DSP. Typically, the PC data type of 64-bit floats is more robust than DSP hardware. By allowing conversion to the lesser precision inherent to the DSP, the effects of DSP performance degradation can be quickly and easily evaluated on the PC. In addition, the convert block can immediately detect loss of precision and numeric overflows.

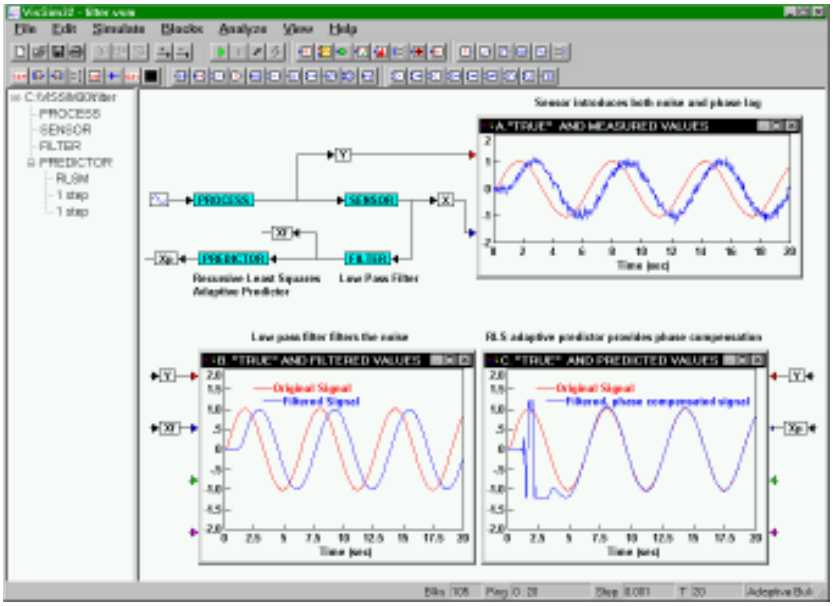
Signal Analysis and Display

VisSim/DSP supports power spectral analysis and provides basic building blocks for filtering and analyzing signals "on-the-fly." The new fft and ifft blocks allow data to be processed in frequency domain or time domain.

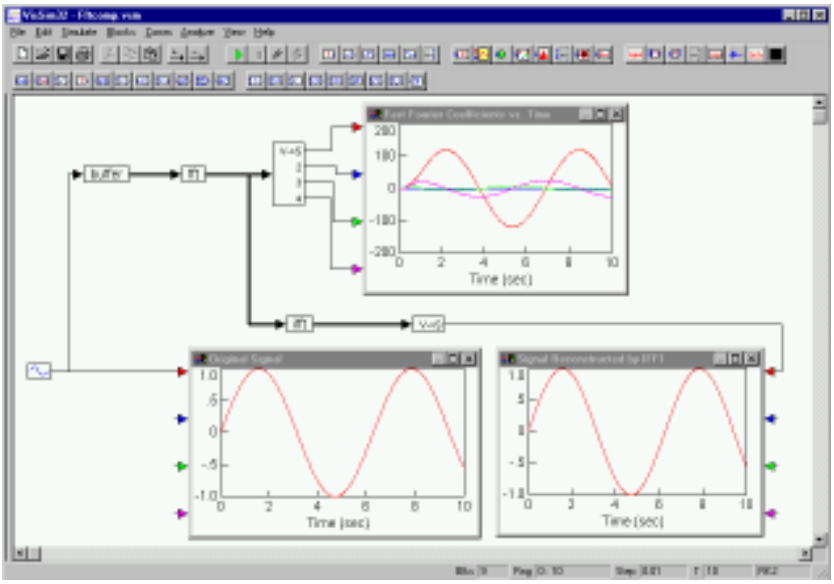
In addition, the FIR and IIR filter design wizards use a built-in bi-linear transform to facilitate construction of digital filters.

Fixed and Adaptive Filter Simulation

VisSim/DSP can take advantage of the fixed and adaptive filters supplied with VisSim/Comm. Alternatively, VisSim's continuous and discrete transferFunctions, integrators, and unitDelay blocks can be used to build and customize fixed filters.



Reconstruction of a signal corrupted with sensor-induced noise and phase lag using a lowpass filter and a Recursive Least Squares (RLS) adaptive predictor.



Conversion of a sinusoidal signal to frequency domain using an fft block, and then reconstructed using an ifft block. The fft block computes a 128-sample FFT of the original sinusoid at a sampling rate of 0.01.

Sample Applications

- Visually-programmed control and DSP development
- Rapid prototyping of control systems
- Hardware-in-the-loop simulation and modeling
- Real-time DSP
- Closed-loop embedded control
- Model acceleration

System Requirements

- 32-Windows (Win 95+ or Win NT 4+)
- Professional VisSim 3.0
- DSP card
- 4 MB RAM
- 4 MB disk space
- 3½" floppy drive

Hardware Support

- Analog inputs and outputs
- Digital inputs and outputs
- Supports all processor speeds

Windows® 95 and NT Compatible

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