MathWorks™ Products

for Signal Processing and Communications

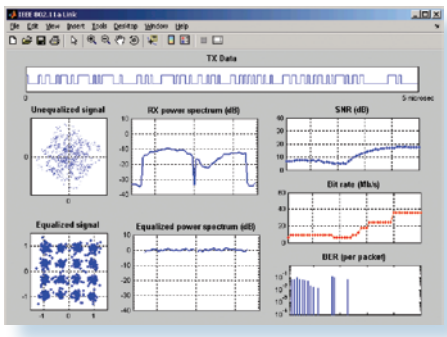
MATLAB®
&SIMULINK®

MATLAB® & SIMULINK®

The MATLAB® and Simulink® product families provide a complete set of tools for applying Model-Based Design to signal processing and communication systems development.

"Using Mathworks tools for Model-Based Design, we improved productivity and completed the design in about half the time."

—Idan Bar-Sade,
BridgeWave Communications



User-defined visualization for IEEE 802.11a Wireless LAN Model.

Simulink® offers an interactive graphical environment and customizable block libraries for designing, simulating, implementing, and testing signal processing and communication systems. Add-on products support specific modeling and design tasks, as well as code generation, algorithm implementation, test, and verification. Simulink is integrated with MATLAB®, giving you access to a rich set of tools for algorithm development and data analysis.

System Modeling

With the Simulink product family, development teams can build comprehensive, system-level models for implementation in software, as well as in analog and digital hardware. The models are hierarchical, enabling you to work at different levels of detail, and can be partitioned into subsystems or components. You can define the interfaces and optimize the interactions between system components.

Simulink supports rapid model refinement. You can create a floating-point reference model and then refine it to explore finite wordlength effects and produce a bit-true, fixed-point design. Analysis and statistical tools enable rapid optimization and debugging.

Unlike procedural languages, Simulink lets you naturally model complex timing behavior, including concurrency, multirate, and feedback.

Algorithm Development and Component Design

The MATLAB and Simulink product families let you develop subsystems and components, such as the equalizer in a wireless communication system, the compression scheme for video processing, or the RF front end of a radar receiver. You can simulate, test, and implement each design component independently and model the interaction between components. You can isolate part of the model to add design detail and use the rest as a test bench.

Simulation and Analysis

The Simulink product family supports sample-based and frame-based processing. Frame-based processing ensures efficient system execution by synchronizing sample arrival rate and algorithm execution rate.

You can compile Simulink models and run simulations on distributed computed clusters to accelerate simulation of large, computationally-intensive systems.

You can analyze system behavior using quantitative measures such as signal-to-noise ration and bit-error rate. Scopes, display blocks, and other tools let you visualize and analyze simulation results. You can automatically document design specifications and produce reports from your models.

"MATLAB is an ideal environment for developing and understanding our algorithms. Simulink integrates well with MATLAB and lets us produce a design that looks very similar to what we end up with ultimately in hardware."

—Francis Swarts, Broadcom

Automatic Code Generation

Code can be generated automatically from the validated model for real-time prototyping and deployment on the target system.

You can execute the code directly on target hardware for verification and debugging, and integrate it with optimized assembly code and other external software. C code can be generated for any embedded processor that supports an ANSI-C-compliant compiler. Target-specific support is provided for popular implementation platforms. You can generate synthesizable, device-independent VHDL® and Verilog® code for digital filters.

Third-party tools and hardware automate implementation on DSPs and FPGAs.

Test and Verification

The Simulink product family lets you run bit-accurate simulations and continuously verify your models throughout the design workflow. System requirements can be associated with design models, letting you trace requirements through to implementation, and with specific test cases that are applied to the design model.

You can measure the level of testing by analyzing structural coverage. You can reuse your test cases to perform simulator-in-the-loop or hardware-in-the-loop cosimulation. You can integrate tests into the models at any stage, and quantify test coverage of the model.

You can verify hardware and software prototypes by acquiring measured data and live signals, video, and images.

About Model-Based Design

In Model-Based Design, a system model is at the center of the development process—from requirements capture and design to implementation and test.

The model is an executable specification that is continually elaborated throughout the development process. Simulation shows whether the model works correctly. When software and hardware implementation requirements are included, such as fixed-point and timing behavior, you can automatically generate code for embedded deployment and create test benches for system verification—saving time and avoiding the introduction of hand-coding errors.

Model-Based Design streamlines development by enabling engineers to:

- Use a common design environment across project teams
- Integrate testing with design for early detection of errors
- Refine algorithms through multidomain simulation
- Automatically generate embedded software
- Develop and reuse test suites
- Automatically generate documentation
- Reuse designs across multiple projects and hardware targets

The MATLAB and Simulink product families support every facet of Model-Based Design.

CUSTOMER SUCCESSES

Broadcom reduced development time by 50% for a 3G standards-based semiconductor that saves handset manufacturers millions of dollars.

ETRI reduced development time by 50% for modem synchronization technology in a 4G mobile telecommunications system.

IDT-Newave reduced mixed-signal simulation time for a voiceband codec chip from three days to thirty minutes.

Motorola reduced simulation time for phase-locked loop development from two hours to 1.2 minutes.

Nallatech developed and implemented algorithms for a reconfigurable video encryption system, reducing design time by two-thirds.

Realtek cut R&D costs, streamlined development, and gained 50% of market share in Taiwan's audio codec market with an audio codec chip for PC multimedia systems.

Sandia implemented a high-performance radar receiver, achieving orders of magnitude higher levels of FPGA integration than they had ever attempted in a radar system.

Multi-Domain Modeling

Signal and Image Processing

The Simulink product family supports the design, simulation, and implementation of floating- and fixed-point signal, video, and image processing algorithms. You have immediate access to a full range of industry-standard techniques, including transforms, buffering, digital filtering, and edge detection. Signal sources and interactive scopes, spectrum analyzers, and other tools let you visualize signals and image and video data. You can model streaming data processing and multirate systems.

Filter architectures and design methods are provided for complex real-time signal processing applications, including adaptive and multirate filtering. You can design fixed-point filters and analyze quantization effects, as well as develop wavelet-based algorithms for analyzing, synthesizing, denoising, and compressing signals and images.

Communications and RF Design

Customizable, built-in blocks are provided for building a reference design. Source coding, interleavers, filters, modulators, and other blocks let you design and simulate the physical layer of communication systems and components. You can model the link layer as a finite state machine.

With the Simulink product family you can design and simulate the behavior of RF systems and components in a wireless system, including RF filters, transmission lines, amplifiers, and mixers. Components can be specified on the basis of network parameters, mathematical behavior, or physical properties. You can read and write industry-standard file formats for network parameters.

Resources and Support

- *ONLINE USER COMMUNITY*
  www.mathworks.com/matlabcentral
- *DEMOS*
  www.mathworks.com/spcdemos
- *THIRD-PARTY PRODUCTS*
  www.mathworks.com/connections
- *TECHNICAL SUPPORT*
  www.mathworks.com/support
- *TRAINING SERVICES*
  www.mathworks.com/training
- *CONSULTING SERVICES*
  www.mathworks.com/consulting
- *BOOKS BASED ON MATLAB AND SIMULINK*
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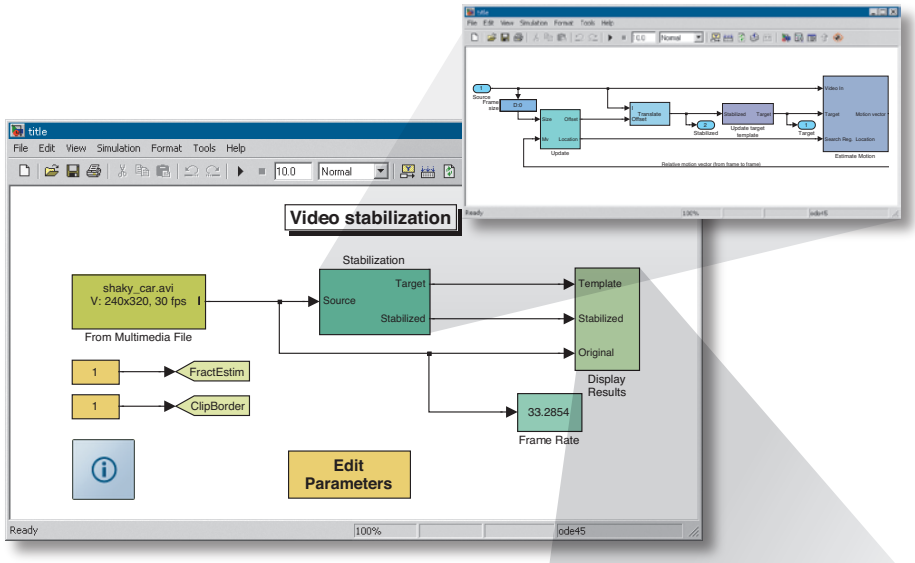

Model illustrating a motion stabilization technique based on the SAD method. The stabilization subsystem applies the SAD technique to remove unwanted translational camera motions and generate a stabilized video.

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The MathWorks