

Model-Based Design with MATLAB[®], Simulink[®], and Altera DSP Builder

MathWorks and Altera Partnership

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Agenda

- A Model-Based Design Methodology
 - What is Model-Based Design?
- From MATLAB and Simulink to Altera FPGA
 - Step by step design and implementation of an edge detection algorithm on FPGA
- Future of Model-Based Design and next steps

The MathWorks



www.mathworks.com/mars

320,000,000 MILES, 380,000 SIMULATIONS
AND ZERO TEST FLIGHTS LATER.

THAT'S MODEL-BASED DESIGN.

After simulating the final descent of the Mars Rovers under thousands of atmospheric disturbances, the engineering team developed and verified a fully redundant retro firing system to ensure a safe touchdown. The result—two successful autonomous landings that went exactly as simulated. To learn more, go to mathworks.com/mars.

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& SIMULINK®**

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The MathWorks
Accelerating the pace of engineering and science

NASA Lands Mars Rover Missions Relying on MathWorks Software



尾气排放锐减 90%

而且开发周期缩短 50%

THAT'S MODEL-BASED DESIGN.

为达到严苛性能目标，日产的工程小组使用动力系统模型取代了文档验证。结果不仅缩短了50%的开发周期，而且还率先开发出满足加州的部分零排放车辆标准（PZEV）的汽车，荣获美国环境保护机构大奖。

如果想了解更多关于“Model-Based Design”或本地代理商的信息，请浏览mathworks.com/mbd

**MATLAB®
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The MathWorks
Accelerating the pace of engineering and science

Nissan Cuts Evaporation Emissions by 100% and Development Time By 50%

Session Goal:

Partner to Overcome Today's Main Design Challenges

- Inconsistent and unintegrated design flows
- As designs get more complex, implementation becomes almost impossible
- Model-Based Design approach
 - One integrated environment to simulate, implement, test, and verify complex systems
 - Path to implementation on FPGA and DSPs

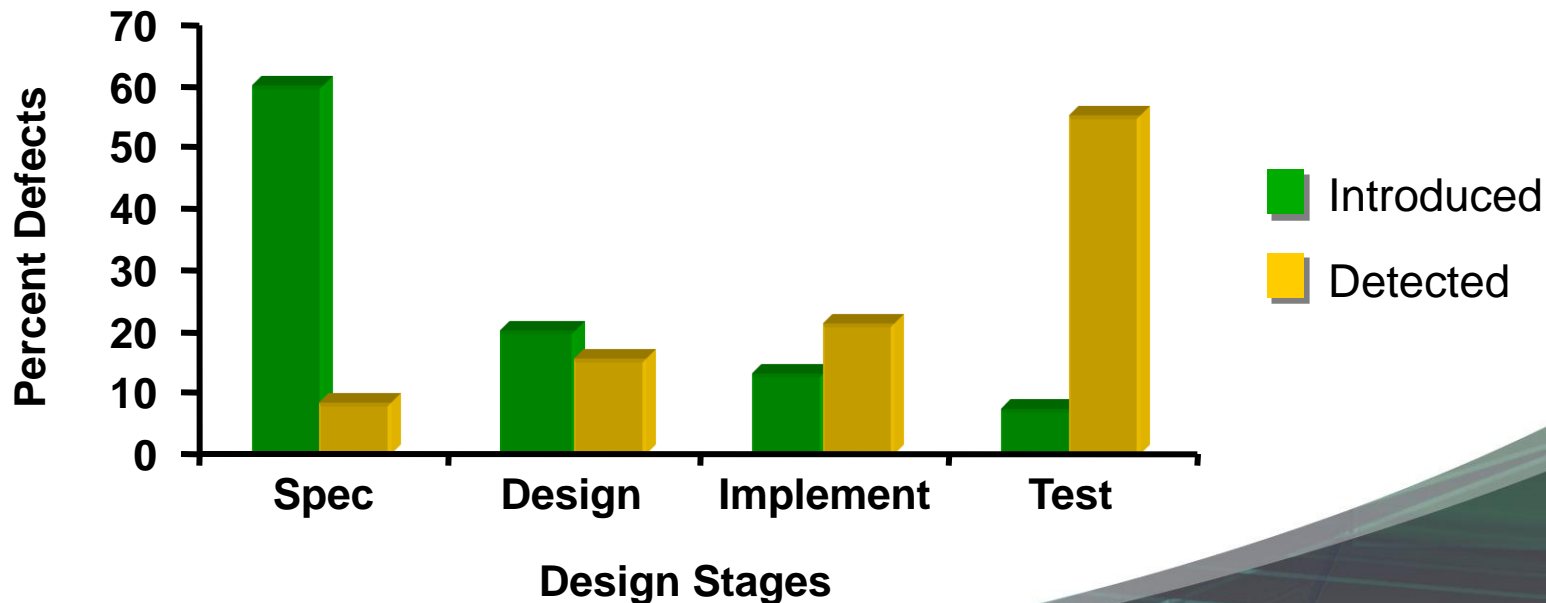
***Deliver better products
in less time***

What is Model-Based Design?

Design Failure and Time-to-Market in Embedded Systems

■ Across industries:

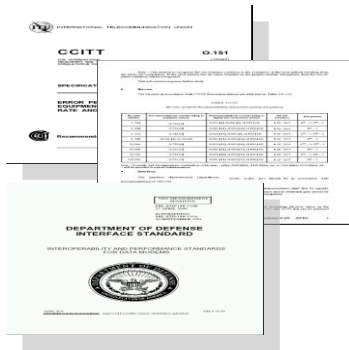
- 50% of projects behind schedule
- 1/3 fail to meet 50% of performance/feature requirements



Source: Embedded Market Forecasters

Traditional Development

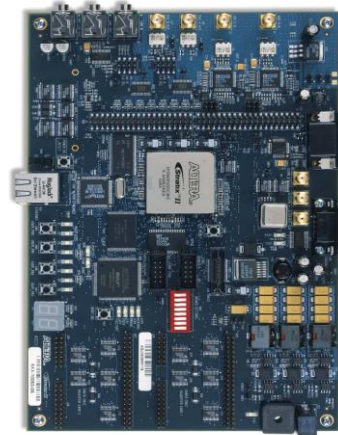
Requirements and Specifications



Design



Implementation



Test and Verification



Text-based
- Prevents rapid iteration

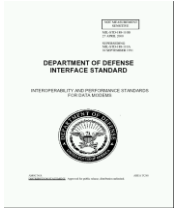
Simulation prototypes
- Incomplete and expensive

Manual coding
- Introduces human errors

Traditional testing
- Errors found too late

Advantages of Model-Based Design

Requirements and Specifications



Design

[illegible]

Implementation

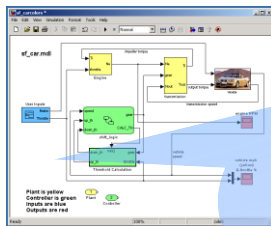


Test and Verification

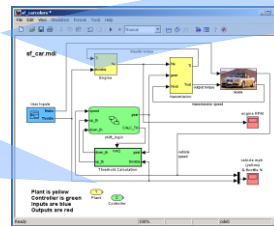


Model Elaboration

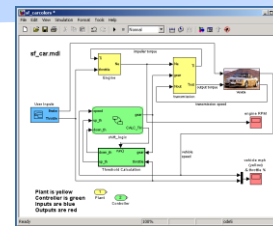
Continuous Verification



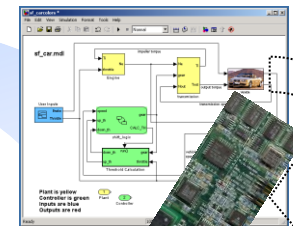
Executable Models



Simulation



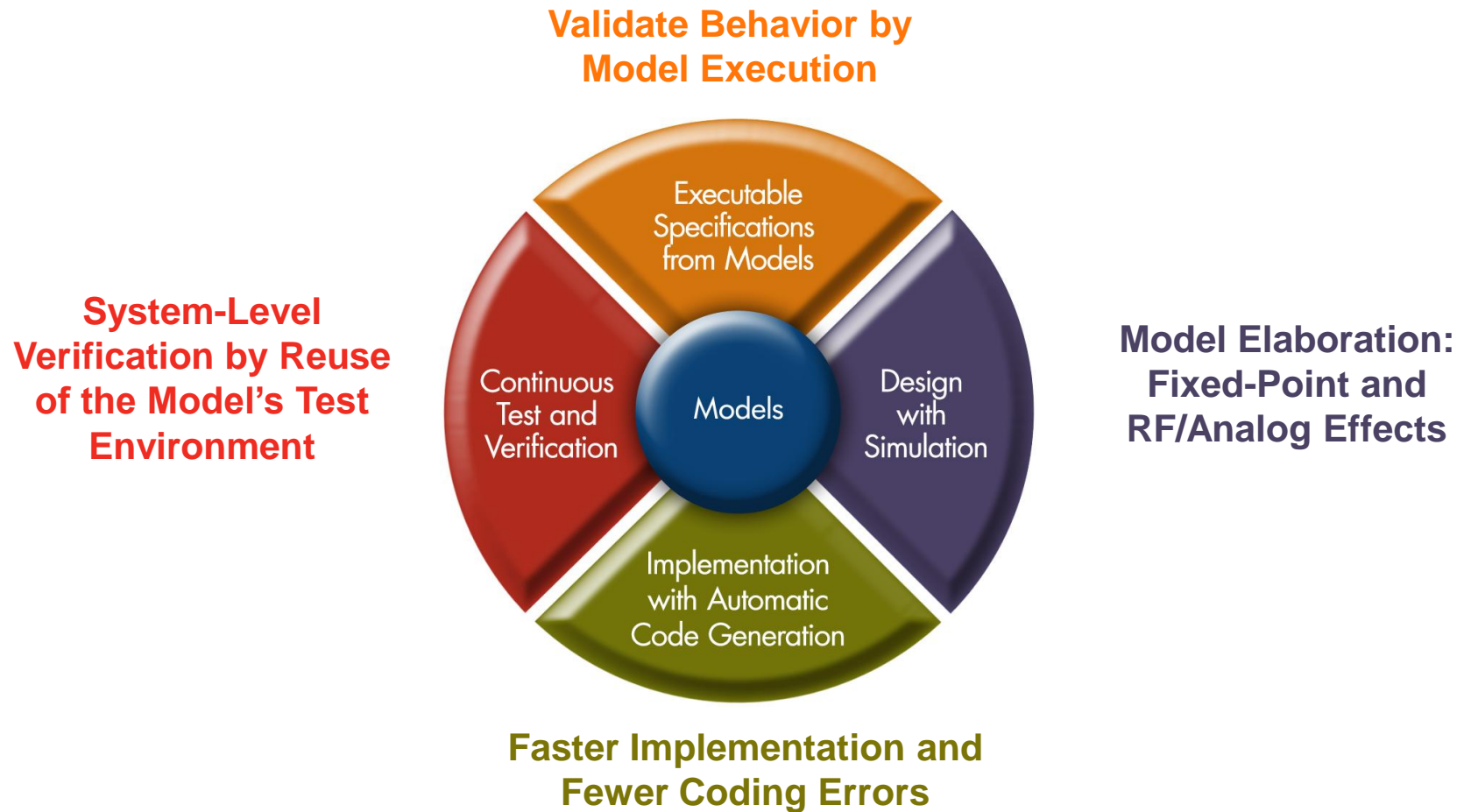
Automatic Code Generation



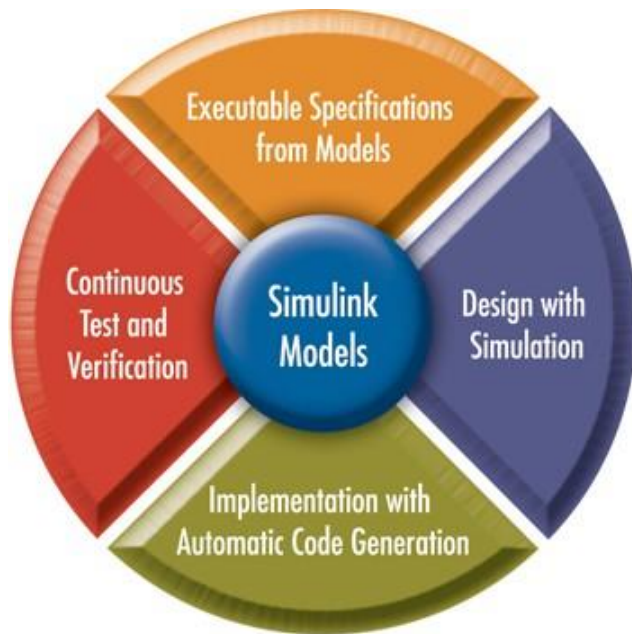
Test and Design



Model-Based Design with MATLAB and Simulink



Model-Based Design with MATLAB and Simulink



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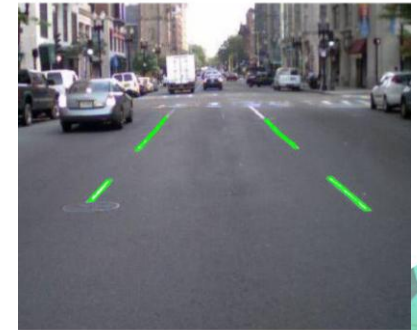
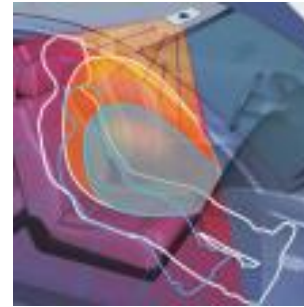
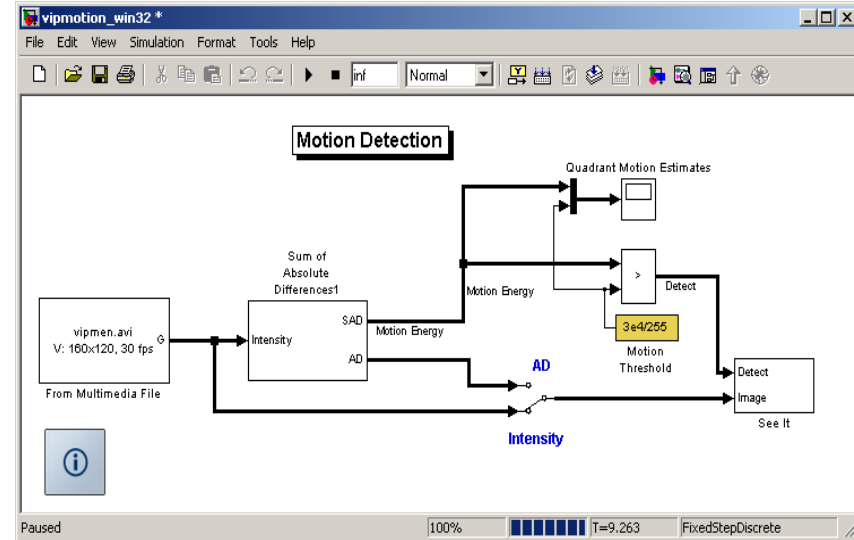

Synplicity®

Model-Based Design With MATLAB, Simulink, and Altera DSP Builder

*-Step by Step design and
implementation of an edge detection
algorithm*

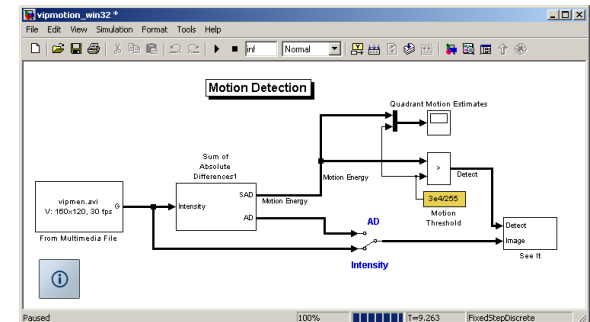
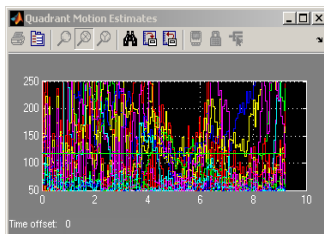
What is Simulink?

- Simulation, modeling, and design tool
- Block diagram environment
- Platform for Model-Based Design



Simulink Key Features

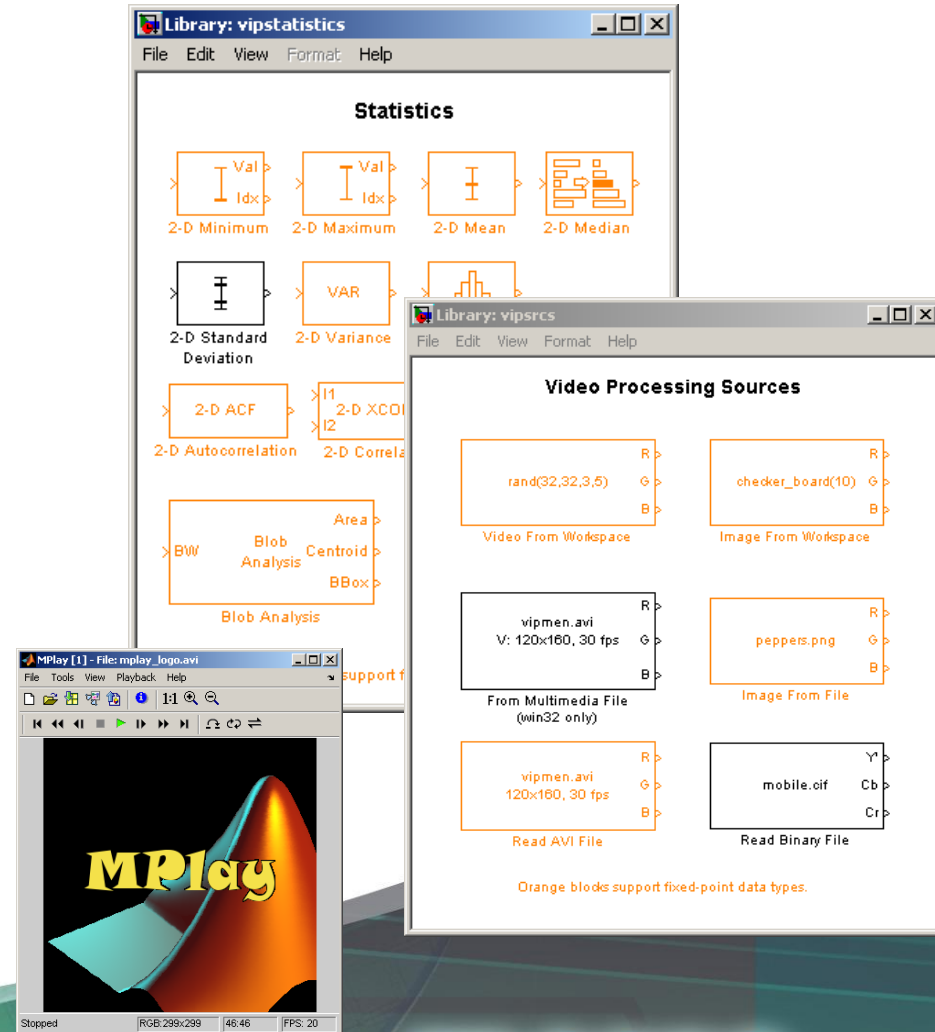
- Hierarchical, component-based modeling
- MATLAB® integration
- Extensive library of predefined blocks
- Application-specific libraries available
- Open Application Program Interface (API)



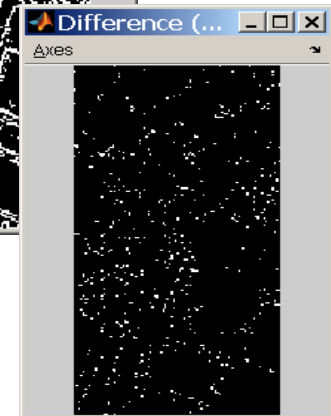
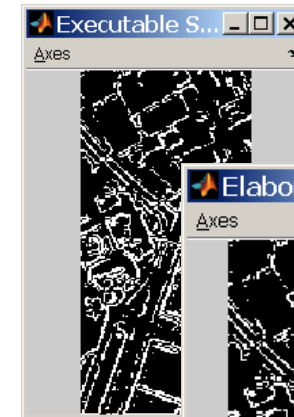
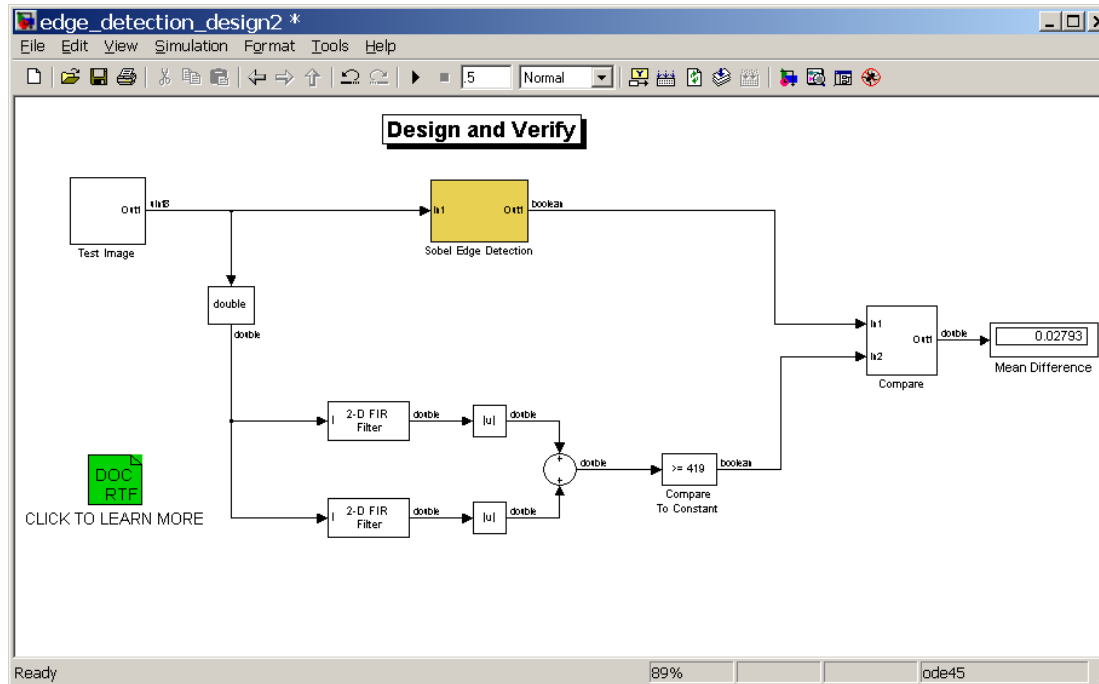
Simulink Libraries and Blocksets

Example: Video and Image Processing Blockset

- Analysis and enhancement
- Conversions
- Filtering
- Geometric transforms
- Morphological operations
- Sinks
- Sources
- Statistics
- Text and graphics
- Transforms
- Utilities



Modeling and Simulation w/Simulink

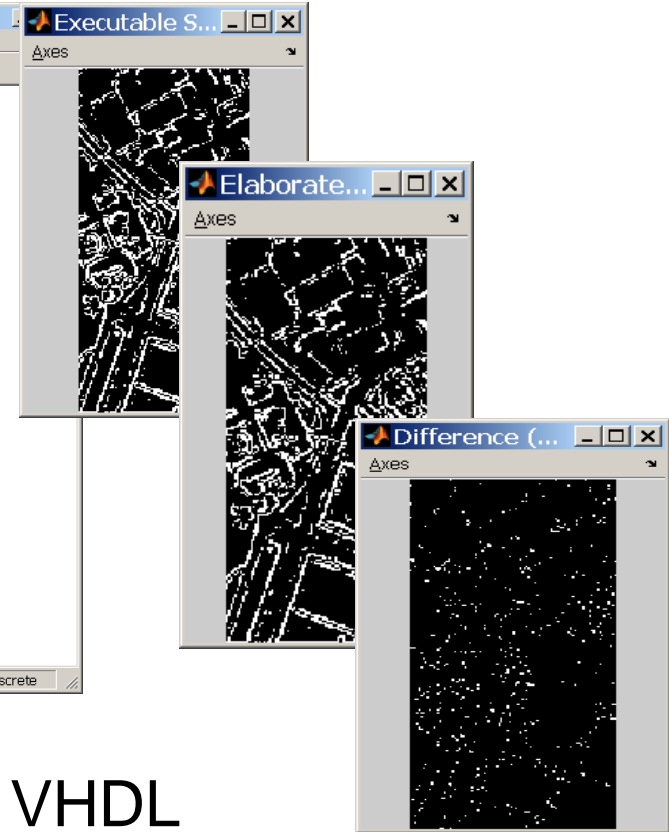
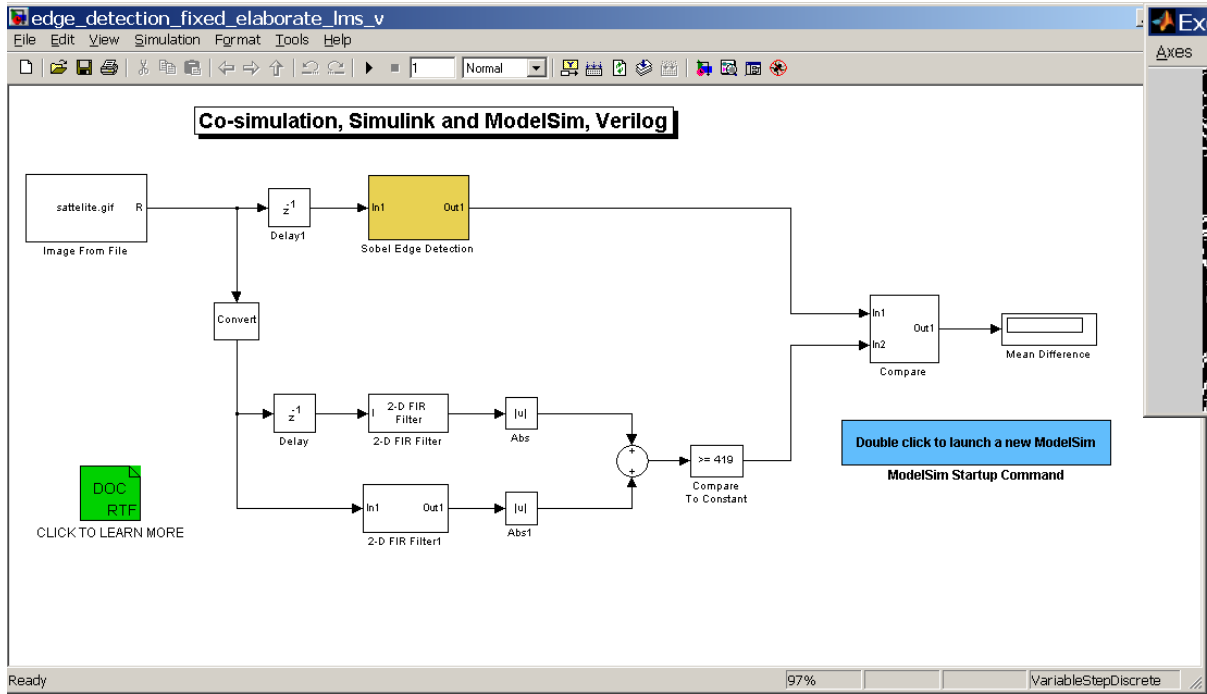


- Executable Specification / Golden Reference
- Design and Verify
- Fixed-Point Design and Verification
- Elaborate and Verify

Live Demo

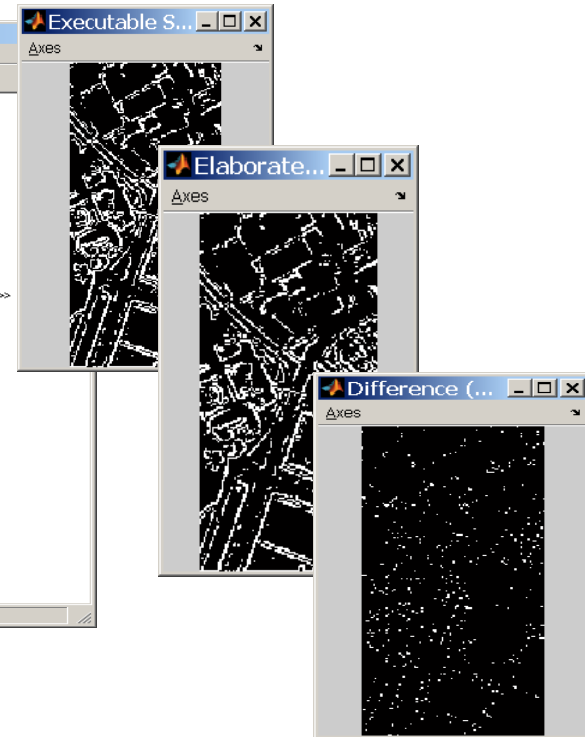
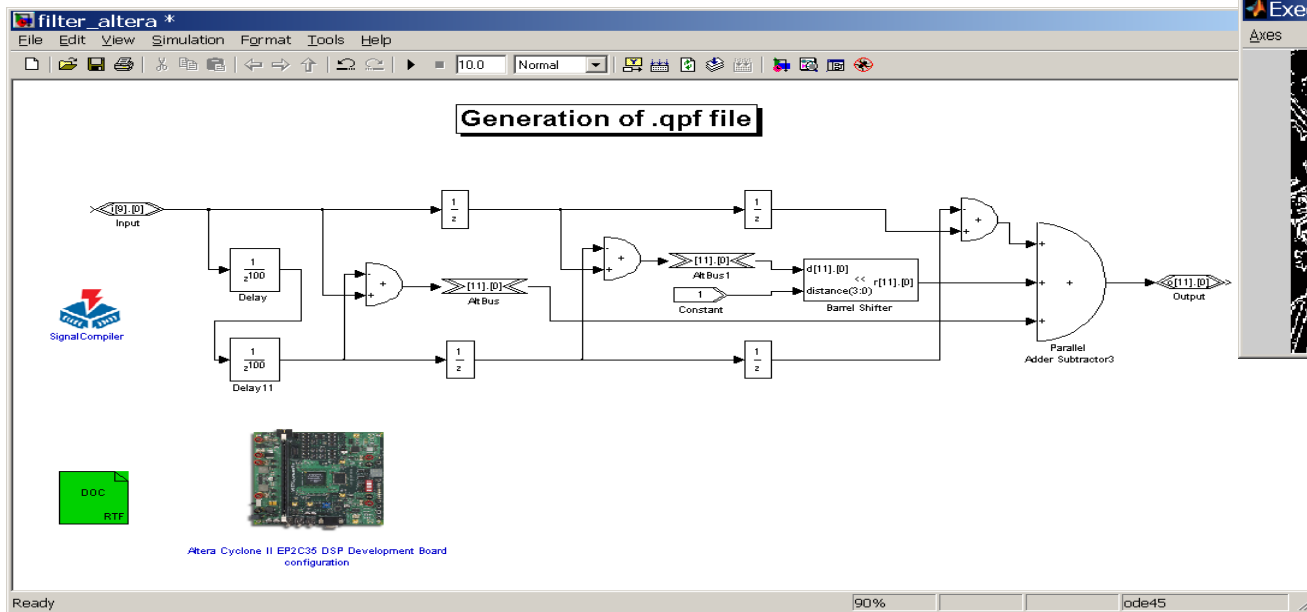
The screenshot displays the MATLAB/Simulink environment with the following components and connections:

- Title Bar:** edge_detection_lms_v
- Menu Bar:** File, Edit, View, Simulation, Format, Tools, Help
- Toolbox:** Includes icons for file operations, navigation, and simulation.
- Diagram Title:** Co-simulation, Simulink and ModelSim, Verilog
- Diagram Components:**
 - satellite.gif** (Image From File) connected to a **Convert** block.
 - Convert** block output splits to a **Delay1** block and a **2-D FIR Filter1** block.
 - Delay1** block output goes to a **Sobel Edge Detection** block.
 - Sobel Edge Detection** block output goes to a **Compare** block.
 - 2-D FIR Filter1** block output goes to an **Abs1** block.
 - 2-D FIR Filter** block output goes to an **Abs** block.
 - Abs** and **Abs1** block outputs are summed at a junction.
 - Sum** block output goes to a **Compare To Constant** block.
 - Compare To Constant** block output goes to a **Mean Difference** block.
- Annotations:**
 - A green box labeled **DOC RTF** with the text **CLICK TO LEARN MORE**.
 - A blue box with the text **Double click to launch a new ModelSim** and **ModelSim Startup Command**.
- Status Bar:** Ready, 97%, VariableStepDiscrete



- ## Live Demo

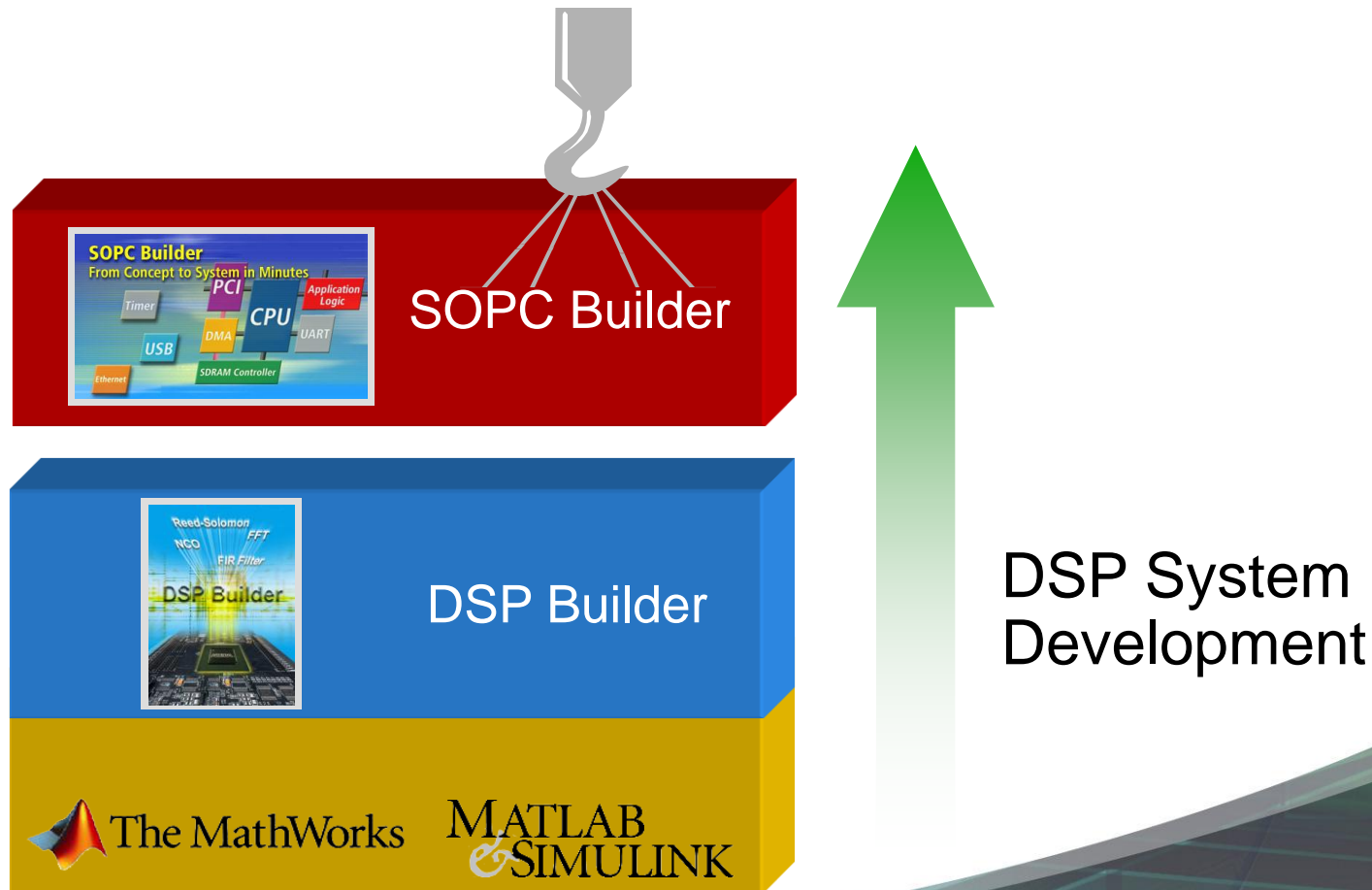
Automatic Code Generation and Continues Verification



- Integrate Altera DSP Builder Blocks
- Automatically generating HDL code
- Elaborate and Verify with Altera DSP Builder
- Implement on FPGA

Live Demo

Model-Based Design Flow from Simulink to Altera FPGAs

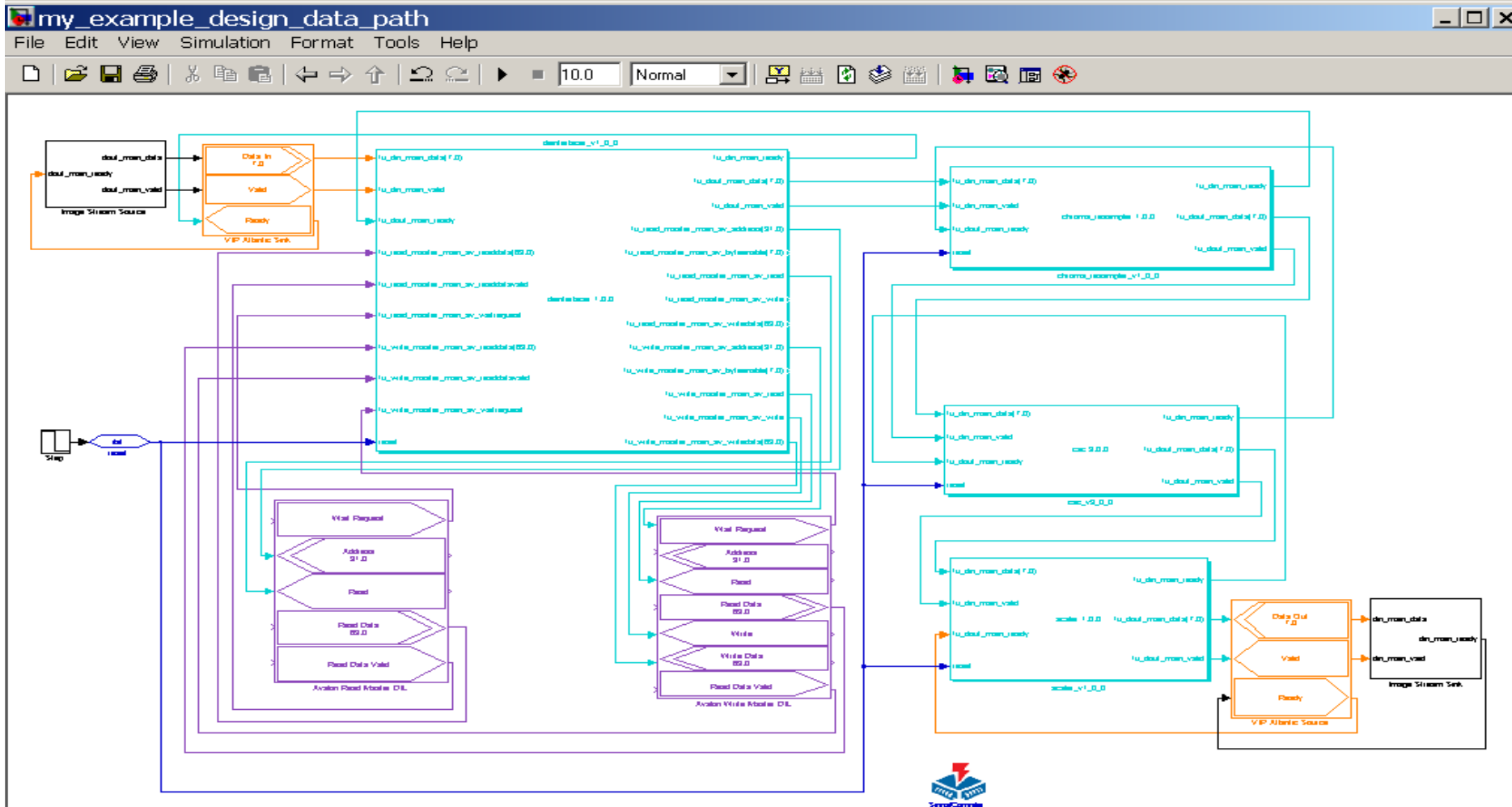


Future of Model-Based Design and next steps

MathWorks and Altera Partnership Roadmap

- Continuing to provide rich set of IPs
 - Signal Processing
 - Video designs
 - Communications
- Seamless integration from Simulink blocks to Altera FPGAs

Latest Designs from Altera: Up Conversion and Wireless IPs



In Summary

- Integrated environment to simulate, implement, test, and verify complex systems
- Automatic code generation for FPGA and DSPs
- MATLAB and Simulink for model-based design
 - Altera DSP builder for FPGA implementation
 - MathWorks provides similar design flow for embedded software implementation

***Deliver Better Products in
Less Time !***

Next Steps

1. Attend DSP Builder sessions this afternoon
2. Visit the MathWorks booth and talk to our engineers
 - Check out designs and demos
 - Ask for a trial, or schedule a meeting for your company

Thank You!