

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

MathWorks and Altera Partnership

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Agenda

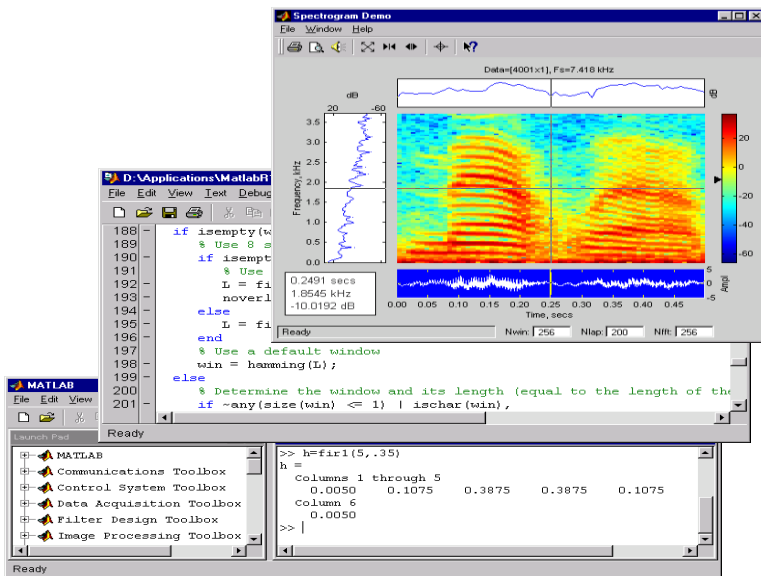
- A Model-Based Design Methodology
 - What is Model-Based Design?
- From MATLAB and Simulink to Altera FPGA
 - Step by step design and implementation of an edge detection algorithm on FPGA
- Future of Model-Based Design and next steps

The MathWorks Mission

Accelerating the Pace of Engineering and Science

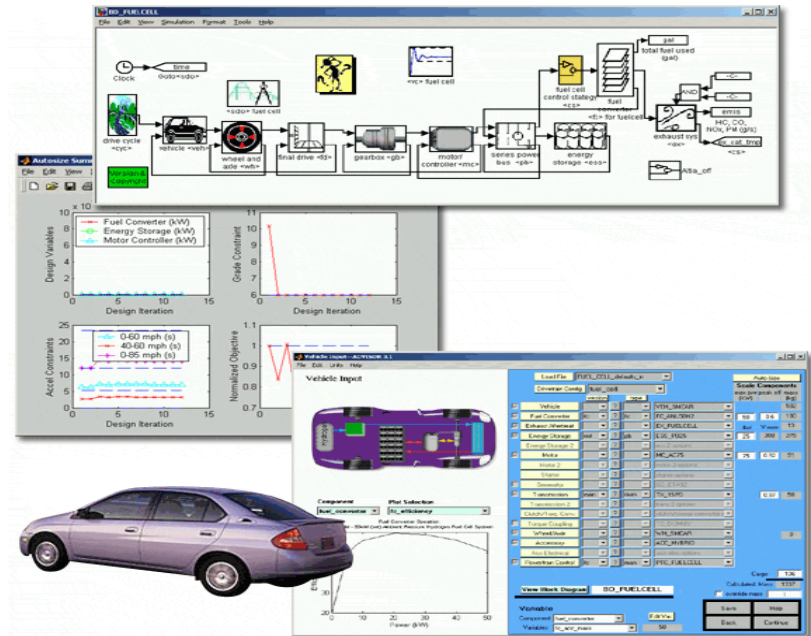
MATLAB®

The leading environment for technical computing



SIMULINK®

The leading environment for modeling, simulating, and implementing dynamic and embedded systems



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.

**MATLAB®
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Accelerating the pace of engineering and science

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**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规范，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。

如果要知道更多关于“Model-Based Design”或本地代理商的信息，详情请访问 mathworks.com/mbd

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**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

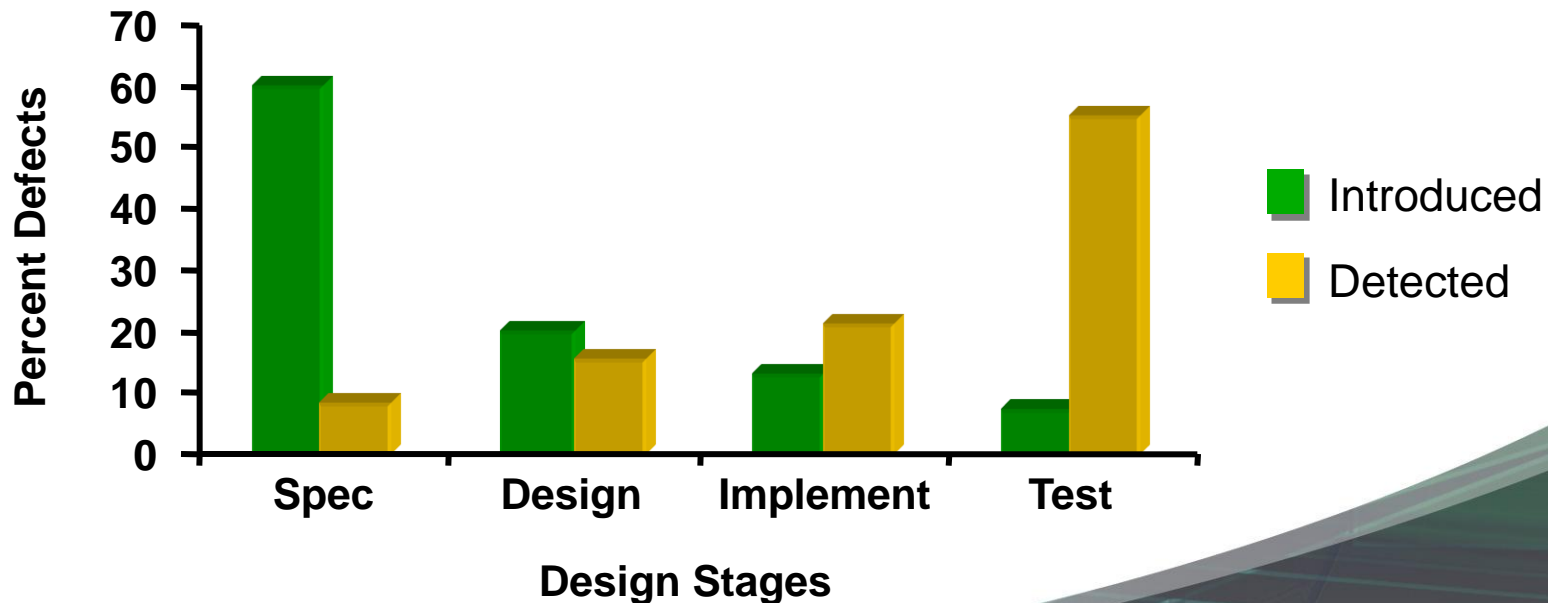
***Deliver better products
in less time***

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

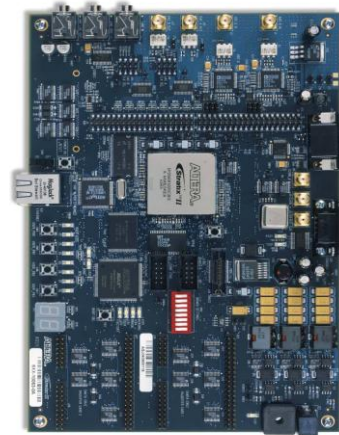
Requirements and Specifications



Design



Implementation



Test and Verification



Text-based
- Prevents rapid iteration

Simulation prototypes
- Incomplete and expensive

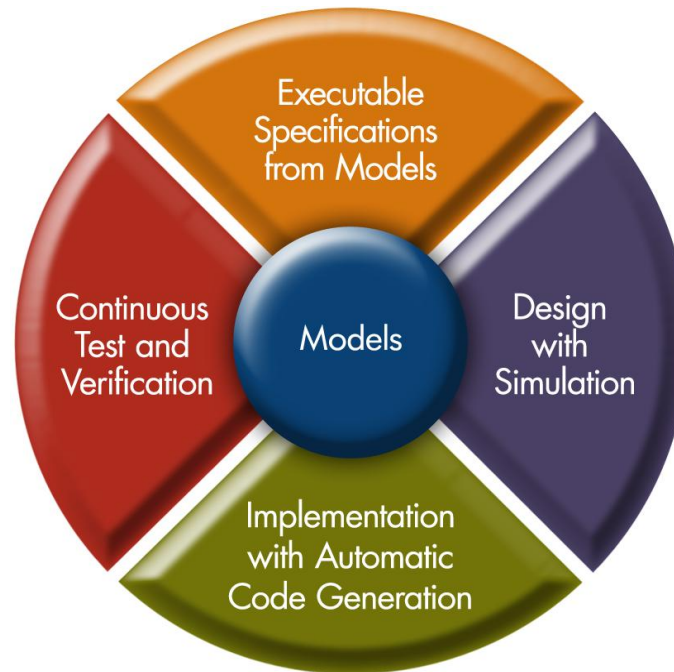
Manual coding
- Introduces human errors

Traditional testing
- Errors found too late

Model-Based Design with MATLAB and Simulink

**Validate Behavior by
Model Execution**

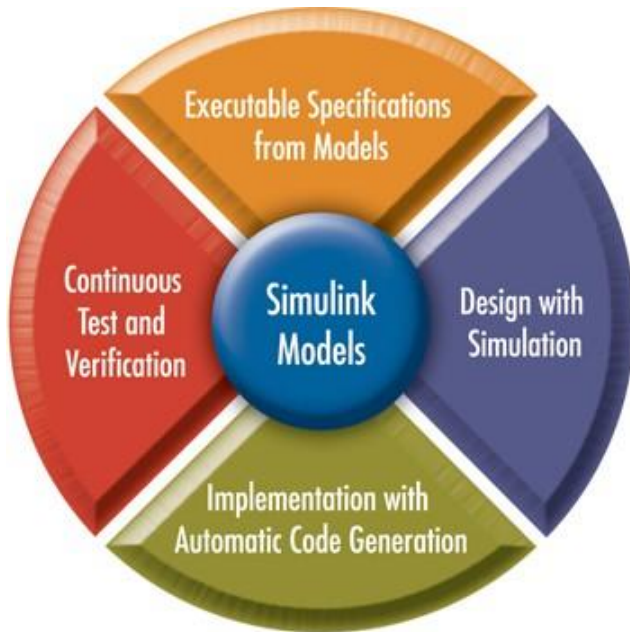
**System-Level
Verification by Reuse
of the Model's Test
Environment**



**Model Elaboration:
Fixed-Point and
RF/Analog Effects**

**Faster Implementation and
Fewer Coding Errors**

Model-Based Design with MATLAB and Simulink



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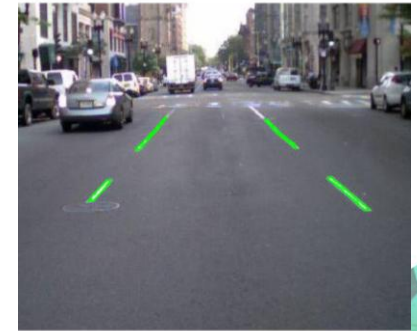
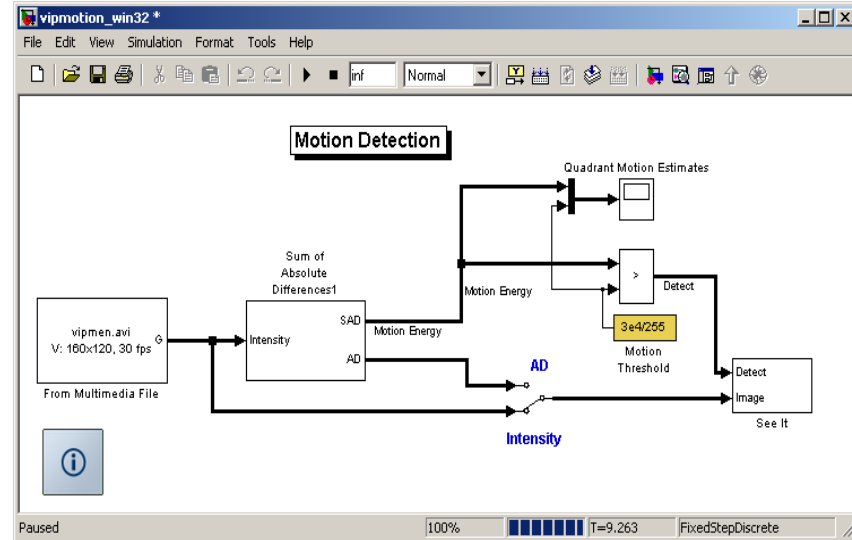
```
nbit_adder:adder1
GENERIC MAP x => 8
PORT MAP {Add5:R[0],R[1],R[2],R[3],R[4],R[5],R[6],R[7]}
multiplexer: mux2to1
GENERIC MAP x => 7
PORT MAP {A:R[0],Z:R[1],R[2],R[3],R[4],R[5],R[6],R[7]}
A[0] <= 1 OTHERS => 0
```

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

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

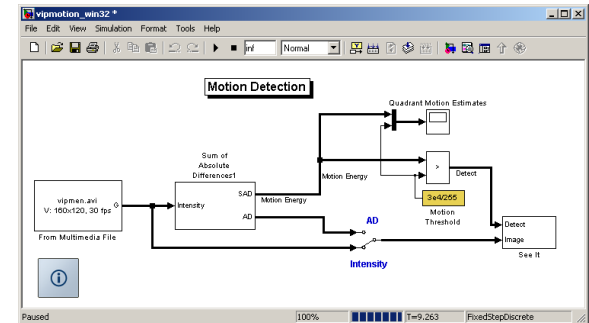
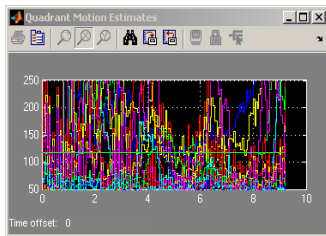
What is Simulink?

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



Simulink Key Features

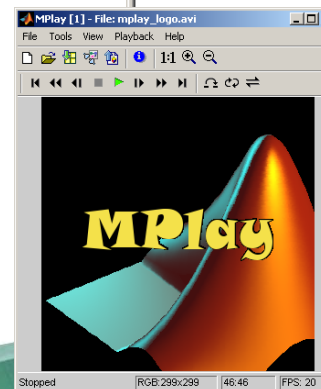
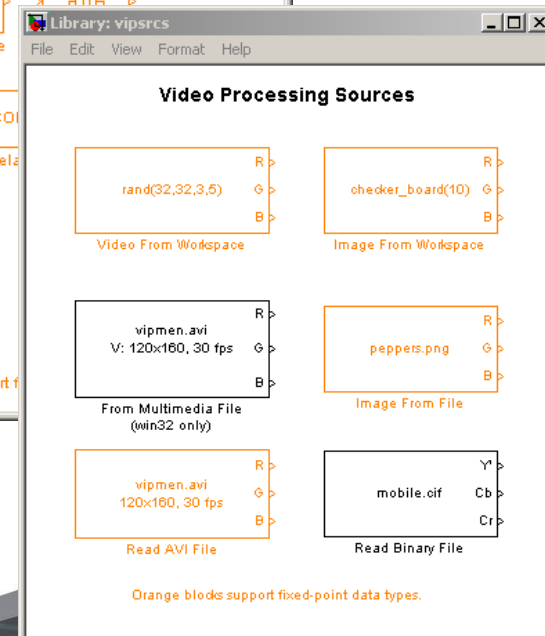
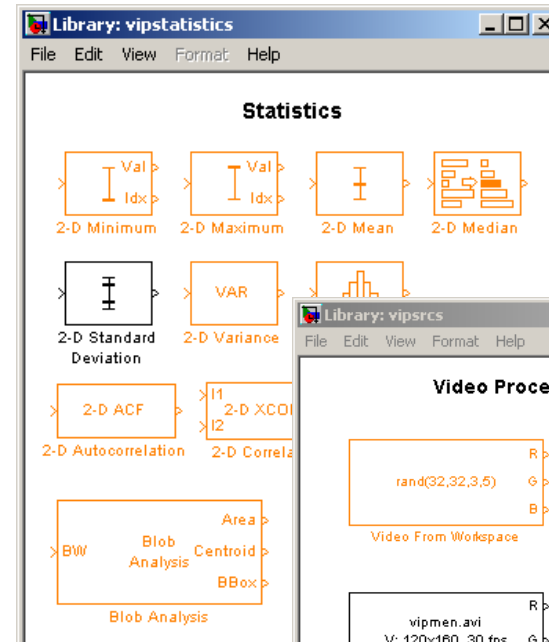
- Hierarchical, component-based modeling
- MATLAB® integration
- Extensive library of predefined blocks
- Application-specific libraries available
- Open Application Program Interface (API)



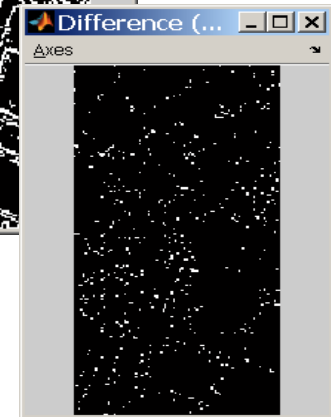
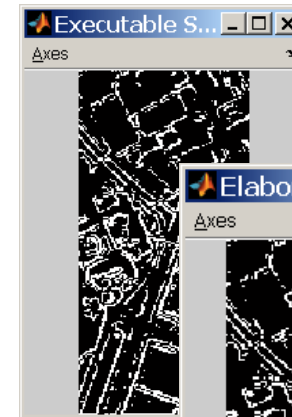
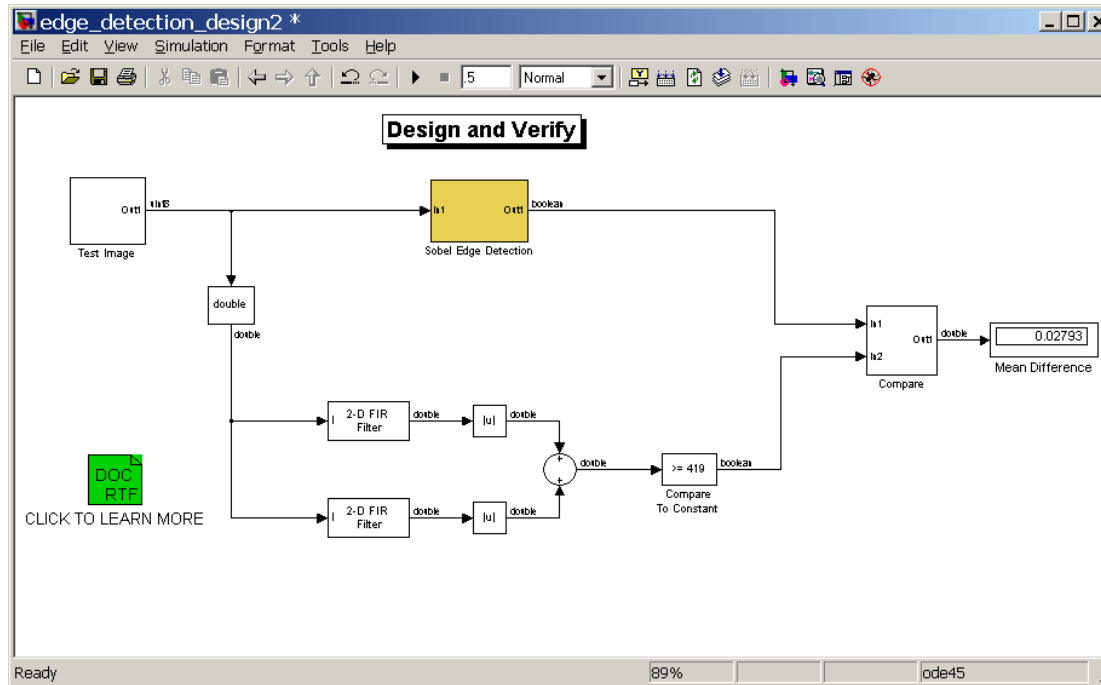
Simulink Libraries and Blocksets

Example: Video and Image Processing Blockset

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



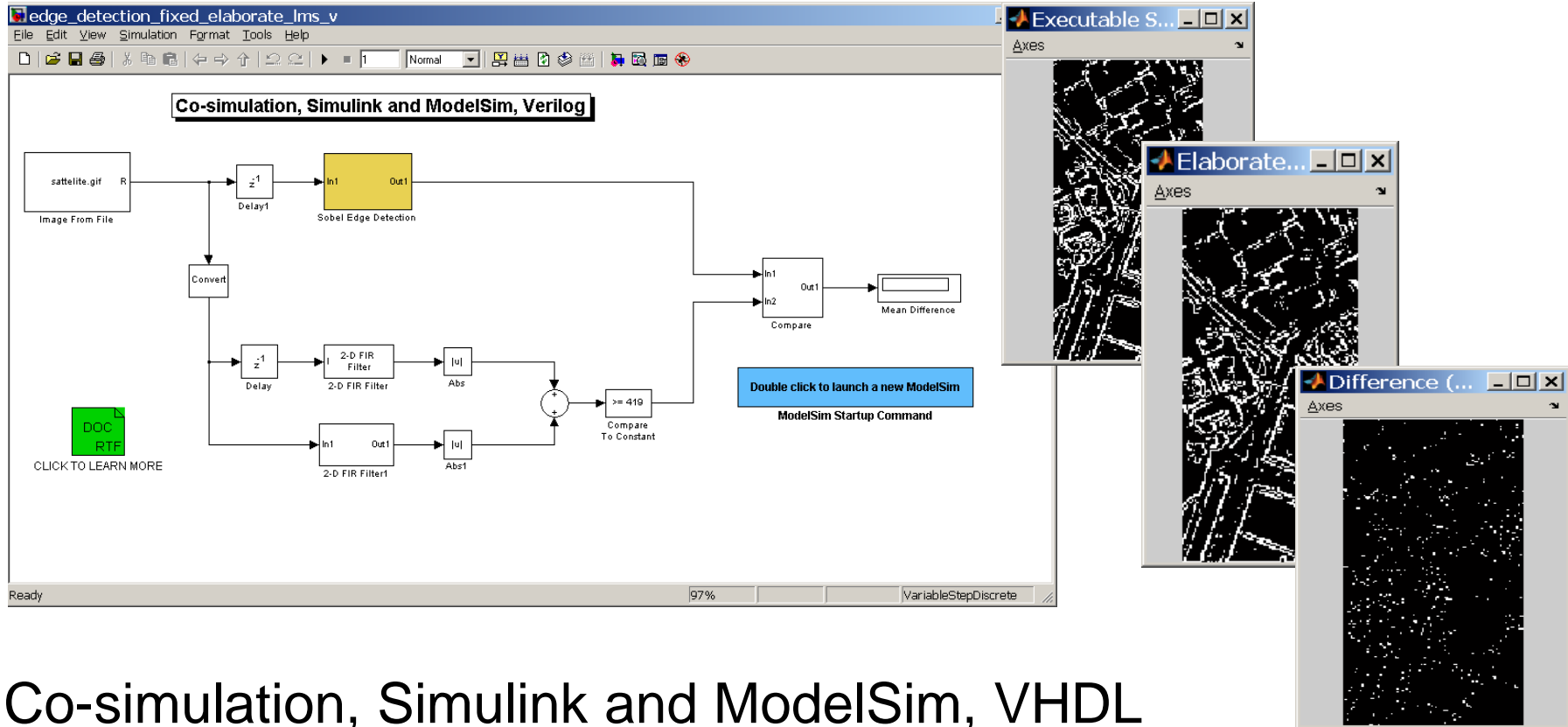
Modeling and Simulation w/Simulink



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

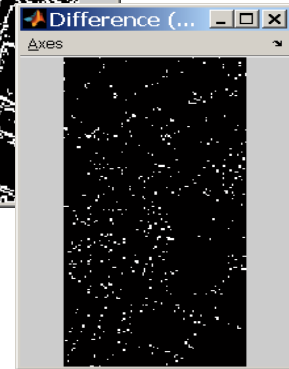
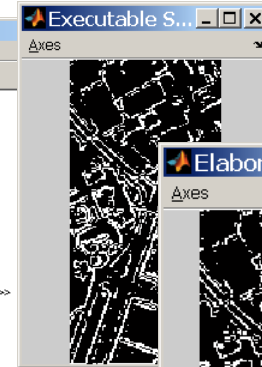
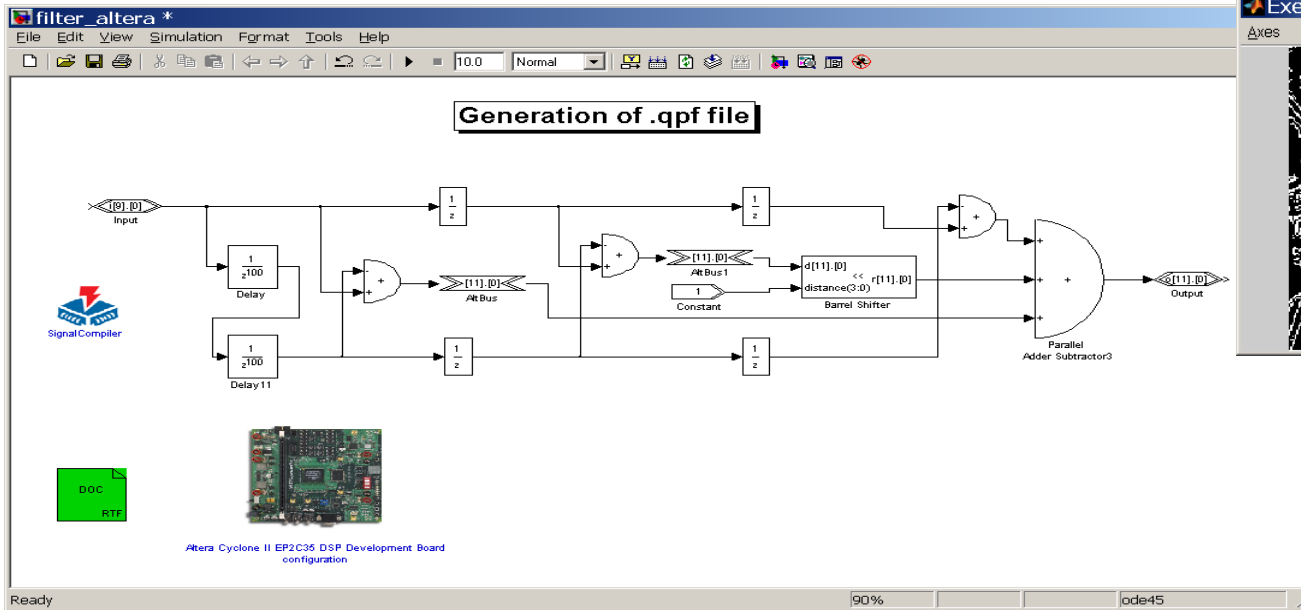
Live Demo

Co-Simulation (HDL code written manually)



Live Demo

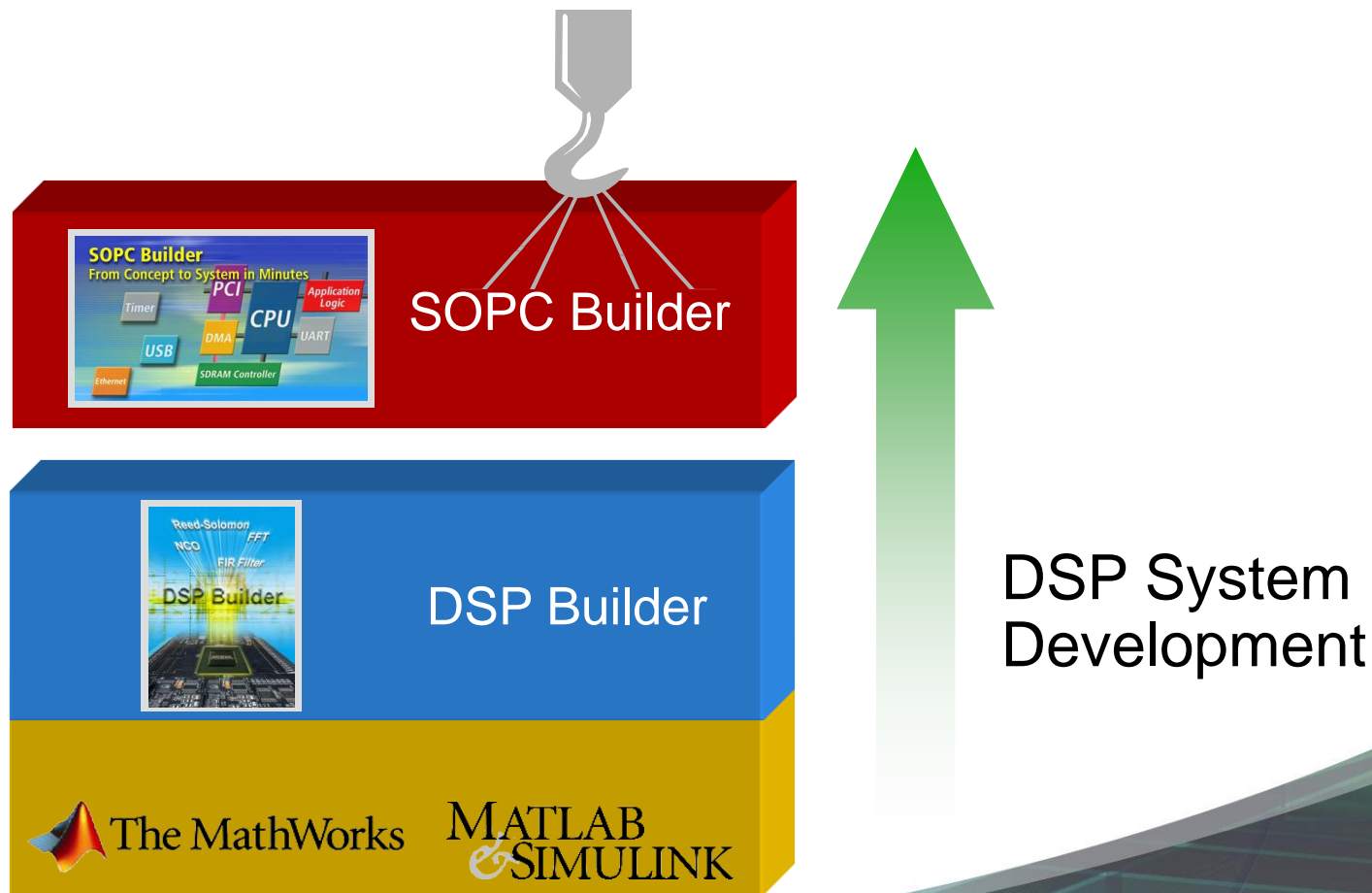
Automatic Code Generation and Continues Verification



- 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

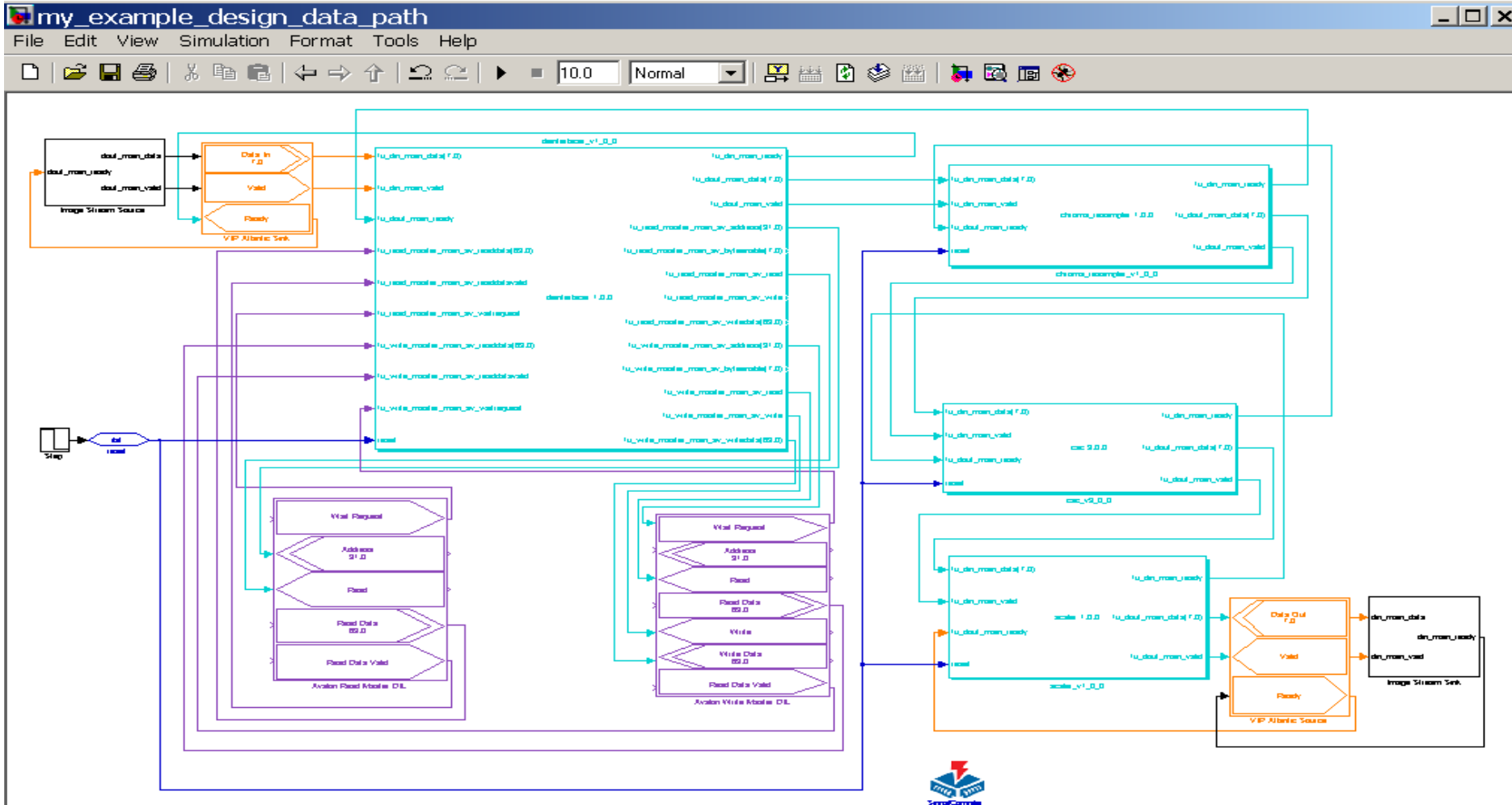


Future of Model-Based Design and next steps

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!