The MathWorks Today

Technical Computing and Model-Based Design

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Common Themes in Aerospace

- Time-to-market pressures, regulatory guidelines, risk management
- Increased functionality, more complexity, difficult implementation choices
- Distributed, multidisciplinary development teams
- Differentiation by innovation
Technical Computing Workflow
Research

- Data & Analysis
- Code & Development
- Hardware

System Design

- Environment
- Physical Components
- Algorithms

Implementation

Test

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Successful adoption of Model-Based Design in Aerospace and Defense

- **Lockheed Martin**
  - Flight control system for F-35 Joint Strike Fighter
  - Overall reduction in manhours/SLOC of ~40%

- **Honeywell**
  - Flight-control systems
  - Design times at Honeywell cut by 60%

- **BAE SYSTEMS**
  - Software-Defined Radio for satellite communications
  - Development time cut by 80%, Clocking and interfacing simplified

- **Flying-Cam**
  - Autonomous mini-helicopter controller
  - Development time reduced, error-free implementation

- **NASA Hyper-X**
  - Flight control software for X-43A scramjet vehicle
  - Development time reduced by months

- **Swedish Space Corporation**
  - Attitude and orbit control system for lunar satellite
  - System development reduced - 50%
Successful Adoption of Model-Based Design in Communications and Electronics

- Broadcom
  - UMTS processor development
  - Development time cut by half compared to C coding

- BridgeWave Communications
  - Building-to-building wireless Ethernet
  - Cut development time from eight months to five

- Realtek
  - Audio processing codec chip
  - Reported higher return on investment

- Yokogawa Electric
  - Optical network components
  - 50% improvement in development time
  - Coding errors fixed before hardware testing
Key Technology Investment Areas

- Embedded MATLAB
- Multidomain Modeling and Simulation
- Video and Image Processing
- Verification and Validation
- Flight Code Generation
- HDL
- Distributed Computing
Embedded Algorithm Development
Embedded MATLAB

- Embedded Subset of MATLAB Language
- Floating and fixed-point
- Brings MATLAB algorithms into Simulink and Stateflow models
- C code generation with Real-Time Workshop
Physical Modeling
Introduction to Simscape

- Extension of Simulink® designed to model multidomain physical systems

- Eases process of modeling physical systems
  - Does not require deriving and programming the equations of motion for the system

- Used by system engineers and control engineers to build a model representing the physical structure of the system

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Verification & Validation

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Simulink Design Verifier

- Test Generation

- Property Proving

Simulink and Stateflow models

Simulink and Stateflow models augmented with design properties

Model Harness with test cases

Analysis Report

Detailed report and violations
Research

System Design

Implementation

Continuous V&V

Test harness

--- Dynamic system models ---

Test vectors

Expected outputs

Algorithms

Test harness

--- Dynamic system models ---

Test vectors

Expected outputs

Digital Electronics

HDL (HDL, Verilog)

C, C++

MCU, DSP

FPGA, ASIC

Test environments (T&M, HIL)
Research

System Design

Implementation

Continuous V&V

Requirements

Test harness

----- Dynamic system models -------

Test vectors

Expected outputs

Algorithms

Generate

Generate

Embedded Software

C, C++

Digital Electronics

HDL (VHDL, Verilog)

MCU  DSP  FPGA  ASIC

Test harness

-- Dynamic system models ---

Test vectors

Expected outputs

Device Under Test

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Verify Hardware and Embedded Software Implementation using Links

- Reuse test sequences
- Reuse model as testbench
- Cosimulate implemented component

<table>
<thead>
<tr>
<th>Embedded Software</th>
<th>Digital Hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td>TI Code Composer Studio</td>
<td></td>
</tr>
<tr>
<td>Analog Devices VisualDSP++</td>
<td></td>
</tr>
<tr>
<td>Altium TASKING</td>
<td></td>
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<tr>
<td>xPC Target</td>
<td></td>
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<tr>
<td>Cadence® Incisive®</td>
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<tr>
<td>Mentor Graphics ModelSim</td>
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</tbody>
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Improved Product Development and Delivery Processes

- Quality focus
  - Continuous product improvement
  - Fine-tuned development processes

- Twice-yearly releases
  - 2006
    - March  R2006a
    - September  R2006b
  - 2007
    - March  R2007a

- Timely delivery
  - More vehicles to address customer input
  - Predictable release schedule
How can I participate in the MATLAB and Simulink community?

Use this conference to network

- Talk to MathWorks staff (badges or blue shirts)
  - Ask about the products and their uses
  - Tell us your requirements – we’re here to talk to you!
- Meet people from other organizations
  - What are they doing with MathWorks products?
- Visit the exhibit hall
  - Get a demo
  - Learn from our partners