# MATLAB EXPO 2017

Simulink as Your Enterprise Simulation Platform

Dr. Mohamed Anas



# **Simulink as an Enterprise Simulation Platform**

# Simulating Spacecraft Communications for Deep-Space Missions

Dr. Deepak Mishra, Scientist/Engineer (SF)

Indian Space Research Organization



# Challenge

- Integrating large multi-faceted project
- Simulation at multiple stages and in multiple domains to explore the problem
   Solution
- Leverage Simulink as a platform

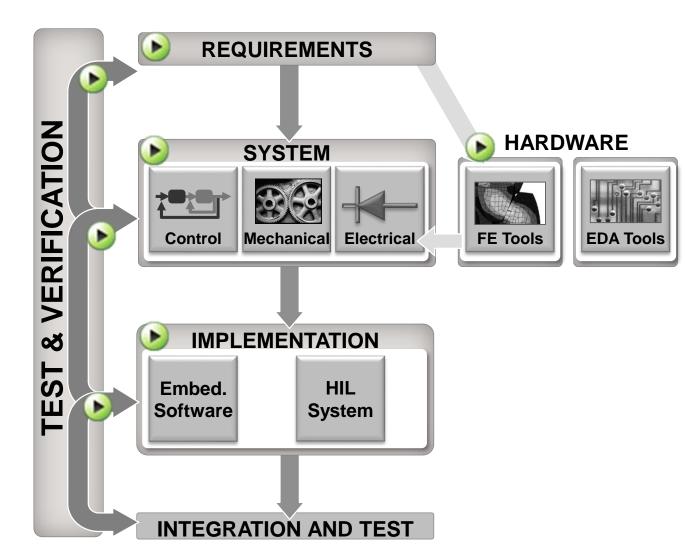


# **Enterprise Simulation Platform**

- Enterprise Any size business or project
- Simulation Evaluating system behavior through computation
- Platform Scalable environment for multi-disciplinary collaboration

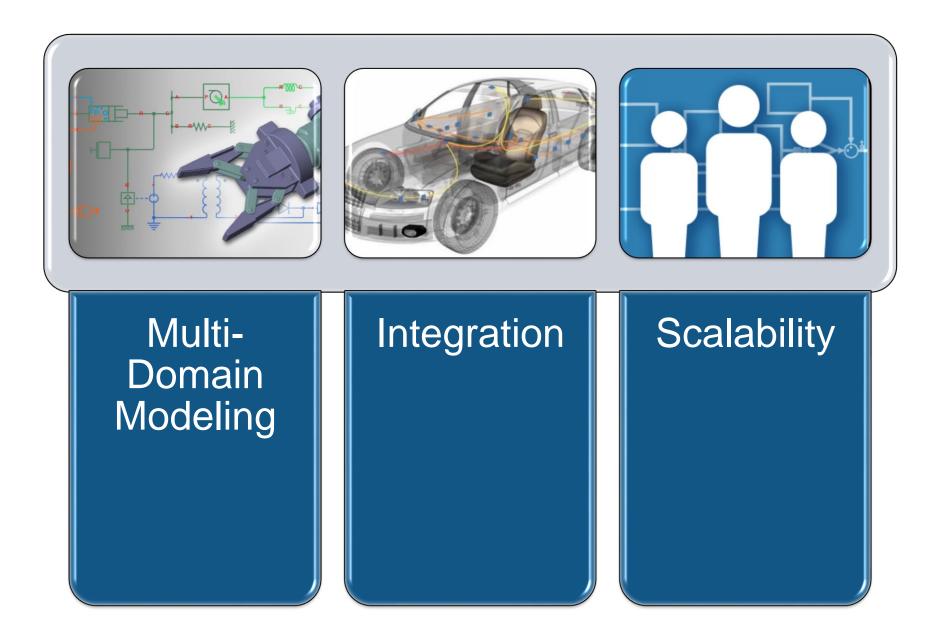


#### **Model Based Design**



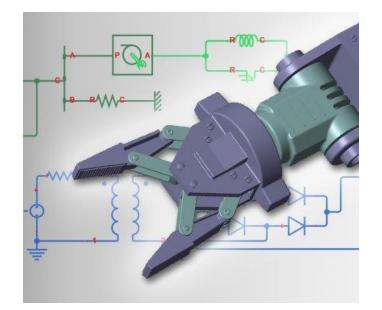


# **Enterprise Simulation Platform Enablers**





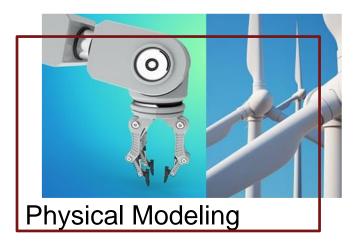
# **Multi-Domain Modeling**

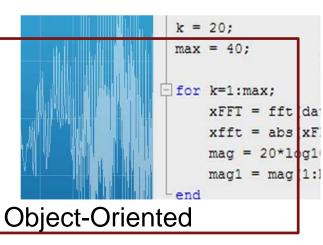




# **Multi-Domain Modeling in Simulink**





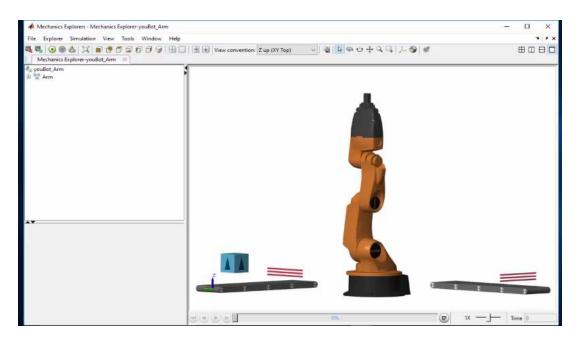


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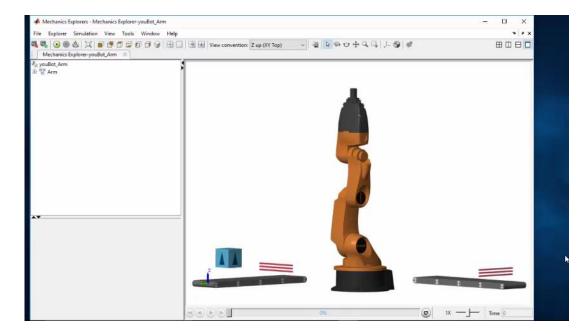


# **Robot Arm Multi-Domain Simulation**

#### Without Network Model

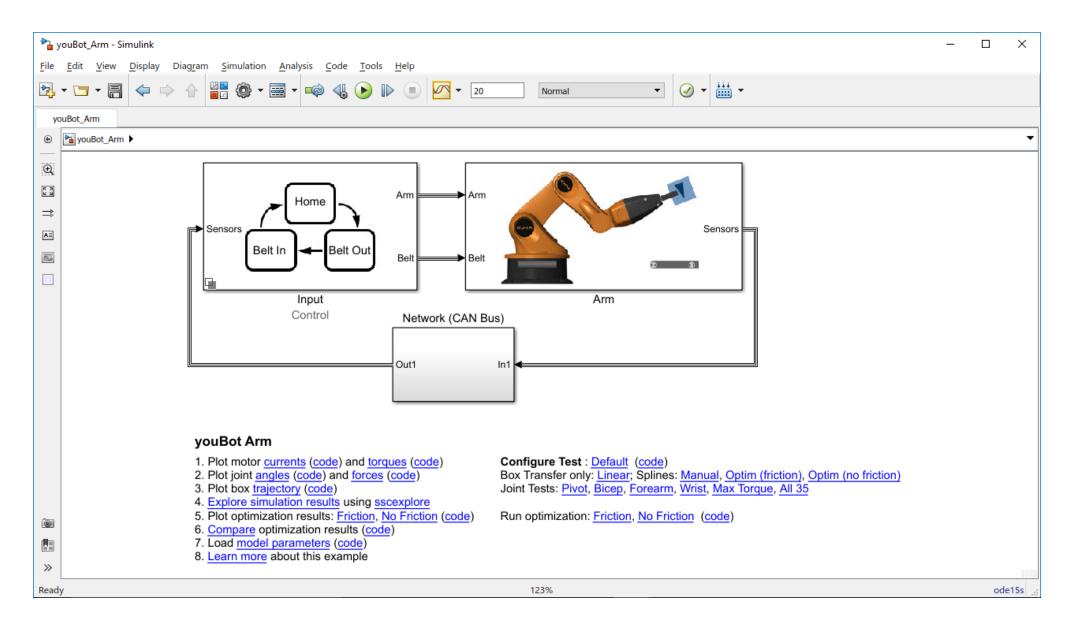


#### With Network Model



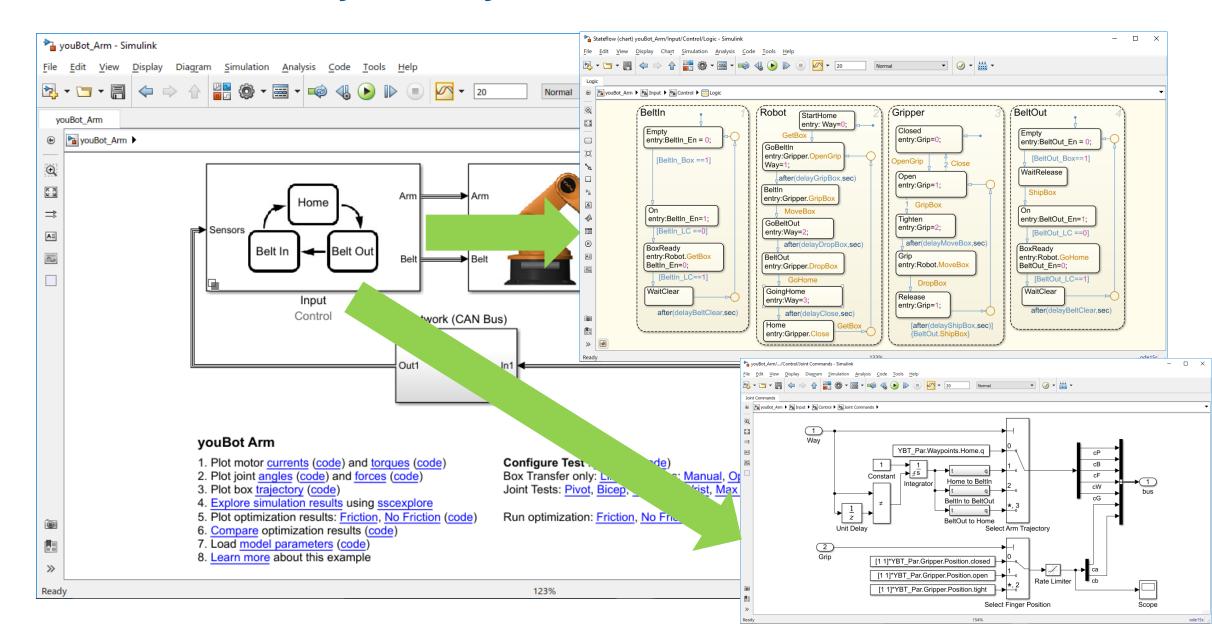


# **Multi-Domain Model**



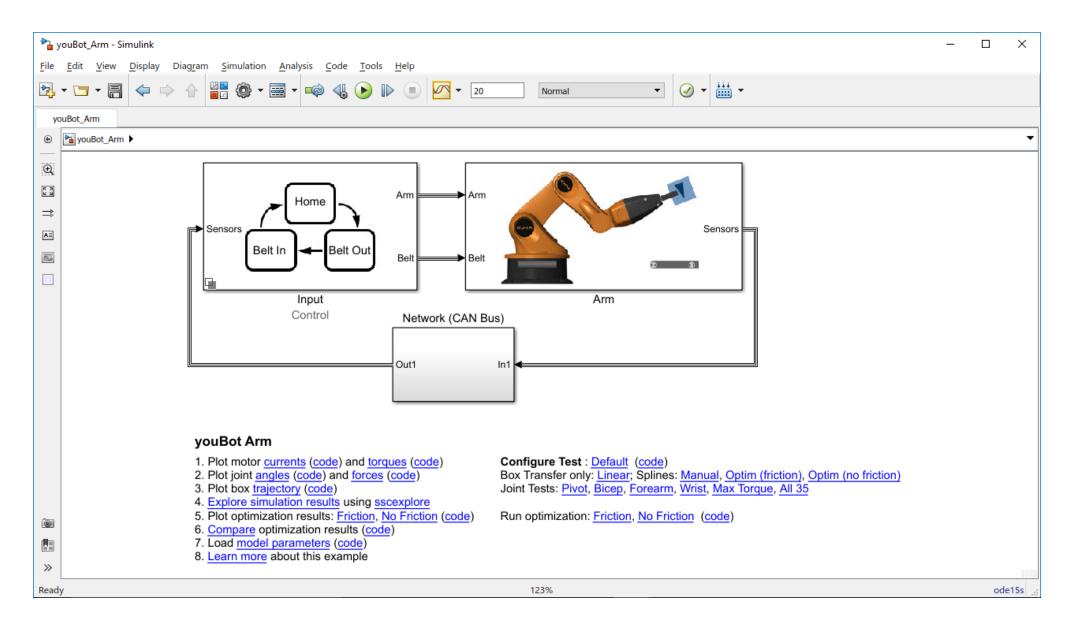


## **State Charts and System Dynamics**



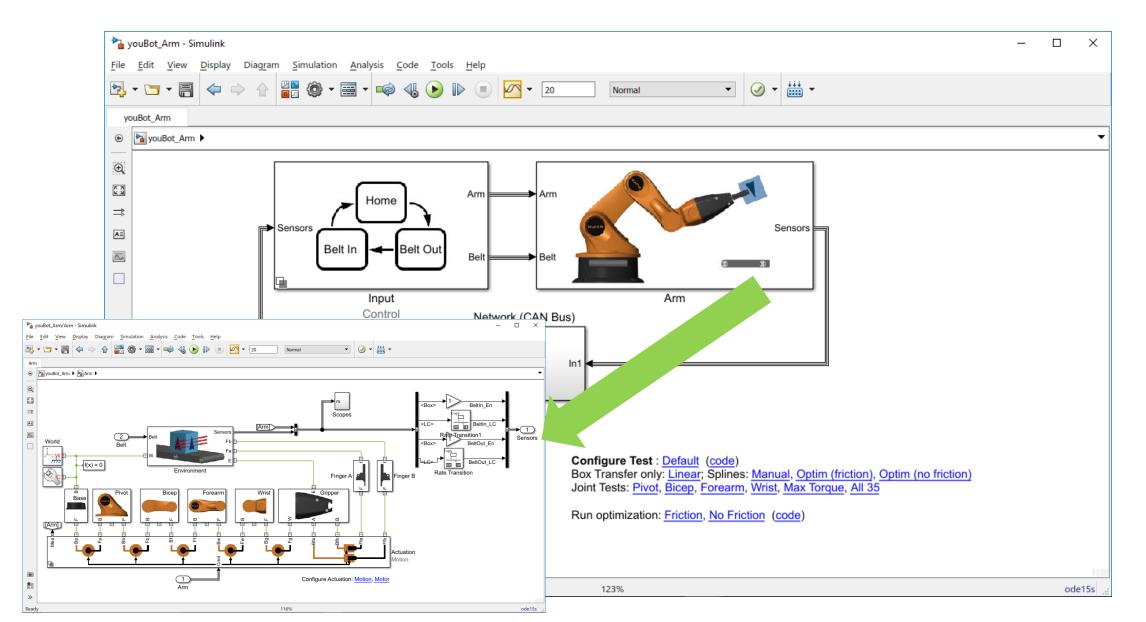


# **Multi-Domain Model**





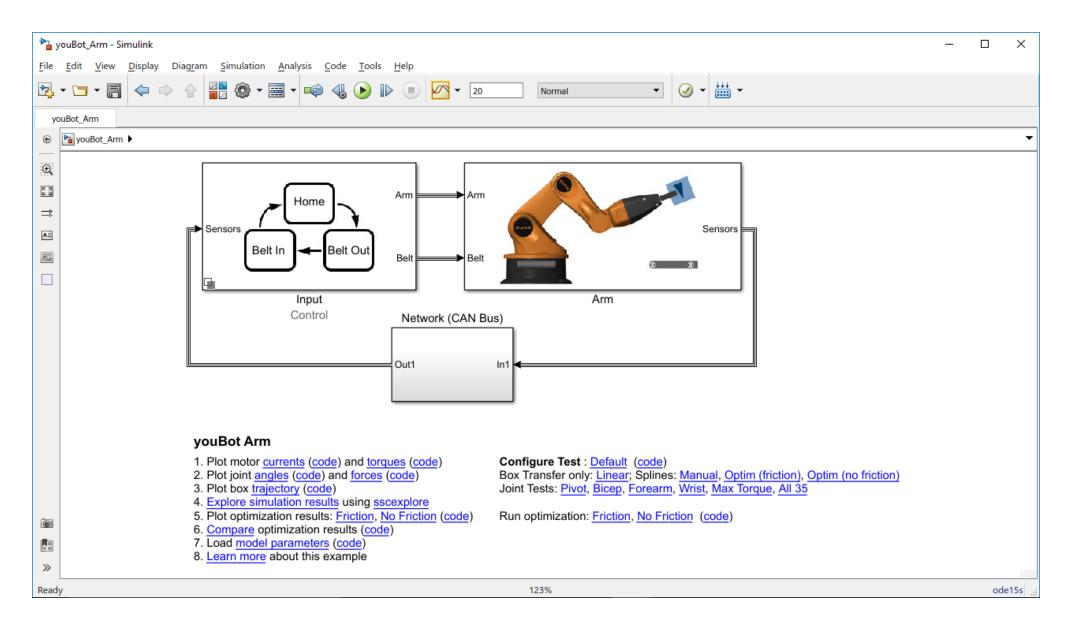
# **Physical Modeling**



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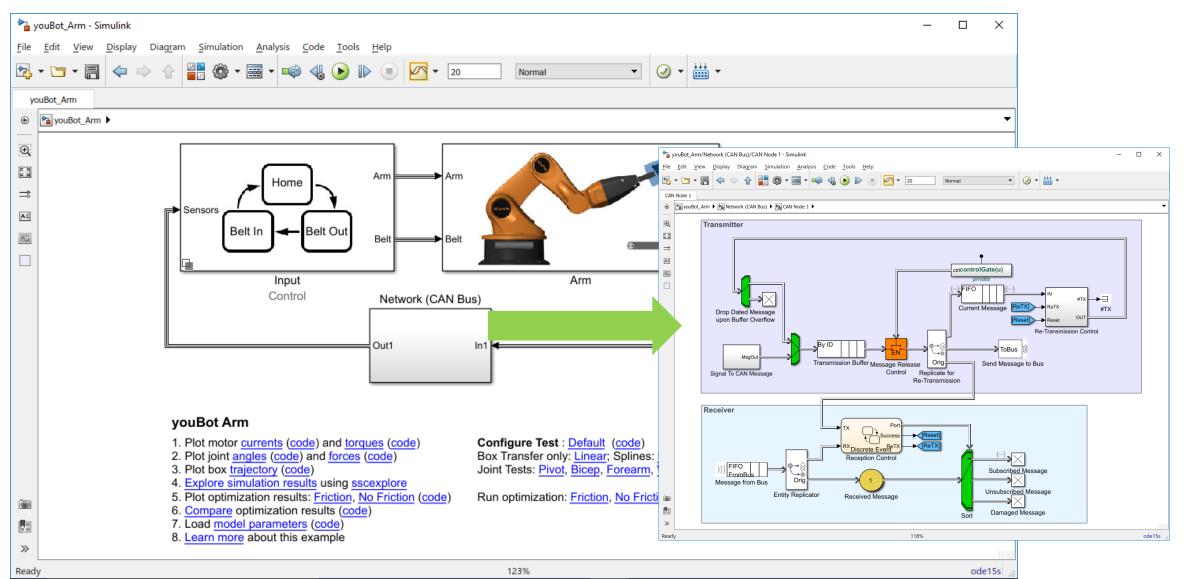


# **Multi-Domain Model**





# **Discrete-Event Modeling**



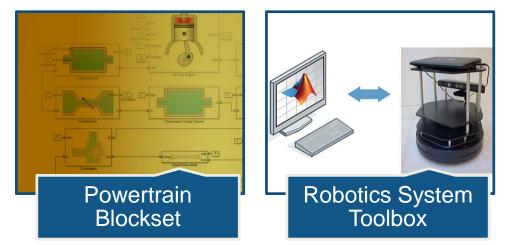
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# **Domain-Specific Blocksets and Toolboxes**

• Simulink has numerous domain-specific tools, for example:





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# **Customer Success in Multidomain Modeling**

# ABB, Deltamarin, and VTT Simulate and Optimize Ship Energy Flows

### Challenge

Increase the energy efficiency of large vessels

### Solution

Use Simulink and Simscape to model, simulate, and optimize ship energy flow

### Results

- Cost- and fuel-saving design improvements
- Testing costs reduced by tens of thousands of euros





# **Customer Success in Multidomain Modeling**

"Simulink and Simscape enabled us to create a dynamic model of a complex energy system that spans several physical domains. By simulating this model, we can see how a new energy subsystem will perform before it is built, and provide customers with an accurate estimate of their return on investment."

Juha Orivuori, ABB



#### Solution

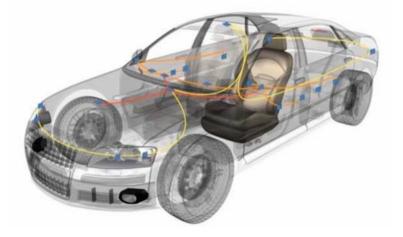
Use Simulink and Simscape to model, simulate, and optimize ship energy flow

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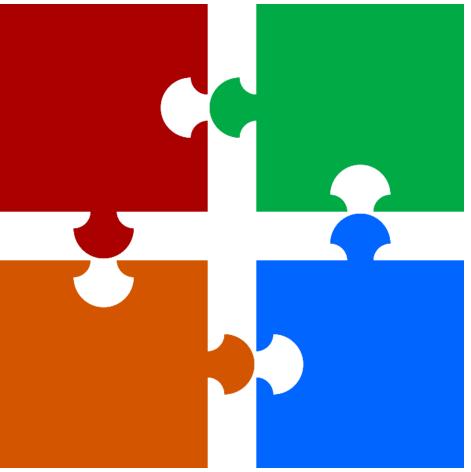
# **Simulation Integration**





# **Disconnected Component Intellectual Property (IP)**

Your IP exists in many forms and in many locations, making integration difficult

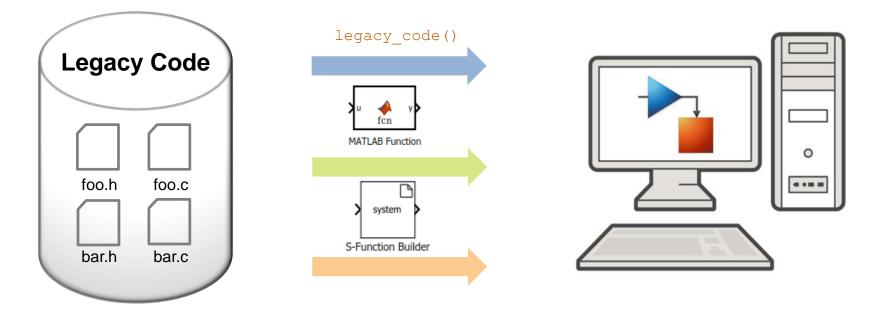


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# **Integrating Your Code**

• Multiple ways to reuse your legacy code with Simulink

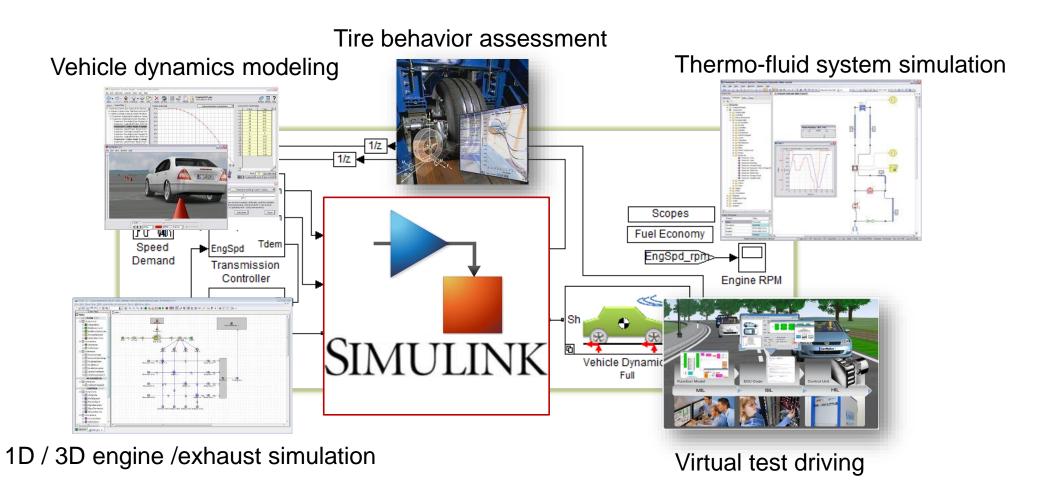


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# **Integrating Third-Party Simulation Tools**

### Mature and extensive APIs for third-party tool integration





### **Partner Ecosystem**

Numerous partners provide interface to Simulink

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# **Customer Success in Simulation Integration**

Develop Integrated Vehicle Safety Applications Siddharth D'Silva, Principal Engineer Autoliv



## Challenge

Design and validate safety-critical algorithms before implementation

# Solution

Leverage Simulink as a platform by integrating third-party software



# **Customer Success in Simulation Integration**

"Seamless integration with third party software solutions enables rigorous development in a safe environment. For application engineers or system engineers, it is very useful that you can export these complex third-party tool functionalities in the form of S-functions and run co-simulation."

Siddharth D'Silva, Autoliv



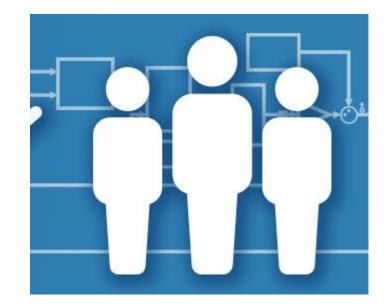
#### **Results**

- Industry first integration of stability control inertial sensor into airbag control unit
- Restraint control module software development time reduced by 30%

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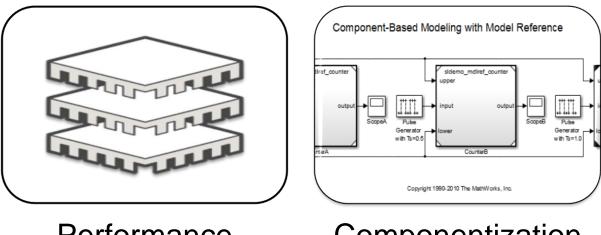


# **Scalability**



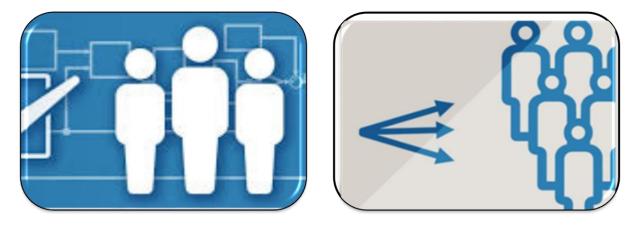


# **Scalability Challenges**



Performance





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Team Workflows

Sharing



# **Performance Scalability**

Easy scalability to multicore or cluster/cloud computation environment

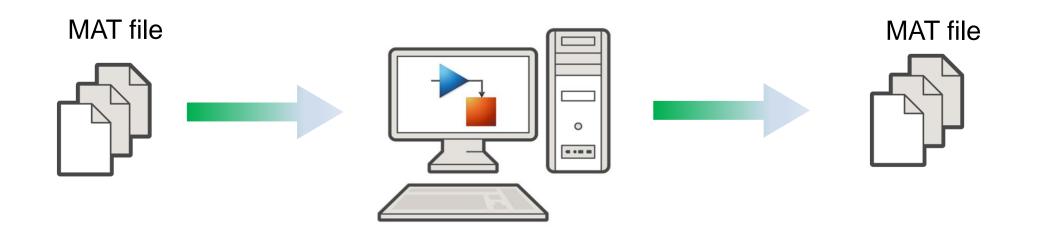
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Performance



# **Performance Scalability**

- Big data workflow
  - Processing large amount of simulation inputs / outputs

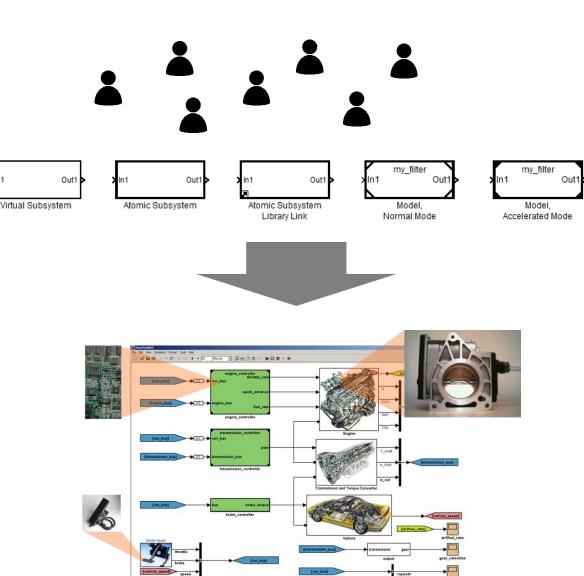




# **Complex Design Development through Componentization**

- Supporting team workflows
  - Faster modular development
  - More effective verification
  - Increased reusability
- Improving performance
  - Incremental loading and code generation
  - Simulation speed
  - Memory usage

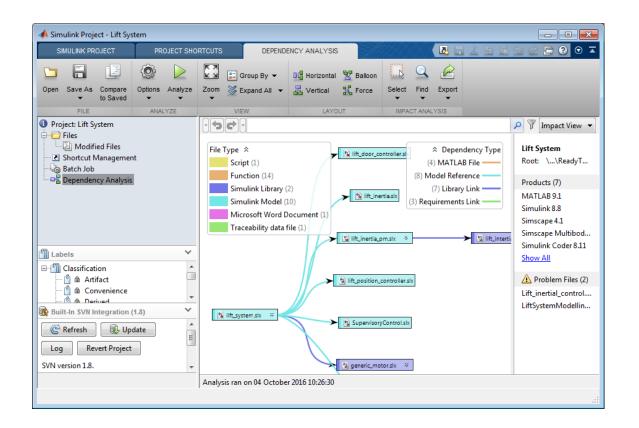
#### Componentization





# **Capabilities Enabling Team Workflows**

- Source control
- Design comparison and merging
- Dependency analysis
- Task automation





# **Source Control Integrations**

 Microsoft Team Foundation Server (TFS) integration available now from MathWorks File Exchange







Team Workflows



# **Integrating Work from Different Engineers via Merge**

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#### Team Workflows



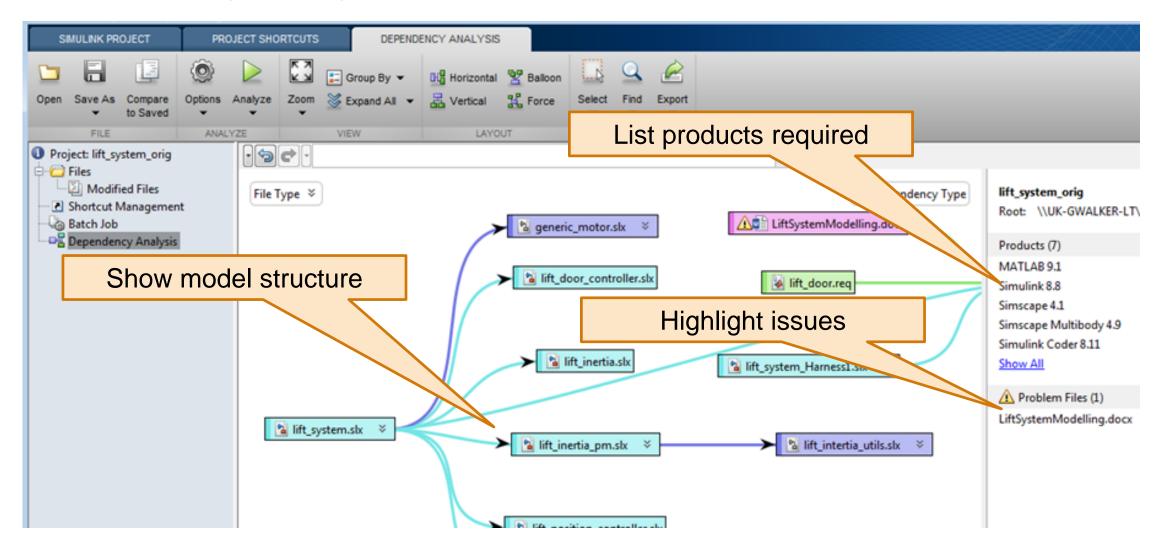
# **Dependency Analysis – Modular Development**

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# **Dependency Analysis – Modular Development**





# **Task Automation – Configuring Project Environment**

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- Robustly configure the team environment
- For everyone
- Automatically

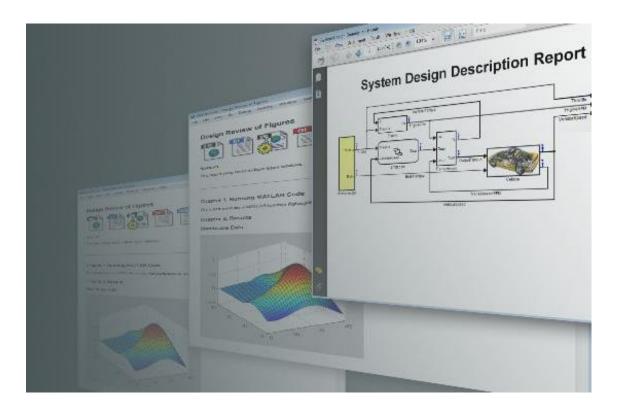


# **Sharing Outside Your Team**



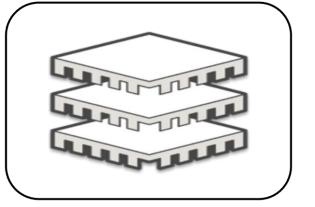
#### Model Protection (IP Management)

# Reporting and Documentation

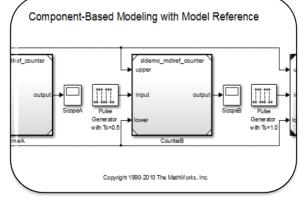




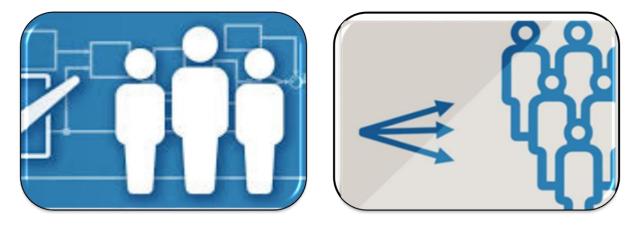
# **Simulink Addressing Scalability Challenges**



Performance



Componentization



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Team Workflows



# **Simulink as Enterprise Simulation Platform**

"There is no such tool, which gives the simulation environment as well as the hardware verification and validation. In a single environment, I am getting these together. **That is why I use MATLAB and Simulink.**"

Dr. Deepak Mishra, Indian Space Research Organization

