



MEI PROPRIETARY

# Automated Generation Of Code From Simulink To An Event-Based Simulation Framework

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Millennium Engineering And Integration

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# Simulation Environments Used By MEI

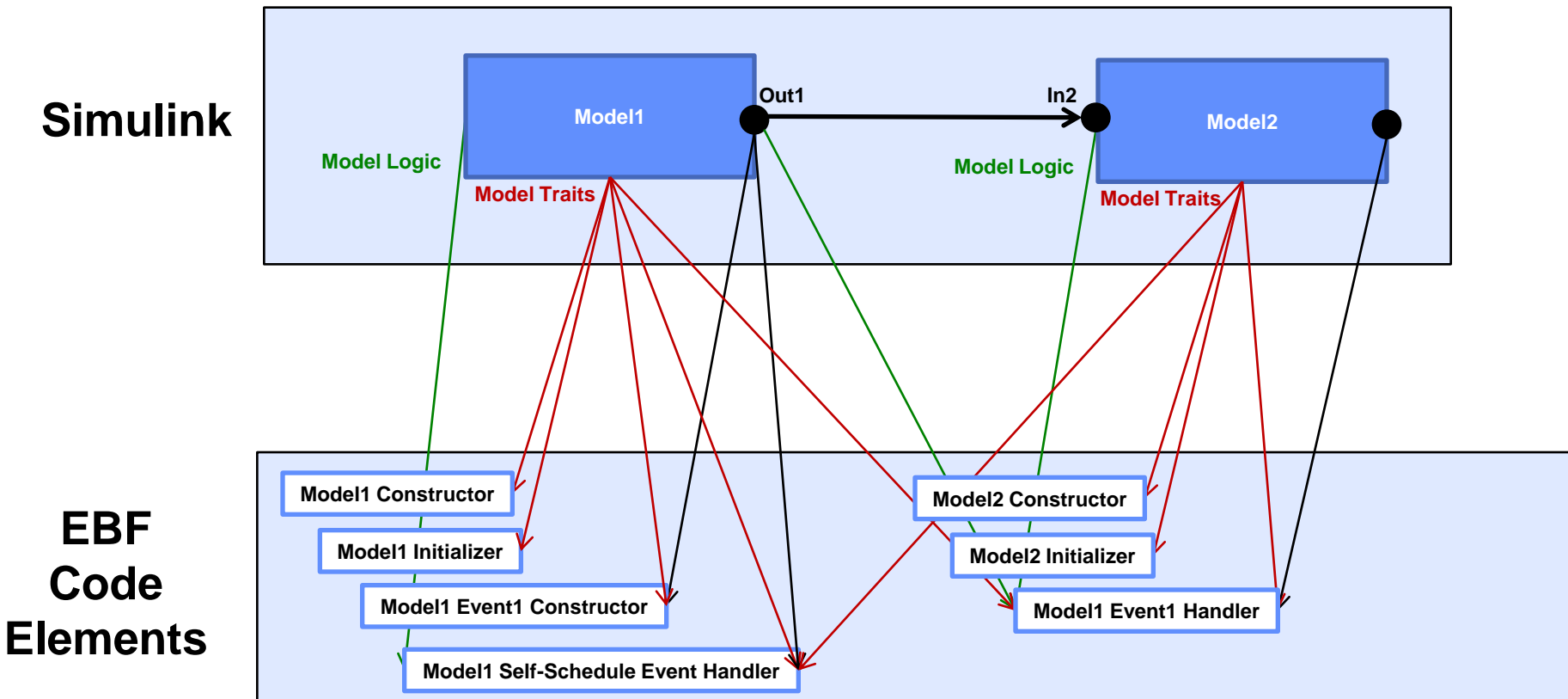
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- **Simulink**
  - **Dynamic System Modeling/Simulations**
  - **Graphical Block-Diagramming Tool**
  - **Tightly Integrated With Matlab Command Library**
  - **Means To Generate Time-Driven Code**
- **Event-based Framework (EBF)**
  - **Discrete Event Messaging**
  - **Models created with compiled code**
  - **Componentized Simulation Layers**
    - **Middleware, Controller Layers**
    - **User Components; Simulation Engine & Model Layers**

**Benefit Derived From Porting Simulink-Developed Models  
Into EBF Simulations**



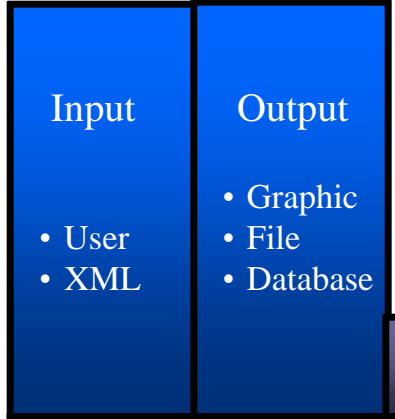
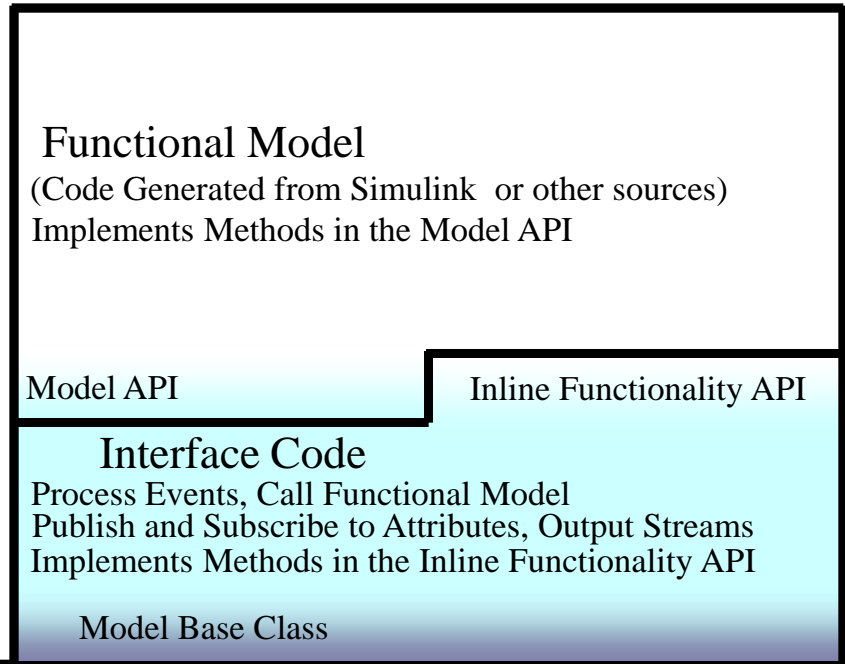
# Required Information Flow From Simulink To EBF During Code Generation





# Time-consuming Manual Approach Initially Used

- Functional model code generated from Simulink
- Other components hand-written





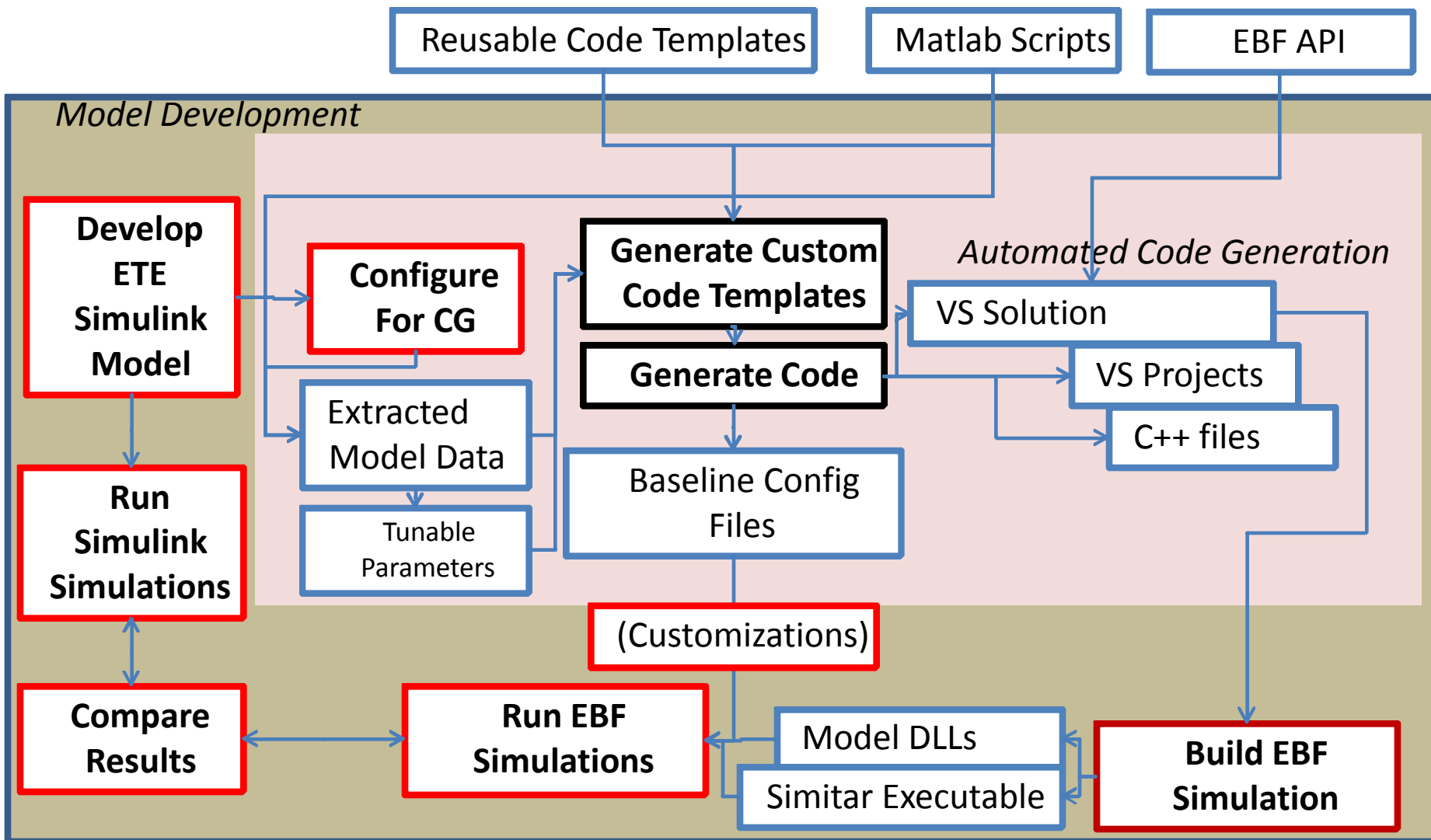
## Tasks For Automation

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- **Extract Information About Targeted Models And Their I/O**
- **Store Information In A .MAT file**
- **Generate Functional Model Code From Simulink Using Standard Templates**
- **Generate Additional Interface Code Using Custom Code Templates**
  - **Model classes, including Event Handling Methods**
  - **Attribute classes**
  - **Event classes**
- **Generate Makefile Or Visual Studio Projects/Solution**
- **Compile & Build EBF code**
- **Generate Prototype Run-Time Configuration Files**
  - **Incorporate Simulink Tunable Parameters**



# Automated EBF Code Generation Implemented





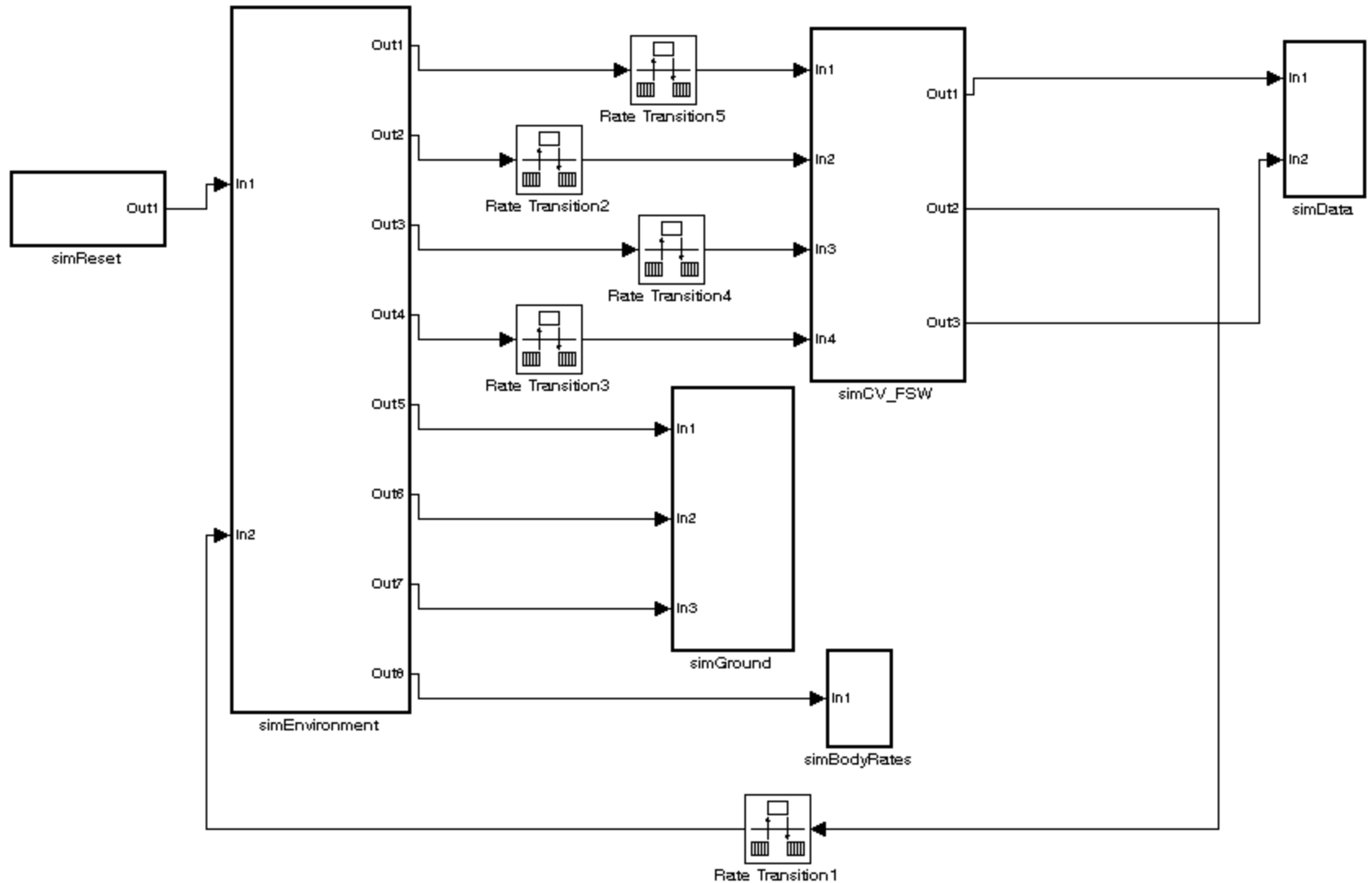
## Testing Performed To Verify Fidelity Of Generated Code

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- **4 Synthetic Test Cases**
  - varied I/O schemes
  - varied feedback schemes
  - multiple rates
- **4 Simulink Models Developed In-House or By MEI Partners**
  - Representation of Sensors, Association, State Estimation, Control, Actuators, and Flight Dynamics
- **Output data from Simulink & EBF Simulations Compared**



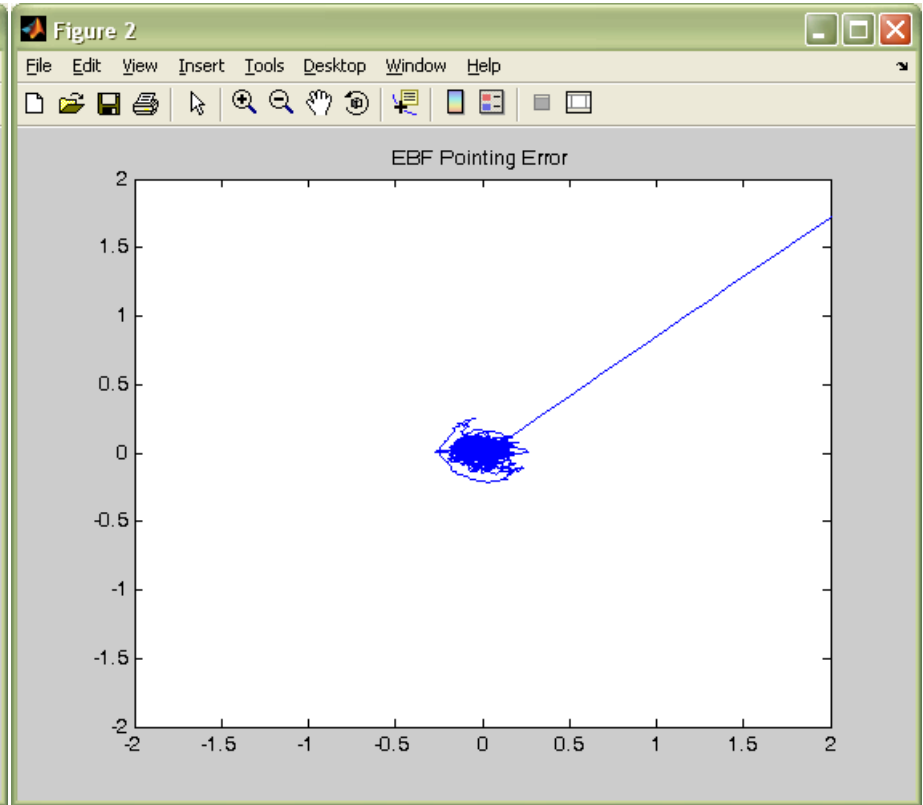
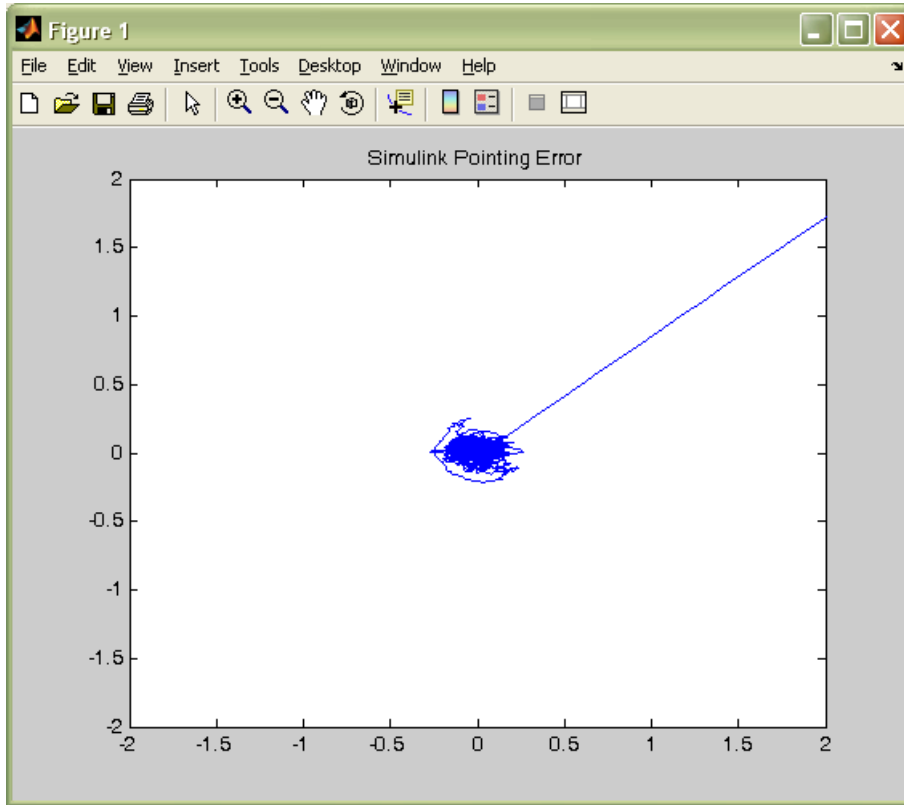
# Example Scenario Targeted For Code Generation





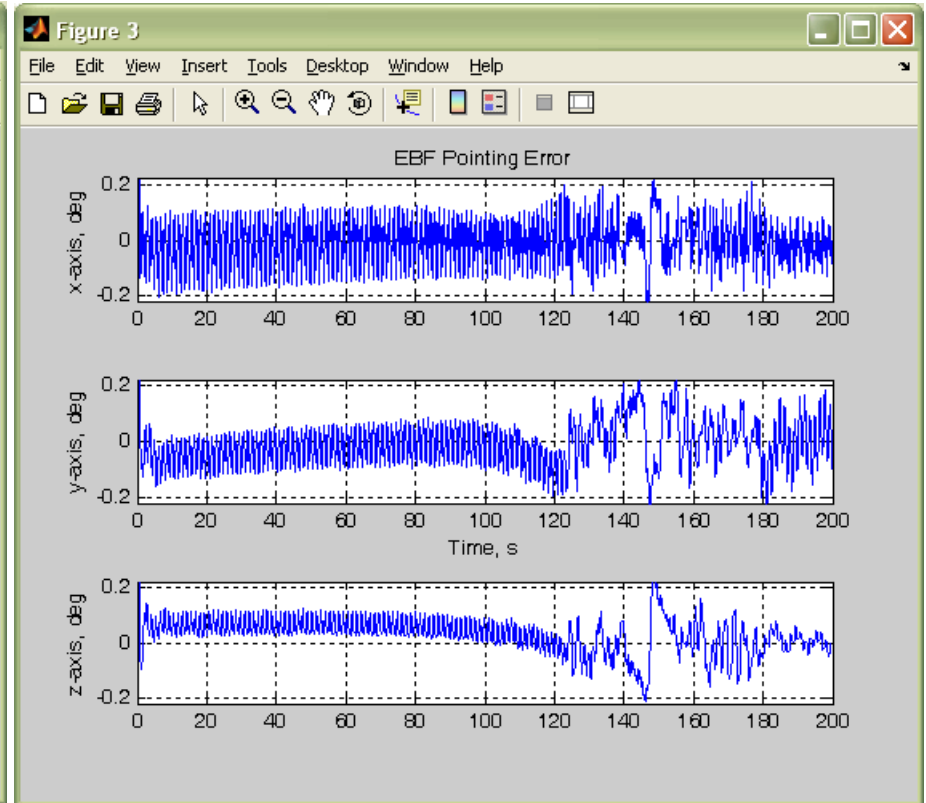
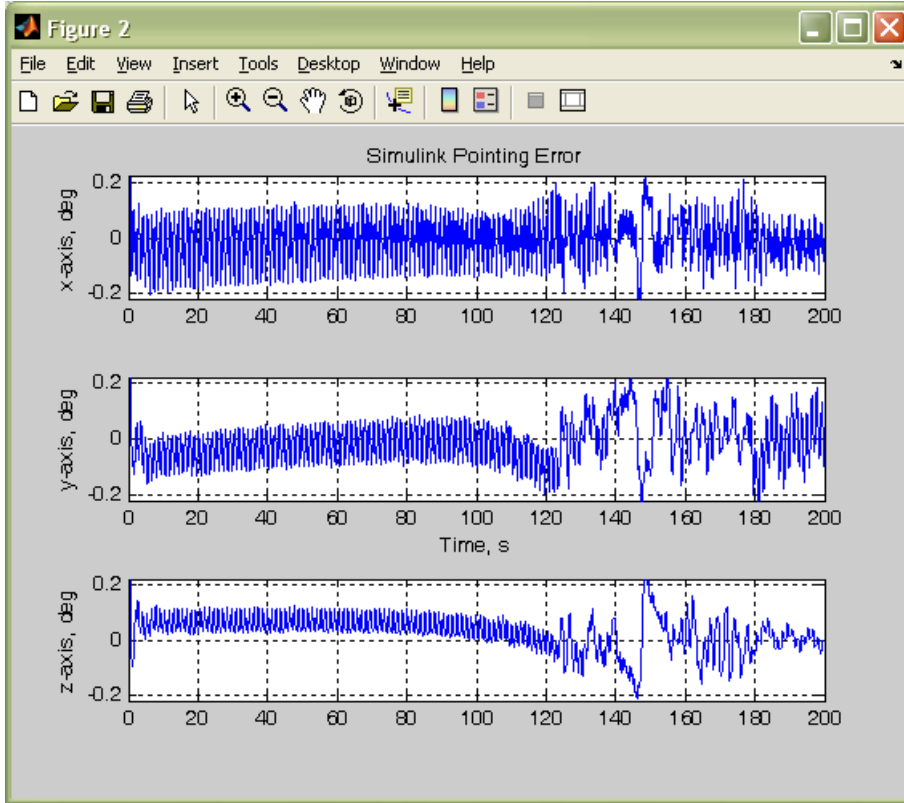


# Example Parameter Compared: Pointing Error



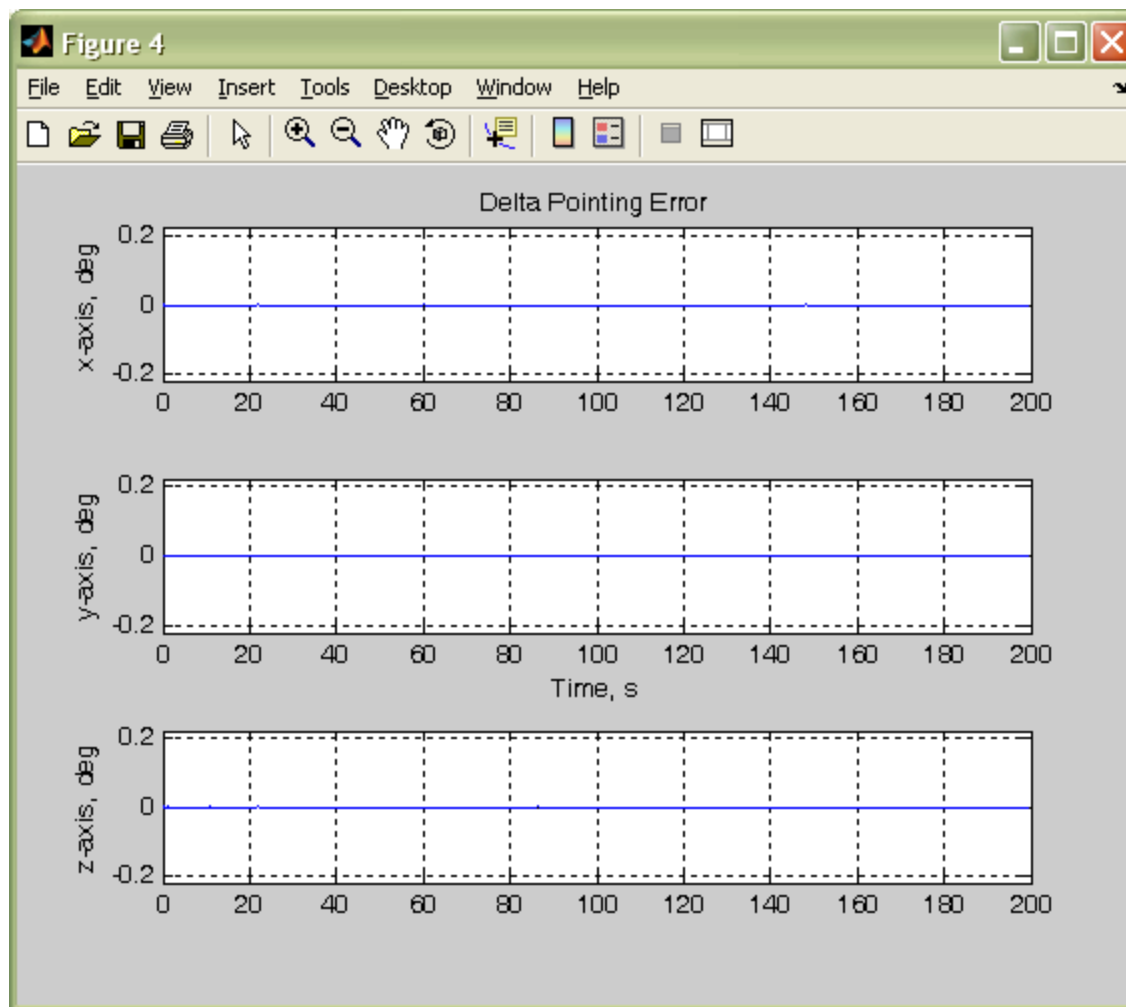


# Pointing Error Time Plots Compared





# Pointing Errors Compare Well





## Summary

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- **Customized scripts and templates used to generate EBF scenario**
  - Inputs/Outputs Characterized and Adapted
  - Model Traits Captured And Incorporated
- **Templates Structured With EBF-Specific Code**
  - Model, Event, Attribute Classes
  - Model Initialization and Event Handling Methods
  - Communication, Event Scheduling, Data Handling
- **Code Generation Interface Tested and Validated With Several Scenarios**