采用Simscape为HIL测试快速建立系统模型

杨兴 amy.yang@mathworks.cn
应用工程师
迈斯沃克
Simulating plant and controller in one environment allows you to optimize system-level performance.

- Automate tuning process using optimization algorithms
- Accelerate process using parallel computing
Detect Integration Issues Earlier

- Controls engineers and domain specialists can work together to detect integration issues in simulation
  - Convert plant models to C code for hardware-in-the-loop tests
  - Distribute models to other internal users without extra licenses
  - Distribute models to external users while protecting IP
Build Accurate Models Quickly

- Requires less domain knowledge and programming effort than traditional methods
  - Spend more time developing, less time modeling
Physical Systems in Simulink

- **Simscape**
  - Mechanical
  - Hydraulic
  - Electrical
  - Thermal
  - Liquid
  - Pneumatic
  - Magnetic
  - Custom Domains via Simscape Language

- **Multidomain physical systems**

- **Electrical power systems**

- **Multibody mechanics (3-D)**

- **Fluid power and control**

- **Mechanical systems (1-D)**

- **Electromechanical and electronic systems**

- **SimPowerSystems**
- **SimMechanics**
- **SimHydraulics**
- **SimDriveline**
- **SimElectronics**

MATLAB, Simulink

MathWorks®
Accelerate control design and system-level analysis with physical system models

- Modeling Multidomain Physical Systems
- Simulating the Entire System in a Single Environment
- Deploying Models to Teams, Departments, or Companies
Modeling Multidomain Physical Systems

MODEL
- Import
- Create
- Integrate

SIMULATE
- Configure
- Test
- Analyze and Document
- Optimize

DEPLOY
- Test Controller
- Integrate Into Other Environments
- Share Models
Using SimMechanics Link, you can automatically create a SimMechanics model from a CAD assembly.
Create and Reuse Intuitive System-Level Models

Model your physical system as a physical network that reflects the structure of the actual system.
Extending an Existing Simscape Library

Simscape Language For Modeling Custom Components

MODEL

Import
Create
Integrate

equations
\[ \begin{align*}
  w &= r.w - c.w; \\
  t &= k \cdot \theta \cdot \theta \cdot \text{sign}(\theta); \\
  w &= \theta.\text{der}; \\
\end{align*} \]
end

Torque = \(-k\theta^2\)
Angular Velocity = \(\frac{d\theta}{dt}\)
Integrate the Physical System and Controller in a Single Environment

Modeling the controller and plant in a single environment results in optimized designs and eliminates the need for cosimulation.
Simulating the Entire System in a Single Environment

MODEL
- Import
- Create
- Integrate

SIMULATE
- Test
- Configure
- Optimize
- Analyze and Document

DEPLOY
- Test Controller
- Integrate Into Other Environments
- Share Models

Simulating the Entire System in a Single Environment
Configure the Model to Balance Model Fidelity and Simulation Speed

Configure your model to balance simulation speed and model fidelity.
Test Your System Efficiently

Running simulations in parallel speeds up your testing process.

Model using Simscape and add-on products
Automate the design process using scripts written in MATLAB and automatically generated reports from the Simulink Report Generator.
SIMULATE

Test

Configure

Analyze and Document

Optimize

Tradeoff studies and optimization algorithms enables finding the design that optimizes system-level performance.
Deploying Models to Teams, Departments, or Companies
Test Controller Using Hardware in the Loop Before Connecting to Prototypes

Hardware-in-the-loop (HIL) testing reduces dependence on expensive prototypes

DEPLOY

Test Controller
Integrate Into Other Environments
Share Models

Processor in the Loop (PIL)
Hardware in the Loop (HIL)
Integrate Your Models into Other Simulation Environments

DEPLOY
- Test Controller
- Integrate Into Other Environments
- Share Models

Model using Simscape and add-on products

C Code

Hardware-in-the-Loop Simulators

Standalone Executable

Other Simulation Environments

Deploy the model as C code to other simulation environments, or use it as a standalone executable
Share Models and Protect Intellectual Property

Share models, and protect when necessary to avoid exposing intellectual property.

DEPLOY

Test Controller

Integrate Into Other Environments

Share Models

Model Developer
Simscape license
Add-on product license

Model using Simscape and add-on products

Model Users
Simscape license
Add-on product installed,
No add-on license required

Protected Model
Use Your Simulation Tool For All Phases of Development

- Modeling Multidomain Physical Systems
- Simulating the Entire System in a Single Environment
- Deploying Models to Teams, Departments, or Companies
Summary

- Create accurate, reusable plant models quickly and easily
- Optimize system performance
  - Develop in a single environment
  - No cosimulation
- Find problems before building hardware using HIL
采用Simscape为HIL测试
快速建立系统模型

杨兴 amy.yang@mathworks.cn
应用工程师
迈斯沃克