



广汽研究院
GAC R&D CENTER

Simulink在智驾软件开发效率提升中的作用

付振元, 广汽研究院



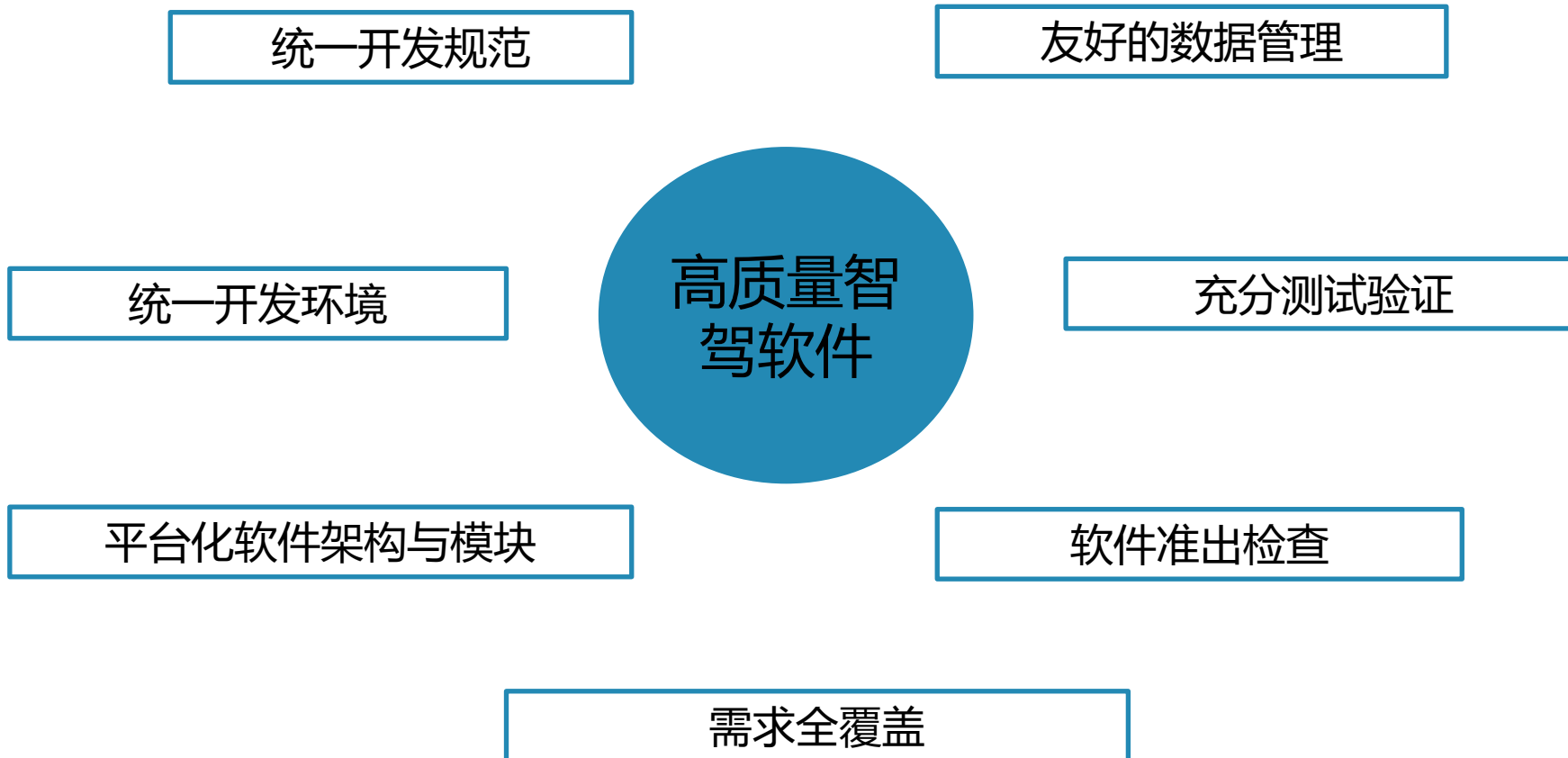
2024 MathWorks
中国汽车年会

主要内容

- 前言
- 软件开发
- 软件测试

主要内容

- 前言
- 软件开发
- 软件测试



开发过程是否有这些问题？

修改软件后，心里没底是否有低级错误

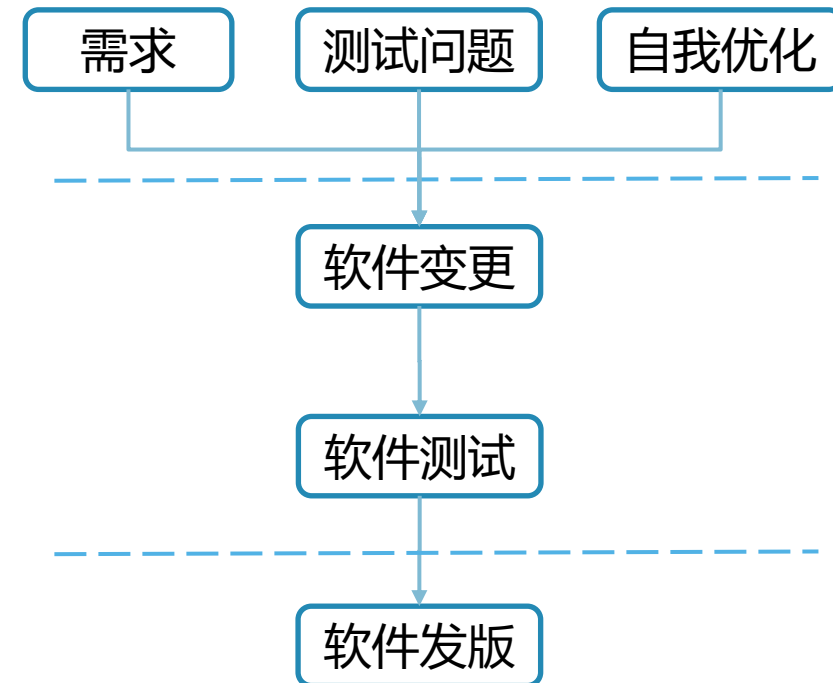
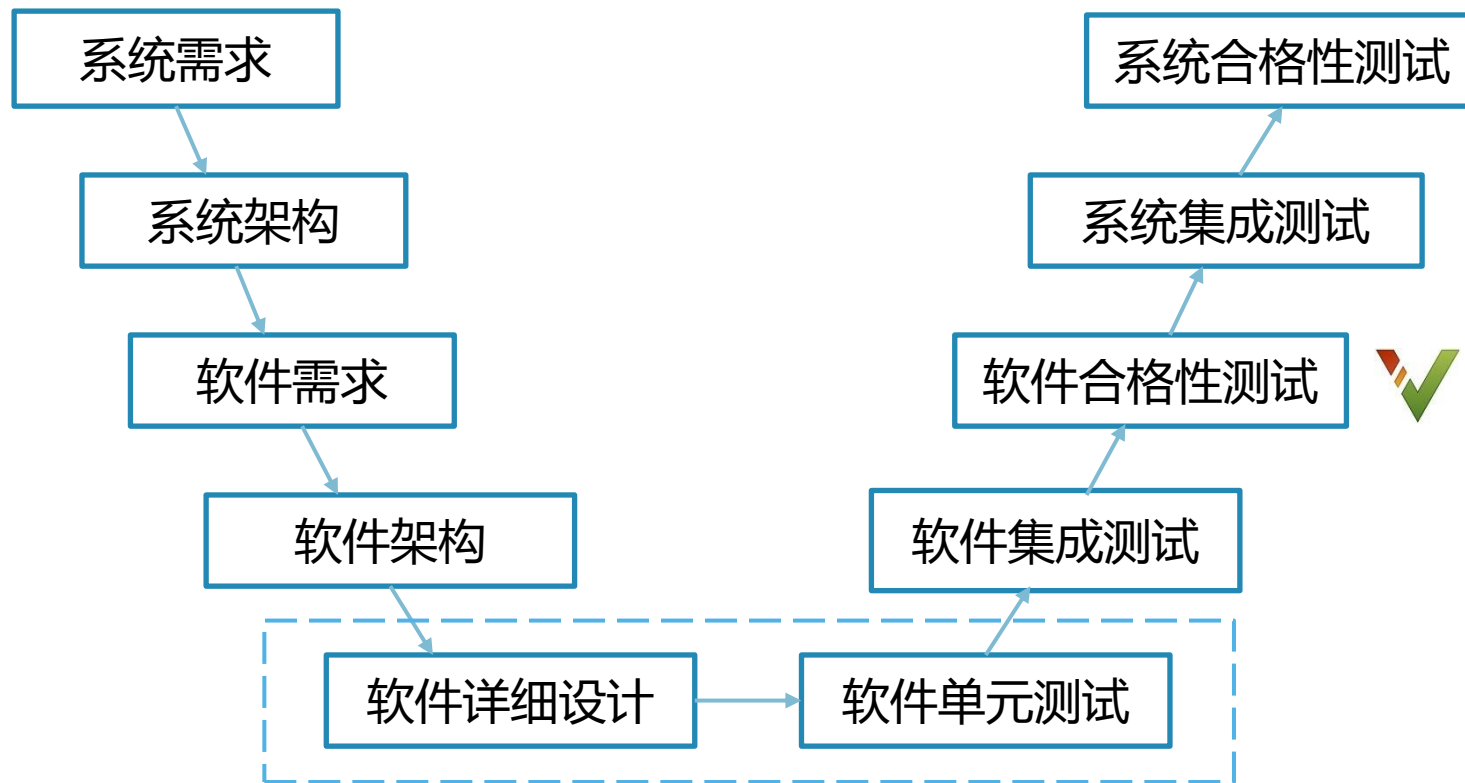
软件变更后，担心以前的测试浪费掉

测试人员测试前要求提供自测报告、标定接口、测试用例等

实车调试繁琐、耗时、约师傅难

是否实车资源太紧张

.....



主要内容

- 前言
- **软件开发**
- 软件测试

统一开发环境、提高开发效率、减少人工操作，开发软件开发过程中使用的20+菜单项与1个特定APP:

过程数据管理

- 数据读取成表格
- 模型端口设置
- 标定量生成
- 监测量生成
- 枚举量生成
- ...

模型前后处理

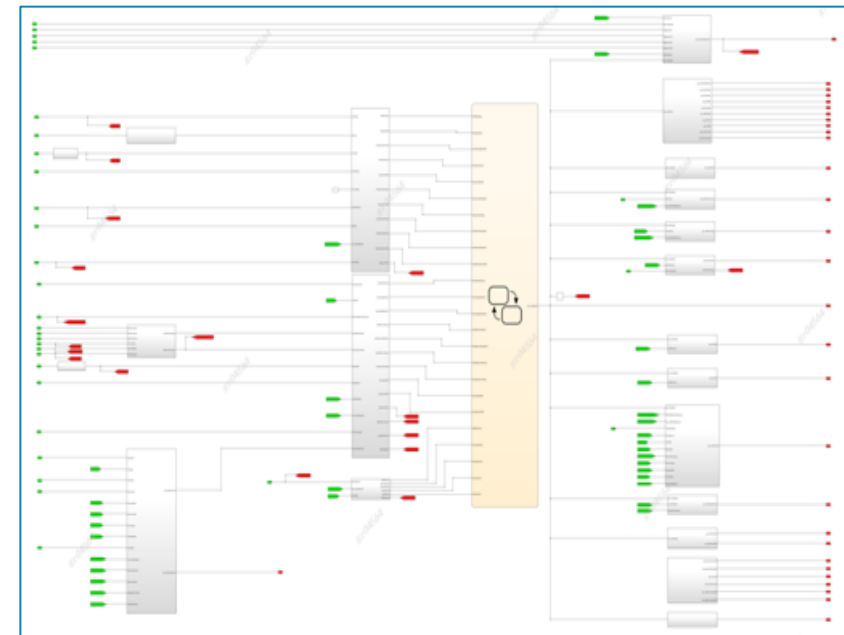
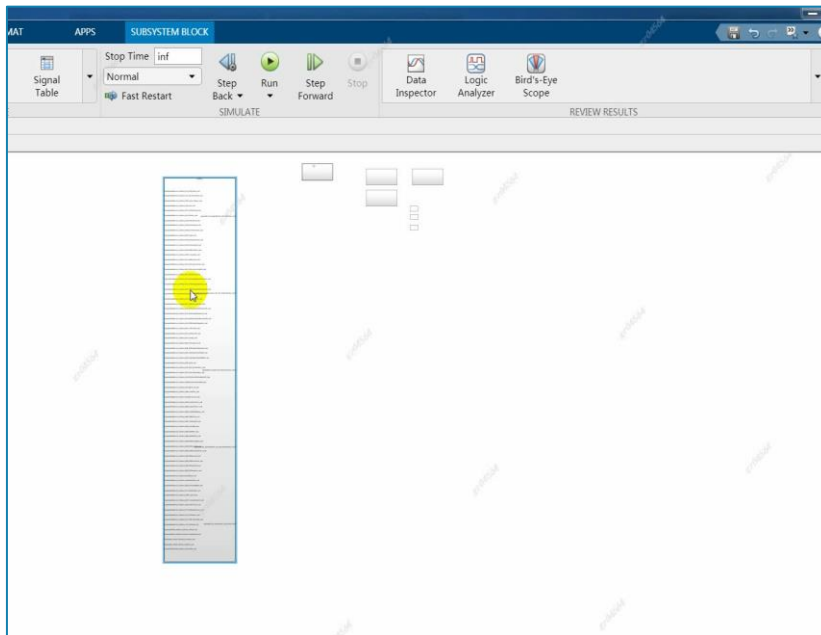
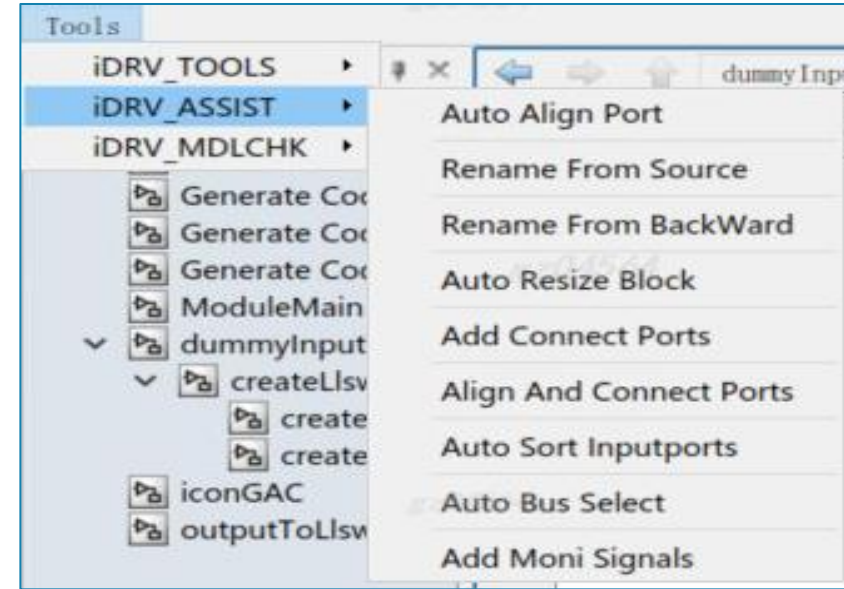
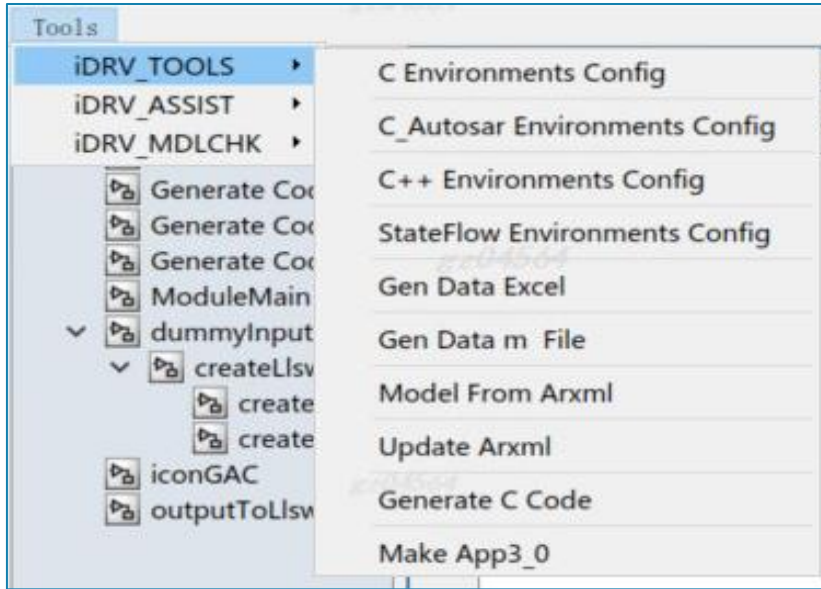
- ARXML更新/模型生成
- 模型打开加载
- 一键编译
- 编译文件copy

开发环境设置

- 配置参数设置
- 模块配置设置
- StateFlow设置

模型模块属性

- 名称集成
- 名称替换
- 模块大小设置
- 模块对齐
- 序号排序
- 自动匹配端口
-

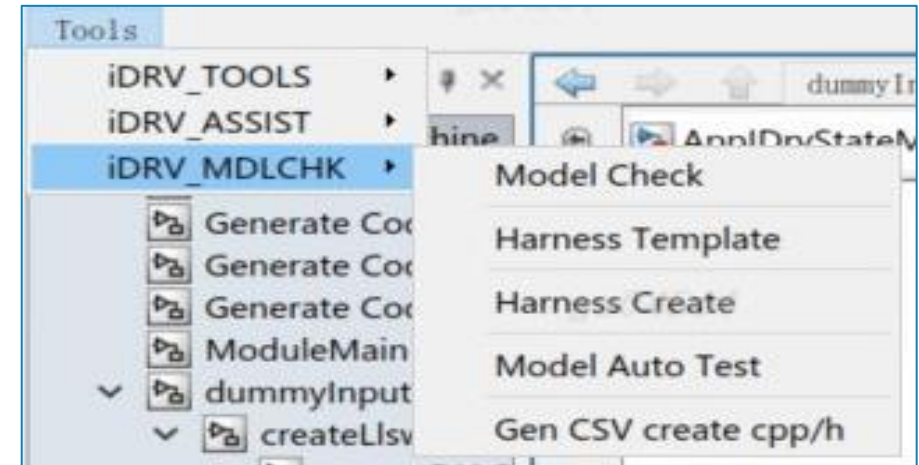
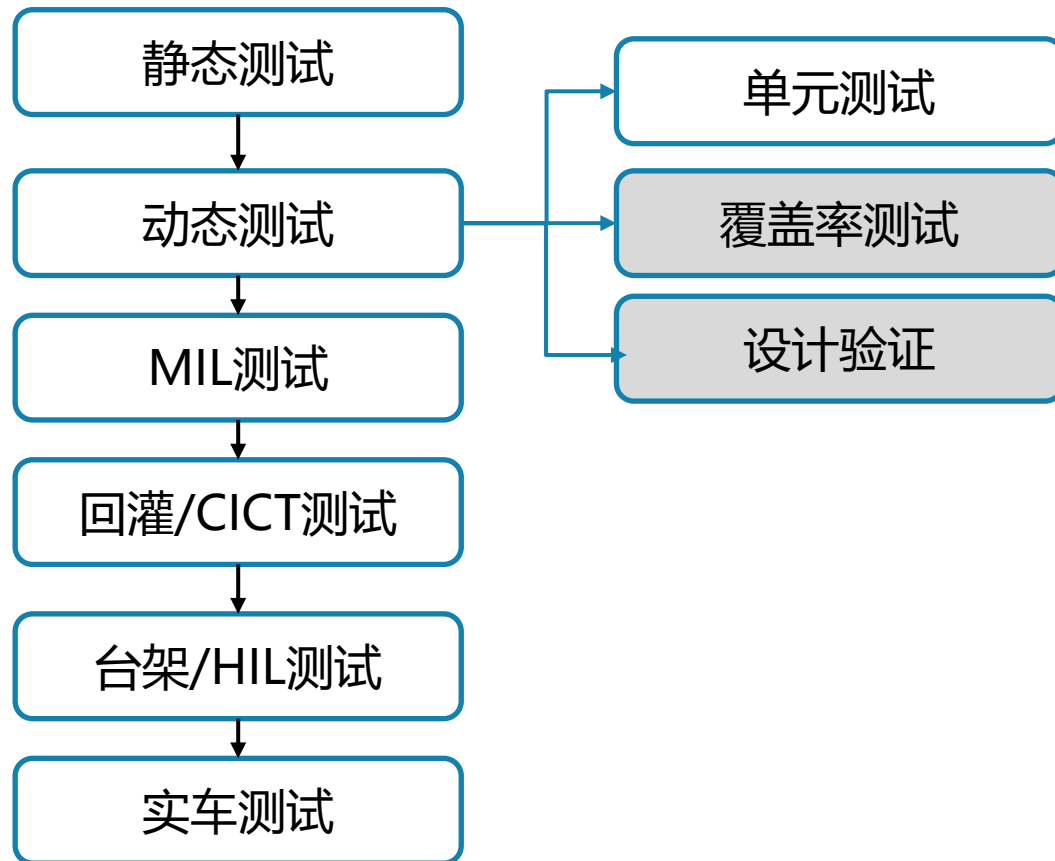


主要内容

- 前言
- 软件开发
- **软件测试**

完成动静态、台架、实车测试，当前已完成**5**个菜单项和**1**个回灌工具APP，

- **静态测试**：当前启用检查规则**69**项，自定义**3**项（继续增加中）
- **动态测试**：**单元测试**前置环境项已经实现自动化，如模块输入输出信号的数据打印、回灌环境生成，**覆盖率测试**为一键生成报告，**设计验证**在开发过程中，也为一键出报告方式。



1	编号	规范编号	检测ID	检测内容	等级	版本
94	93	GAC_Check_1.1102	mathworks.jmaab.jc.0242	Check length of folder name at every level of model path	Warning	
95	94	GAC_Check_1.1103	mathworks.jmaab.jc.0201	Check subsystem names mathworks	Warning	
96	95	GAC_Check_1.1104	mathworks.jmaab.jc.0211	Check port block names mathworks	Warning	
97	96	GAC_Check_1.1105	mathworks.jmaab.jc.0231	Check character usage in block names mathworks	Warning	
98	97	GAC_Check_1.1106	mathworks.jmaab.jc.0244	Check length of Inport and Outport names mathworks	Warning	
99	98	GAC_Check_1.1107	mathworks.jmaab.jc.0222	Check character usage in signal names and bus names	Warning	
100	99	GAC_Check_1.1108	mathworks.jmaab.jc.0232	mathworks	Warning	
101	100	GAC_Check_1.1109	mathworks.jmaab.jc.0245	Check character usage in parameter names mathworks	Warning	
102	101	GAC_Check_1.1110	mathworks.jmaab.jc.0246	Check length of signal and bus names mathworks	Warning	
103	102	GAC_Check_1.1111	mathworks.jmaab.jc.0795	Check length of parameter names mathworks	Warning	
104	103	GAC_Check_1.1112	mathworks.jmaab.jc.0796	Check character usage in Stateflow data names mathworks	Warning	
105	104	GAC_Check_1.1113	mathworks.jmaab.jc.0791	Check length of Stateflow data name mathworks	Warning	
106	105	GAC_Check_1.1114	mathworks.jmaab.jc.0792	Check duplication of Simulink Data names mathworks	Warning	
107	106	GAC_Check_1.1115	mathworks.jmaab.jc.0700	Check unused data in Simulink Model mathworks	Warning	
108	107	GAC_Check_1.1116	mathworks.maab.na.0019	Check for unused data in Stateflow Charts mathworks	Warning	
109	108	GAC_Check_1.2001	mathworks.sldv.deadlogic	Check usage of restricted variable names mathworks	Warning	未启用
110	109	GAC_Check_1.2002	mathworks.sldv.arraybounds		Fail	开发中
111	110	GAC_Check_1.2003	mathworks.sldv.divbyzero		Fail	开发中
112	111	GAC_Check_1.2004	mathworks.sldv.integeroverflow		Fail	开发中
113	112	GAC_Check_1.2005	mathworks.sldv.infnan		Fail	开发中
114	113	GAC_Check_1.2006	mathworks.sldv.subnormal		Fail	开发中
115	114	GAC_Check_1.2007	mathworks.sldv.minmax		Fail	开发中
116	115	GAC_Check_1.2008	mathworks.sldv.dsmaccessviolations		Fail	开发中
117	116	GAC_Check_1.2009	mathworks.sldv.blockingrangeviolations		Fail	开发中
118	117	GAC_Check_1.2010	mathworks.sldv.hismviolationshsl_0002		Fail	开发中
119	118	GAC_Check_1.2011	mathworks.sldv.hismviolationshsl_0003		Fail	开发中
120	119	GAC_Check_1.2012	mathworks.sldv.hismviolationshsl_0004		Fail	开发中
121	120	GAC_Check_1.2013	mathworks.sldv.hismviolationshsl_0005		Fail	开发中
122	121	GAC_Check_2.1001	DRVBlockColorSettings	Checks that the block color setting	Fail	IDRVCHK
123	122	GAC_Check_2.1002	DRVRootPortDataTypeSettings	Checks that Root Ports Datatype settings Which Can Not Be Auto	Fail	IDRVCHK
124	123	GAC_Check_2.1003	DRVConnConsistentChk	Check whether the line and portname is same	Warning	IDRVCHK

静态检查规则

自定义

Model Advisor Report

Simulink version: 10.2
System: PILTSM
Treat as Referenced Model: off
Model version: 1.750
Current run: 2024/07/27 11:24:44

Run Summary

Pass	Fail	Warning	Not Run	Total
69	0	0	0	69

Check for blocks not recommended for C/C++ production code deployment
Identify blocks not supported by code generation or not recommended for C/C++ production code deployment.
Passed
Blocks not recommended for C/C++ production code deployment were not found in the model or subsystem.

iDRV Validate block color settings
Identify blocks color settings are correct.
All blocks color settings are correct.

iDRV Validate Root Ports Datatype Settings
Identify blocks datatype settings are correct.
All blocks datatype settings are correct.

iDRV Check whether the line and portname is same

命令行窗口

20240704_171847.xlsx	2024/7/9 14:26	Microsoft Excel 工作表
20240704_171719.xlsx	2024/7/9 14:25	Microsoft Excel 工作表
20240702_114359.xlsx	2024/7/9 14:25	Microsoft Excel 工作表
20240702_114208.xlsx	2024/7/9 14:25	Microsoft Excel 工作表
20240702_114011.xlsx	2024/7/9 14:25	Microsoft Excel 工作表
20240702_113658.xlsx	2024/7/9 14:25	Microsoft Excel 工作表
20240702_113609.xlsx	2024/7/9 14:24	Microsoft Excel 工作表
20240702_113450.xlsx	2024/7/9 14:24	Microsoft Excel 工作表
20240702_113412.xlsx	2024/7/9 14:24	Microsoft Excel 工作表
20240702_113322.xlsx	2024/7/9 14:24	Microsoft Excel 工作表
20240702_113032.xlsx	2024/7/9 14:23	Microsoft Excel 工作表
20240628_115027.xlsx	2024/7/9 14:23	Microsoft Excel 工作表
20240628_113925.xlsx	2024/7/9 14:23	Microsoft Excel 工作表
20240628_111537.xlsx	2024/7/9 14:21	Microsoft Excel 工作表
20240628_111330.xlsx	2024/7/9 14:19	Microsoft Excel 工作表
20240628_111222.xlsx	2024/7/9 14:19	Microsoft Excel 工作表
20240628_111145.xlsx	2024/7/9 14:19	Microsoft Excel 工作表
20240628_110615.xlsx	2024/7/9 14:18	Microsoft Excel 工作表
20240628_110530.xlsx	2024/7/9 14:18	Microsoft Excel 工作表
20240628_105556.xlsx	2024/7/9 14:18	Microsoft Excel 工作表

Summary

Name	Outcome	Duration (Seconds)
Results: 2024-Jul-04 11:13:39	5	270.941
New Test Case 1	5	270.94
20240702_113032	5	48.704
20240702_113322	5	48.45
20240702_113412	5	57.256
20240702_113450	5	55.199
20240702_113609	5	56.82

The screenshot displays a comprehensive vehicle control interface. At the top, it shows the filename 'PariDriveMtlTestPlatform_v1.slx' and the workspace path. Below this, there are several gauges and indicators:

- 实际油门开度** (Actual Throttle): A gauge ranging from 0 to 1.0.
- 实际制动踏板开度** (Actual Brake Pedal): A gauge ranging from 0 to 10.
- 实际车速** (Actual Vehicle Speed): A gauge showing 6.822.
- LKAStmgWhtTorq** (Lateral Control Torque): A gauge ranging from -5 to 5.
- 车辆手动档位** (Manual Gear): A dial showing 'R' (Reverse) and 'D' (Drive).
- columnTorque** (Column Torque): A gauge ranging from -5 to 5.

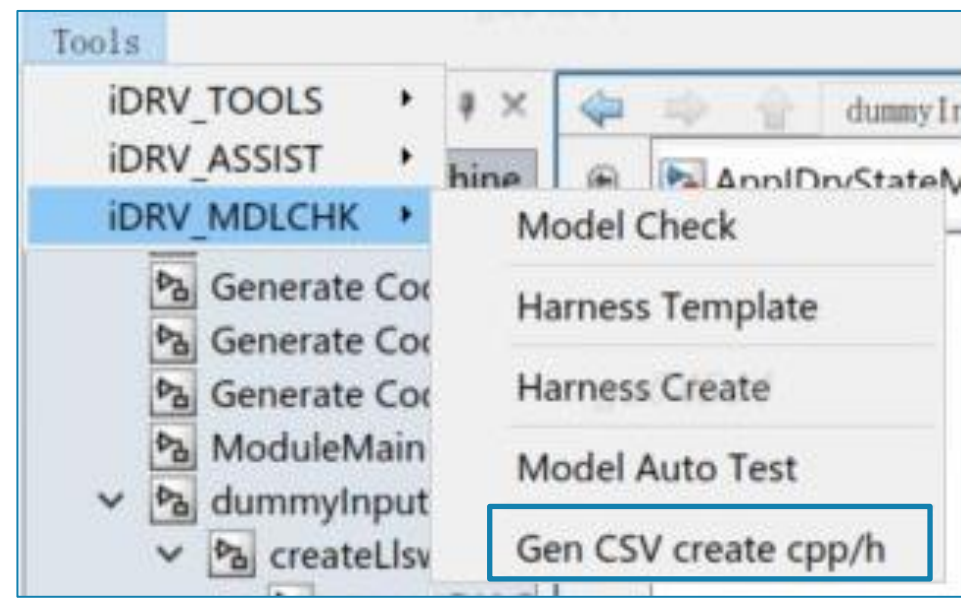
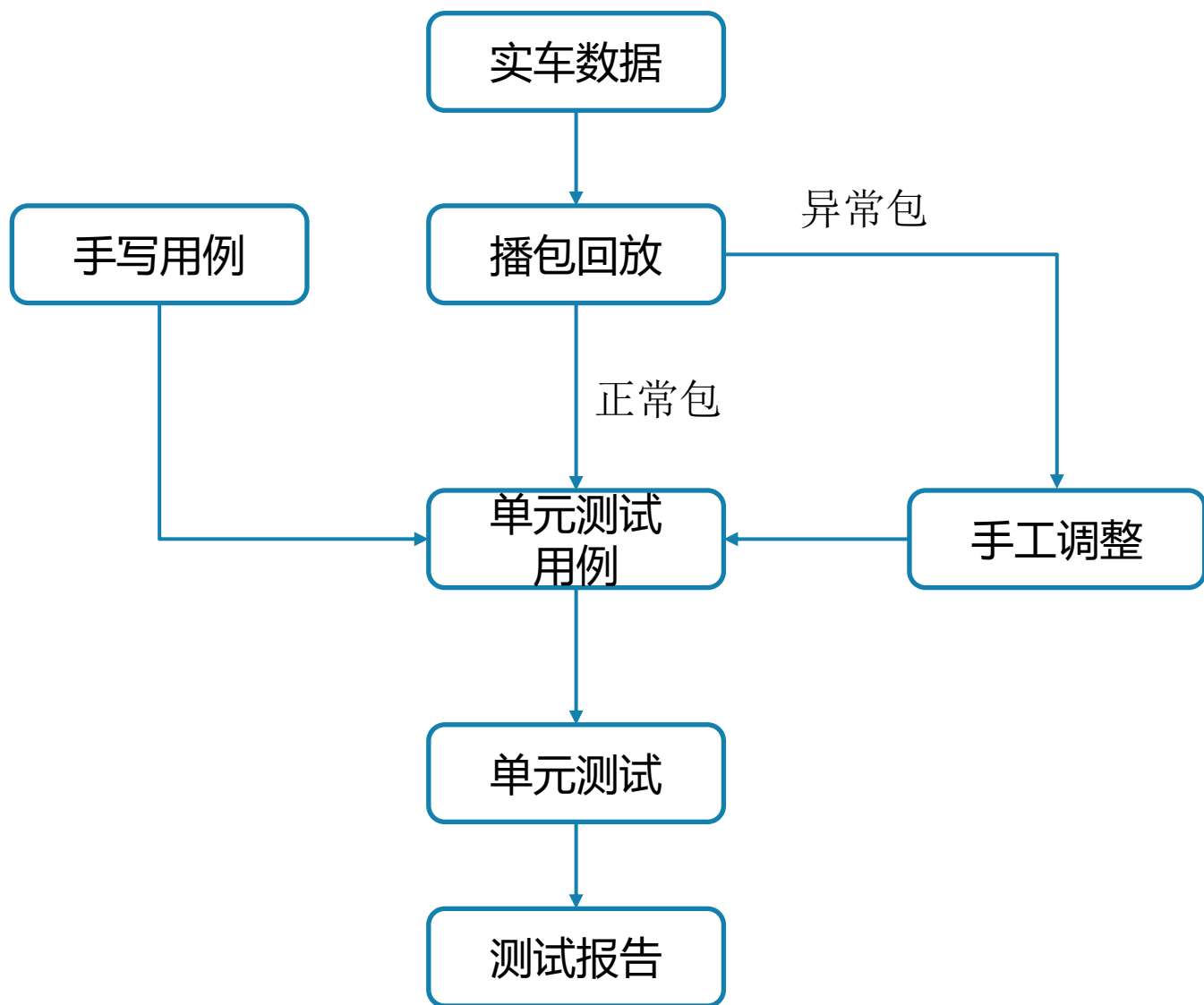
The bottom section contains a grid of toggle switches for various vehicle systems:

- 制动系统** (Brake System): Includes switches for '制动信号' and '制动'.
- 转向系统** (Steering System): Includes switches for '转向助力' and '转向'.
- 动力系统** (Power System): Includes switches for '油门' and '油门'.
- 安全系统** (Safety System): Includes switches for '安全带' and '安全带'.
- 其他系统** (Other Systems): Includes switches for '转向灯' and '转向灯'.

At the bottom, there are buttons for 'Stop', 'Pause', 'Run', 'Continue', and '100 Steps Run', along with a '74.820' value.

The screenshot displays the Simulink environment for a project named "APASTM". The interface includes a top menu bar with tabs for SIMULATION, DEBUG, MODELING, FORMAT, and APPS. Below the menu is a toolbar with various simulation and development tools, including "Log Signals", "Add Viewer", "Signal Table", "Step Back", "Run", "Step Forward", "Stop", "Data Inspector", "Logic Analyzer", and "Bird's-Eye Scope". The "Stop Time" is set to "inf".

The main workspace shows a simulation model with several components labeled "zx04564". A vertical data inspector is visible in the center, displaying a series of data points. The left sidebar contains the "Model Browser" and "Tools" panels, and the right sidebar contains the "Property Inspector".



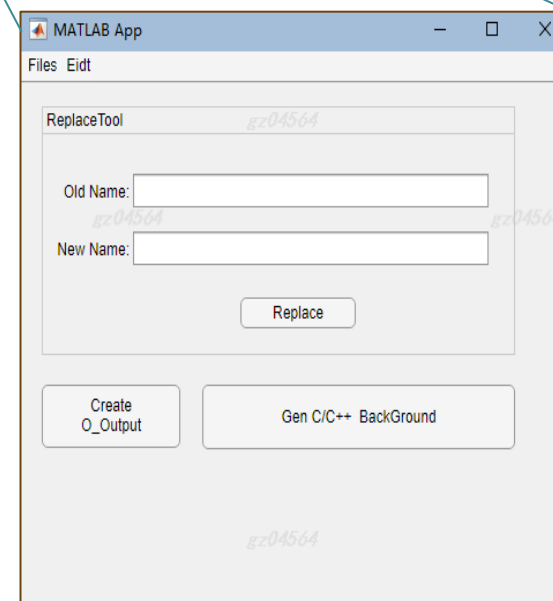
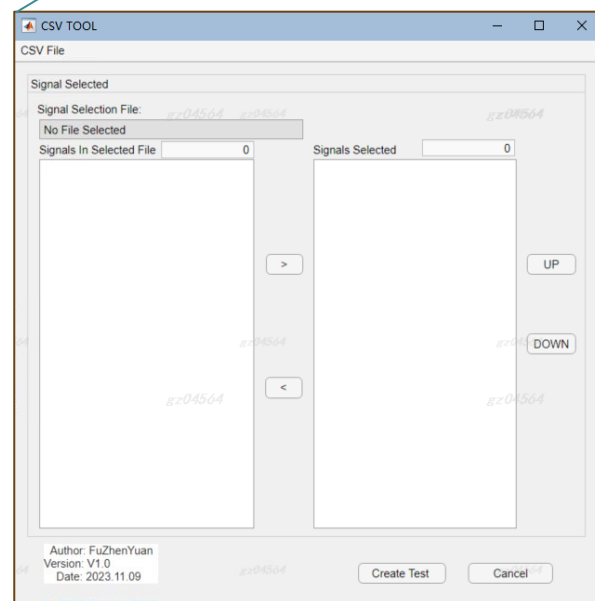
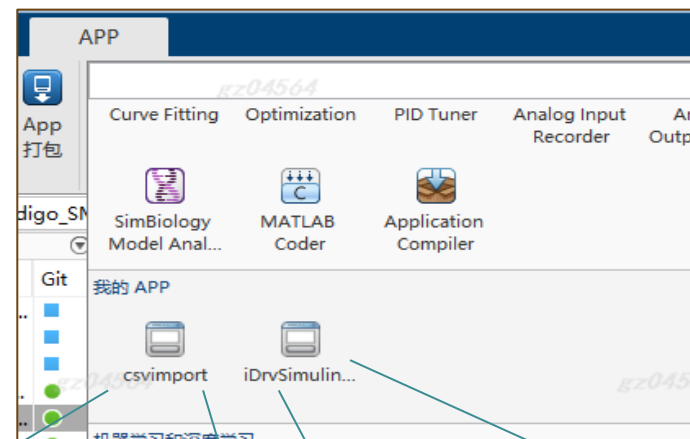
```
cal_TestCaseGenFunc_APASTM.cpp × +
1 #include "cal_TestCaseGenFunc_APASTM.h"
2
3 #include <fstream>
4 #include <cstdio>
5 #include <sstream>
6 #include <string>
7 #include <iostream> EZ04564
8
9 using std::cout;
10 using std::endl;
11 using namespace std;
12 fstream apastmiofile;|
13 ofstream apastmofile;64 EZ04564
14
15 bool isFileExists_ifstream_apastm(string& name)
16 {
17     ifstream f(name.c_str());
18     return f.good();
19 }
20
21 long long ExcelGenClassAPASTM::getCurrentTime() {
22     auto now = std::chrono::system_clock::now().time_since_epoch(); EZ045
23     auto us = std::chrono::duration_cast<std::chrono::milliseconds>(now);
```

Csvimport:

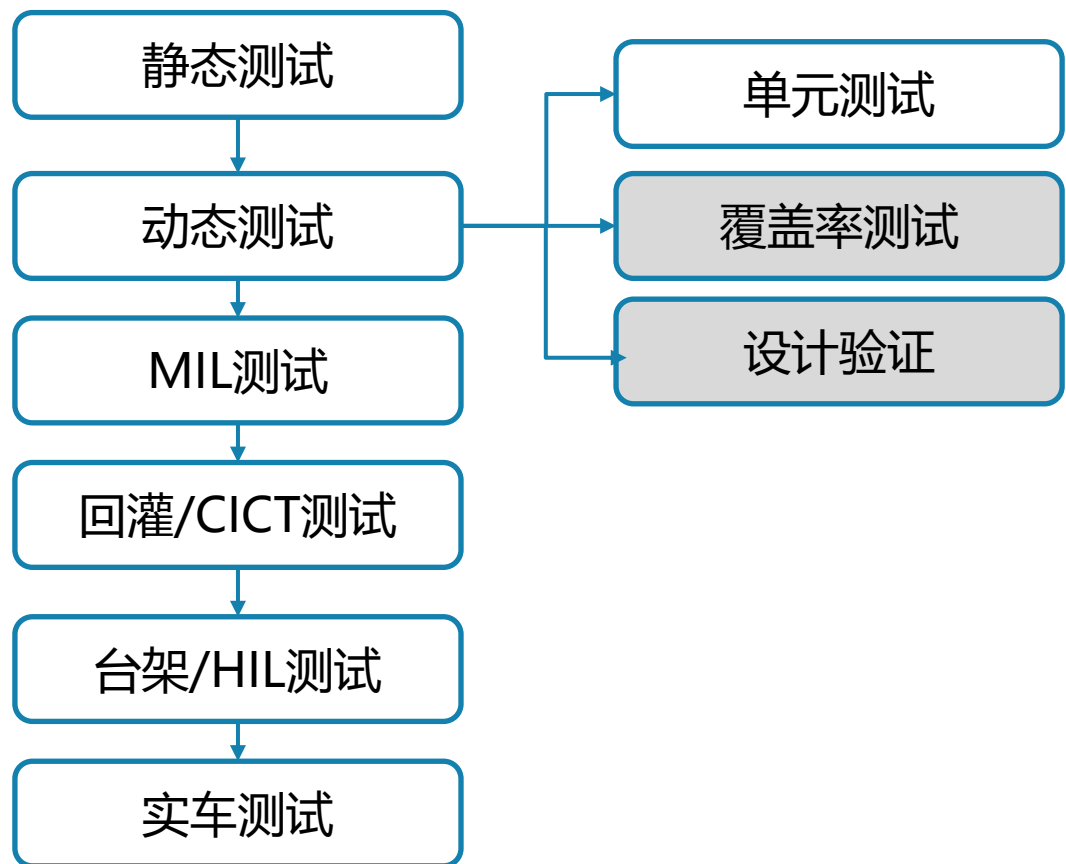
- ❑ 选择录取数据信号
- ❑ 调整信号顺序
- ❑ 生成模型运行匹配环境

iDrvSimulinkTool

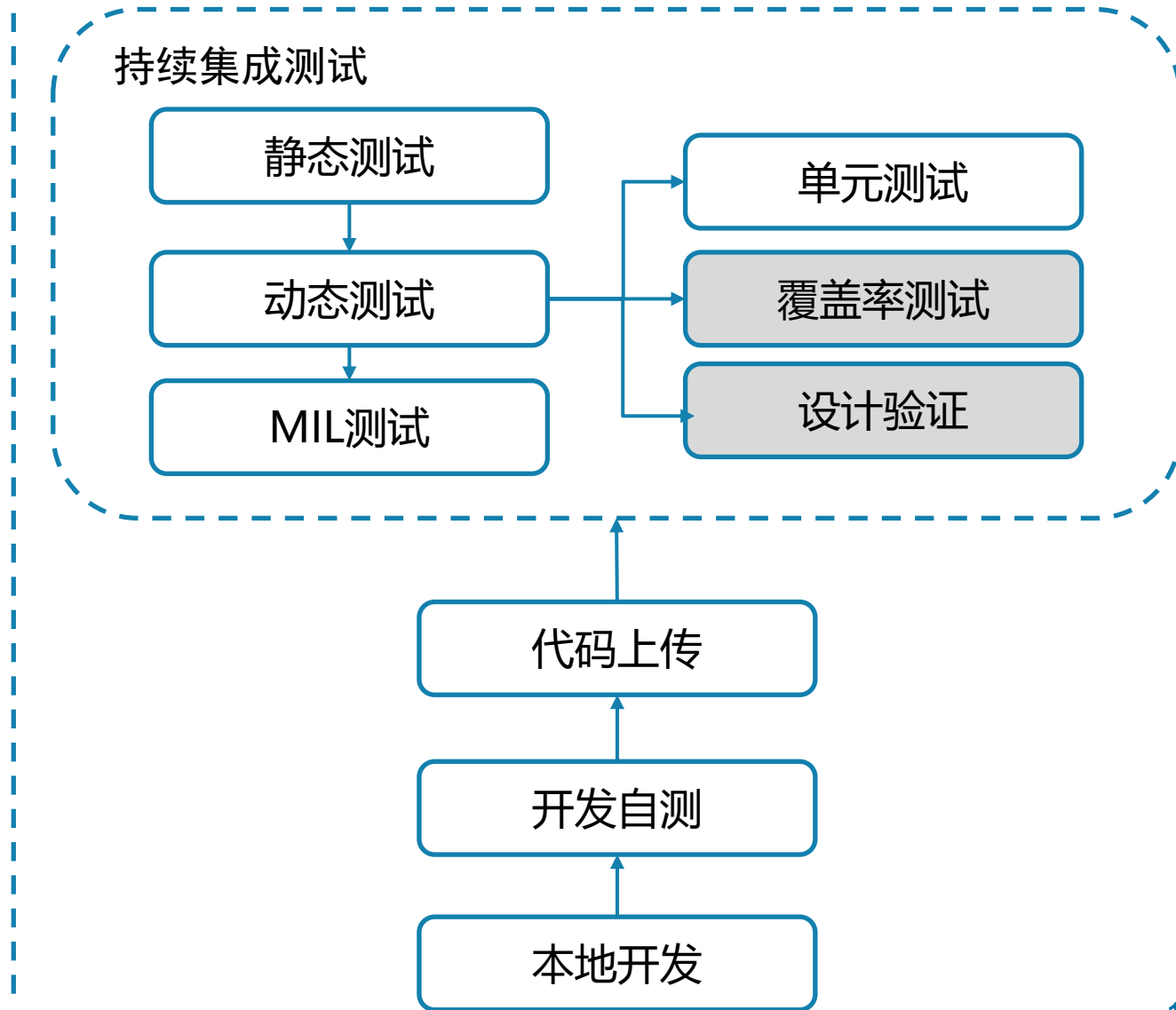
- ❑ 一键替换名称
- ❑ 自动生成输入输出模型
- ❑ 后台编译



当前



将来



软件开发

- ❑ 开发效率提升**30+%**
- ❑ 降低BUG率**10+%**
- ❑ 降低返工概率
- ❑ 软件更加规范统一
- ❑ 降低对工程师的经验依赖

软件测试

- ❑ 代码测试效率的提升
- ❑ 大量减少实车依赖，腾出实车测试资源
- ❑ 降低旧问题复发概率
- ❑ 提升了软件发版时的信心

2024 MathWorks 中国汽车年会

Thank you

