ANSYS CONVERGENCE CONFERENCES

2018年7月11-13日 上海

SCADE定制开发分享

侯锡立（中国通号）

SCADE定制开发分类

SCADE模型类：
TCP/UDP/COM/PLOT……

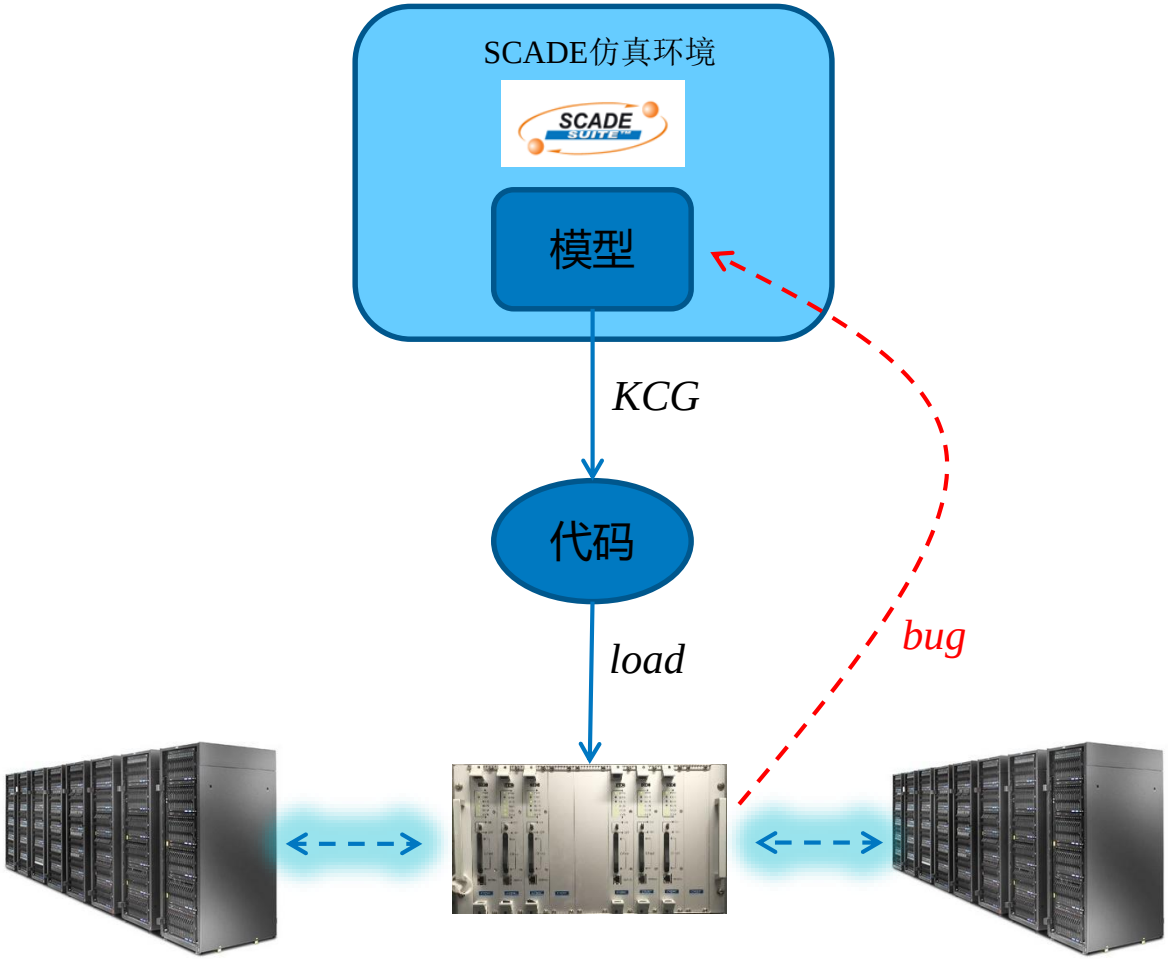
TCL脚本类：
Document Generator/
Simulation & Test Framework/
Co-Simulation Platform

辅助开发类：
SCADE Interlocking Builder

辅助验证类：
SCADE Interpreter/
SCADE Coder/
SCADE Verifier/
SCADE Test Case Generator

开发中...

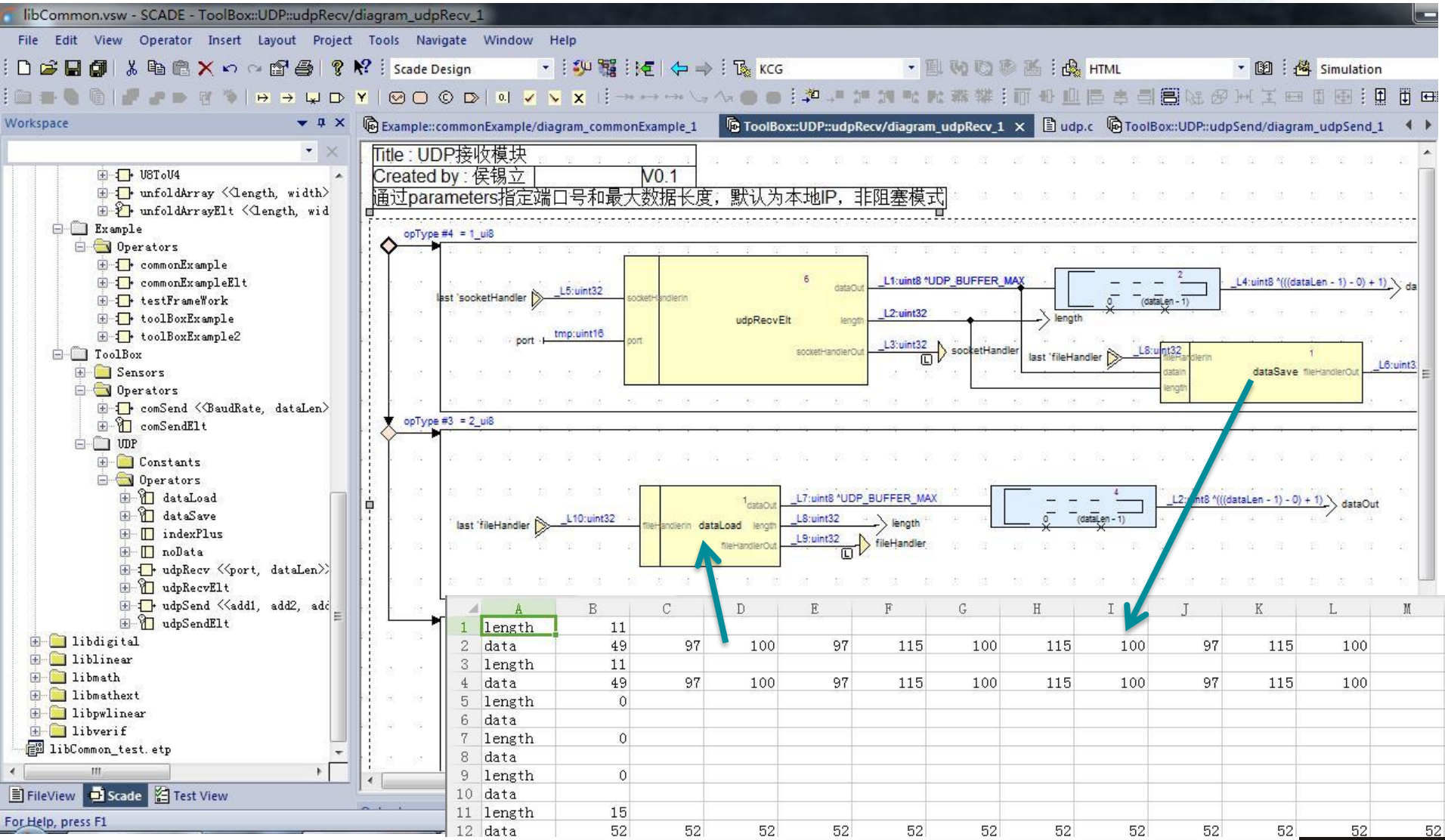
SCADE模型类：TCP/UDP/COM…



模型仿真

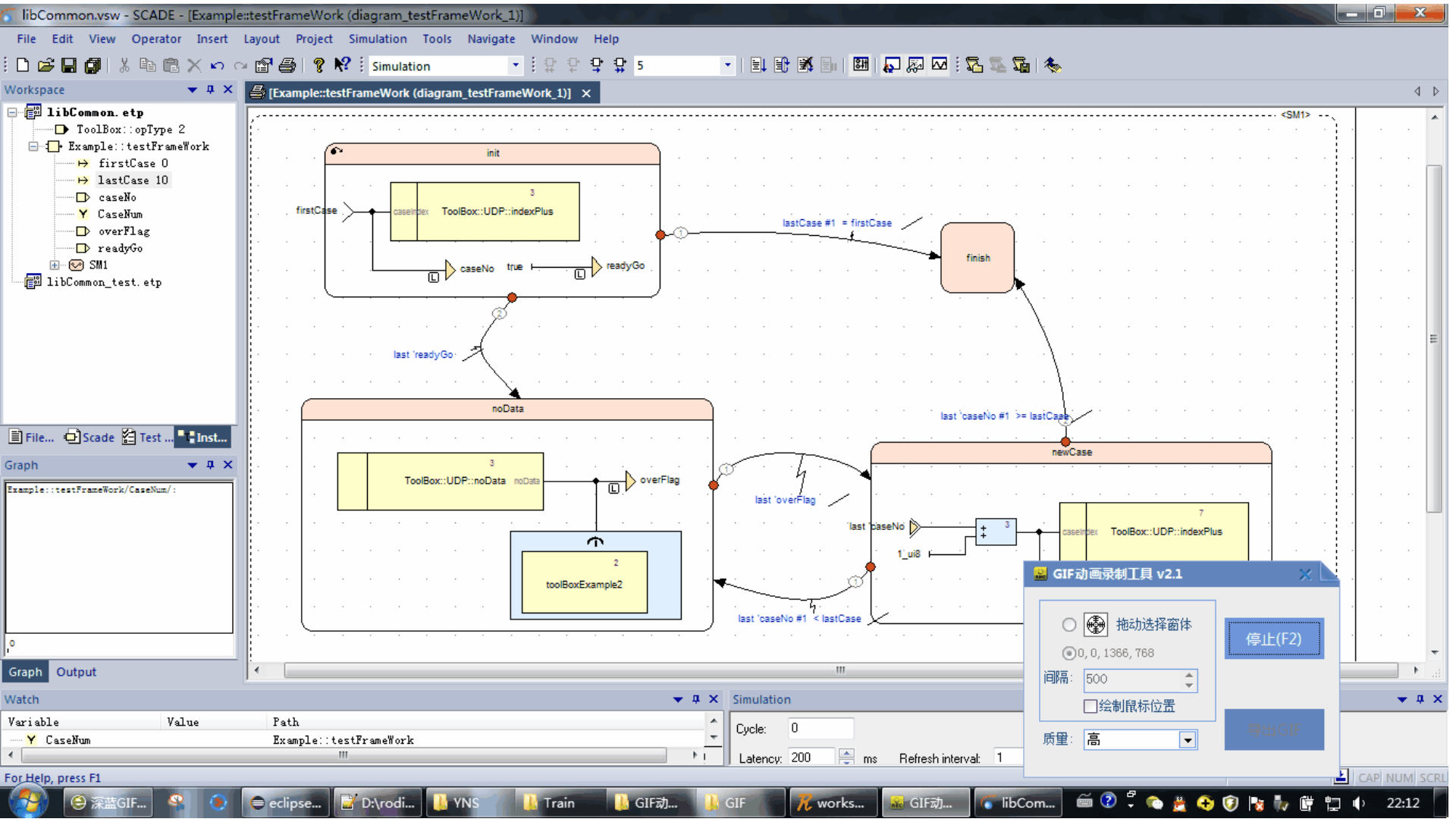
系统仿真

SCADE模型类：TCP/UDP/COM…

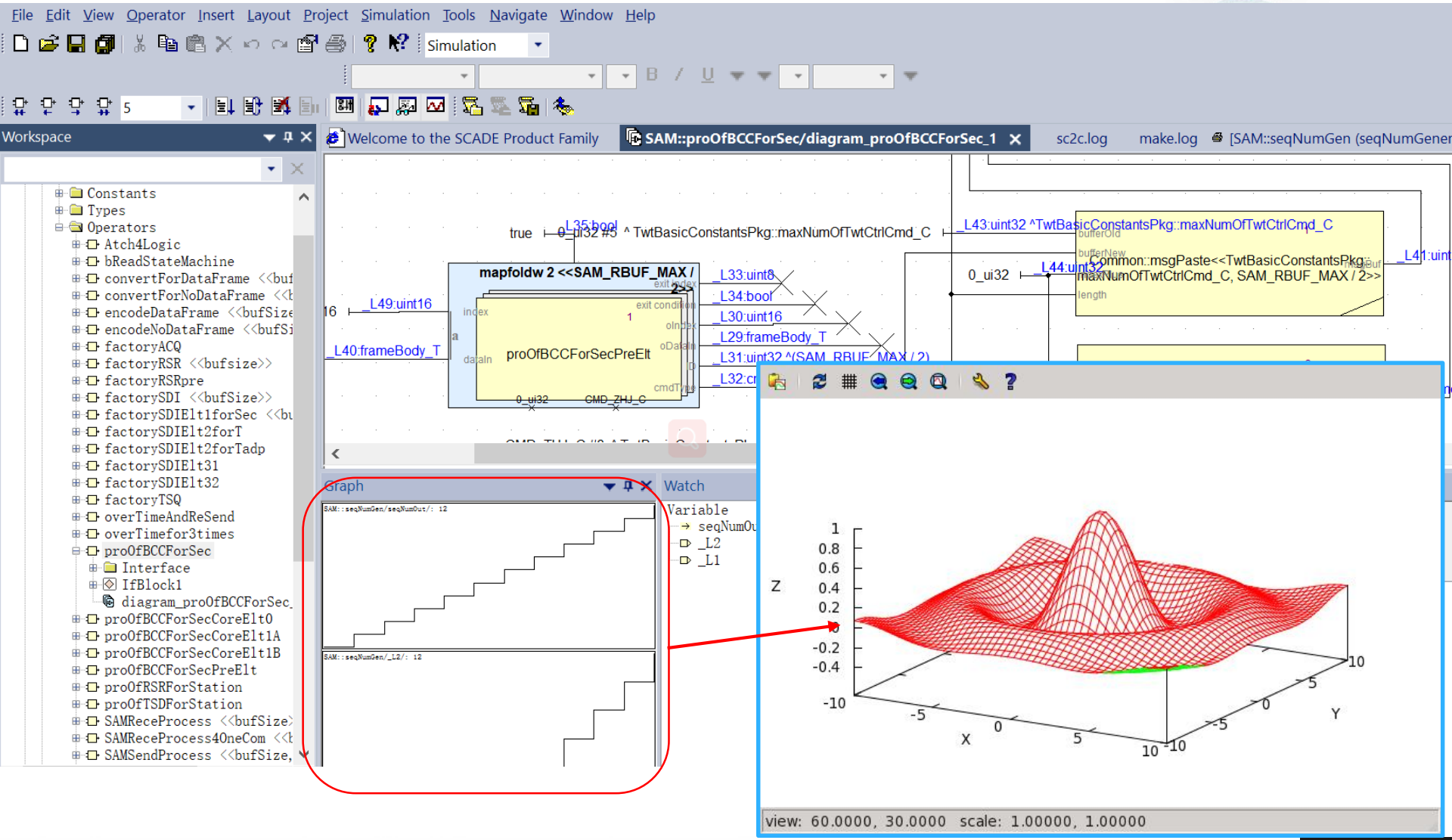


	A	B	C	D	E	F	G	H	I	J	K	L	M
1	length	11											
2	data	49	97	100	97	115	100	115	100	97	115	100	
3	length	11											
4	data	49	97	100	97	115	100	115	100	97	115	100	
5	length	0											
6	data												
7	length	0											
8	data												
9	length	0											
10	data												
11	length	15											
12	data	52	52	52	52	52	52	52	52	52	52	52	52

SCADE模型类：TCP/UDP/COM…



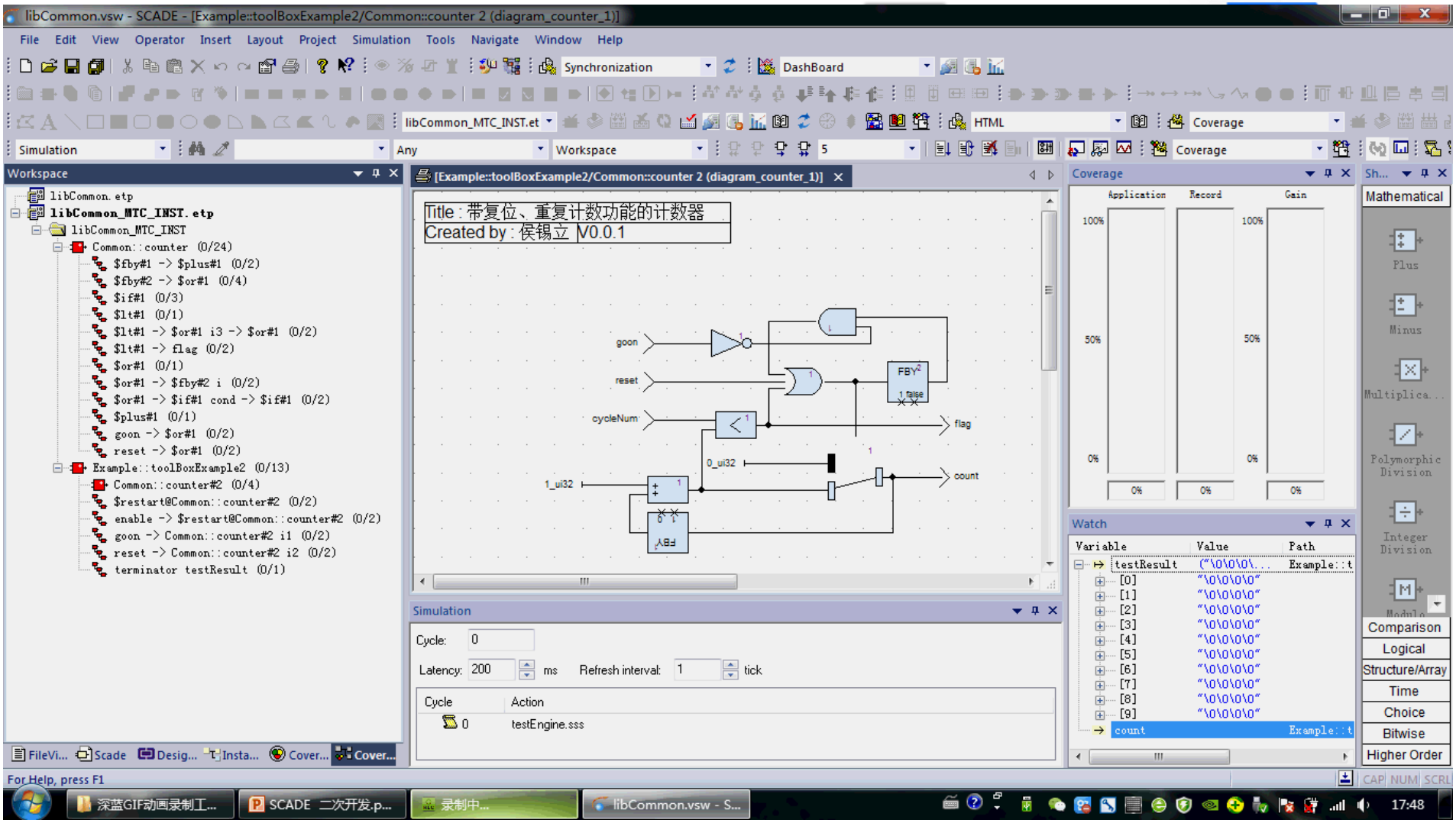
SCADE模型类：PLOT



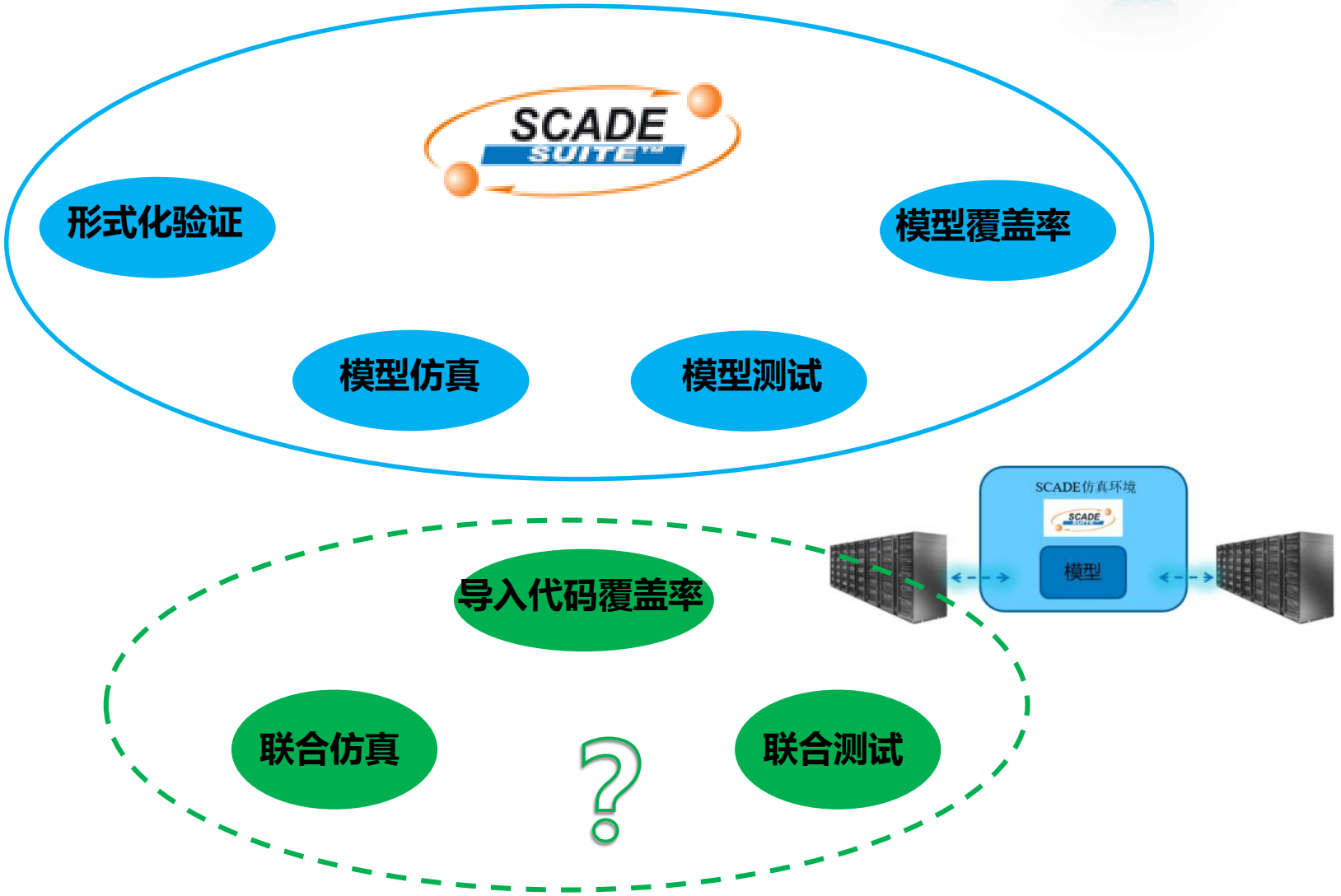
TCL脚本类：Simulation & Test Framework

要求	仿真环境	测试环境	理想环境
各节点数据显示/检测	√	×	√
激活模块显示	√	×	√
单步/多步执行	√	×	√
断点调试	√	×	√
数据检查	×	√	√
测试结果统计	×	√	√
模型覆盖率分析	×	√	√
测试脚本管理/回归测试	×	√	√
其他数据文件读写	×	×	√
更丰富的脚本功能	√	×	√

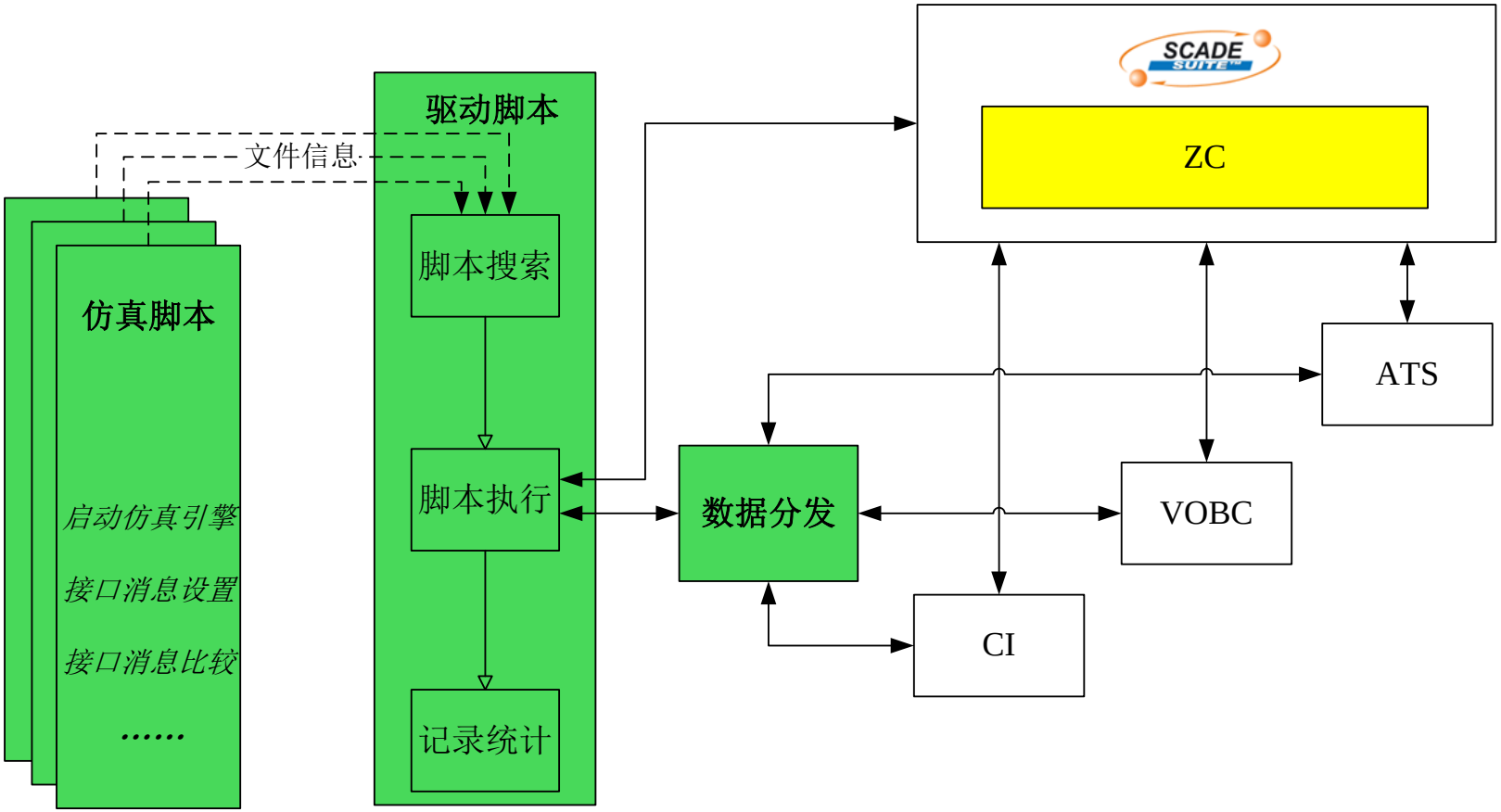
TCL脚本类：Simulation & Test Framework



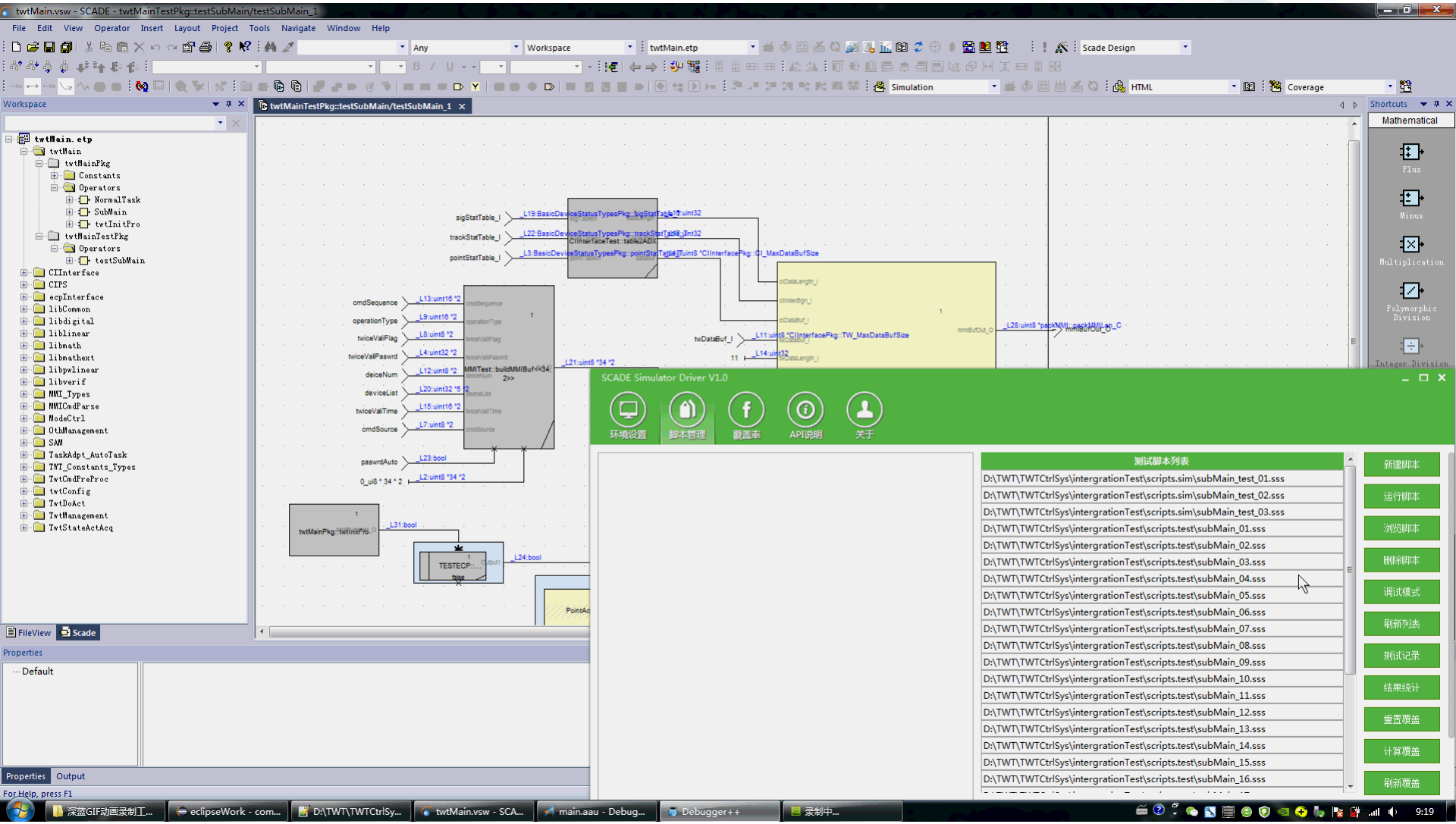
TCL脚本类：Co-Simulation Platform



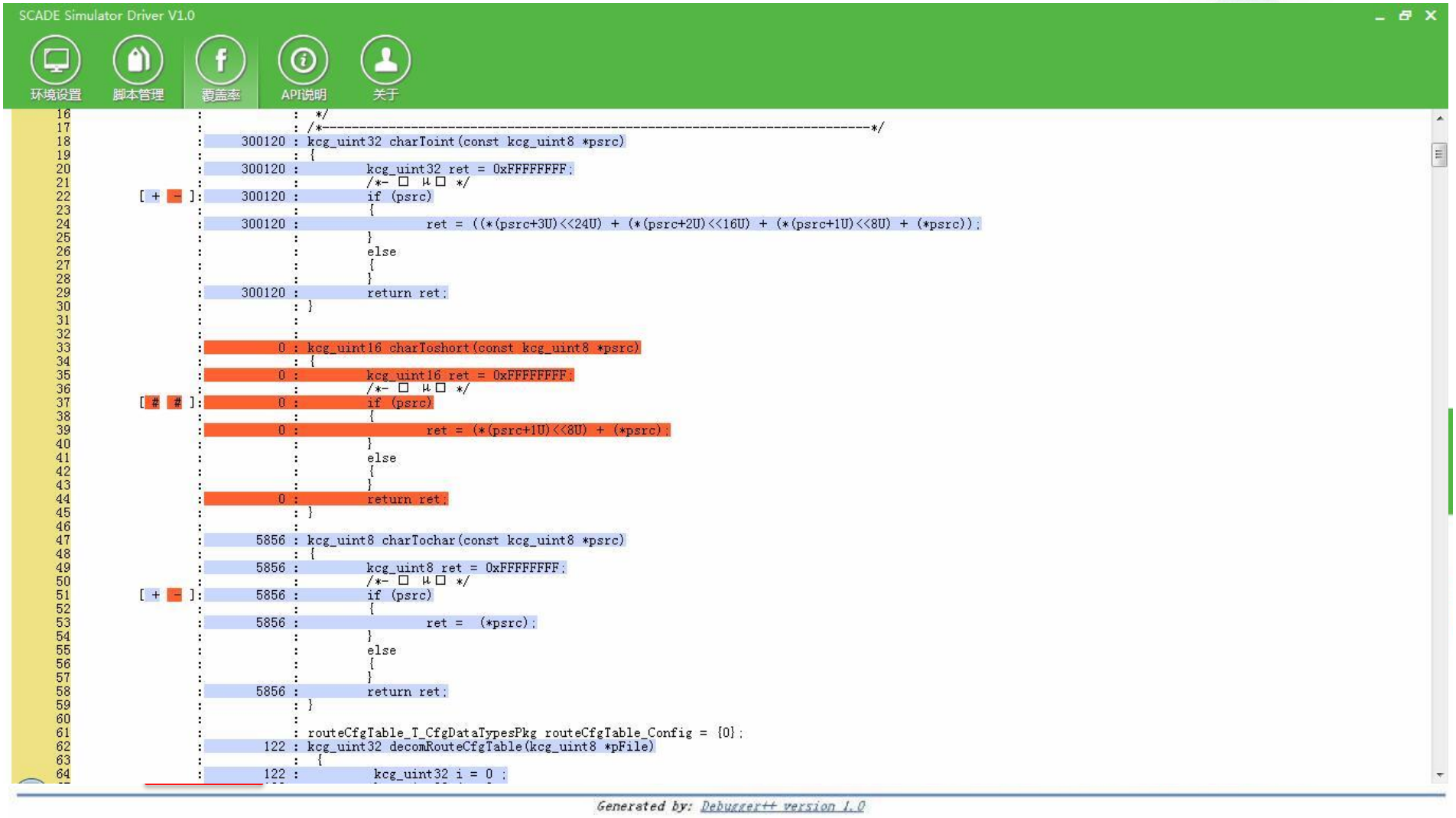
TCL脚本类：Co-Simulation Platform



TCL脚本类：Co-Simulation Platform



TCL脚本类：Co-Simulation Platform

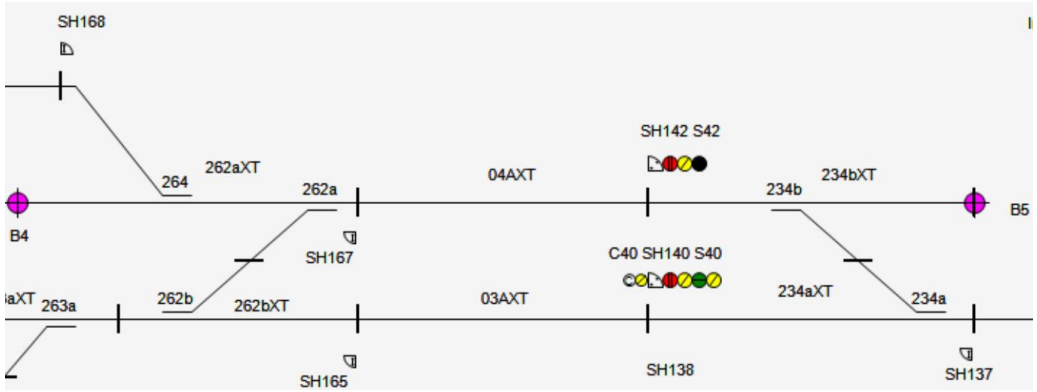



```
                :           */
                :           /*-------------------------------------------------------------------------------*/
         300120 :           kcg_uint32 charToint(const kcg_uint8 *psrc)
                :           {
         300120 :                   kcg_uint32 ret = 0xFFFFFFFF;
                :                   /*- □ μ□ */
[ + - ]  300120 :                   if (psrc)
                :                   {
         300120 :                           ret = ((*(psrc+3U)<<24U) + (*(psrc+2U)<<16U) + (*(psrc+1U)<<8U) + (*psrc));
                :                   }
                :                   else
                :                   {
                :                   }
         300120 :                   return ret;
                :           }
                :
                :
              0 :           kcg_uint16 charToshort(const kcg_uint8 *psrc)
                :           {
              0 :                   kcg_uint16 ret = 0xFFFFFFFF;
                :                   /*- □ μ□ */
[ # # ]       0 :                   if (psrc)
                :                   {
              0 :                           ret = (*(psrc+1U)<<8U) + (*psrc);
                :                   }
                :                   else
                :                   {
                :                   }
              0 :                   return ret;
                :           }
                :
           5856 :           kcg_uint8 charTochar(const kcg_uint8 *psrc)
                :           {
           5856 :                   kcg_uint8 ret = 0xFFFFFFFF;
                :                   /*- □ μ□ */
[ + - ]    5856 :                   if (psrc)
                :                   {
           5856 :                           ret =  (*psrc);
                :                   }
                :                   else
                :                   {
                :                   }
           5856 :                   return ret;
                :           }
                :
                :           routeCfgTable_T_CfgDataTypesPkg routeCfgTable_Config = {0};
            122 :           kcg_uint32 decomRouteCfgTable(kcg_uint8 *pFile)
                :            {
            122 :                    kcg_uint32 i = 0 ;
```

辅助开发类：SCADE Interlocking Builder

- 面向对象；
- 输入站场数据/电子地图，自动生成联锁模型，测试案例，验证模型；
- 大幅压缩模型状态空间，提高形式化验证效率；

辅助开发类：SCADE Interlocking Builder



设计“类”模型：
信号机模型
道岔模型
区段模型
进路模型

根据站场数据/电子地图获取对象关系，将“类”模型实例化，并依据对象关系进行各对象模型接口连接

线路关系：
信号机与进路
进路与道岔
进路与区段
……

测试“类”脚本：
信号机测试
道岔测试
区段测试
进路测试

验证“类”模型：
安全需求
……

数据关系：
允许开放
红灯/绿灯
搬动道岔
区段占用

辅助开发类：SCADE Interlocking Builder

Signal

Switch

Section

Route

Class Models(.xscade file)

SIB

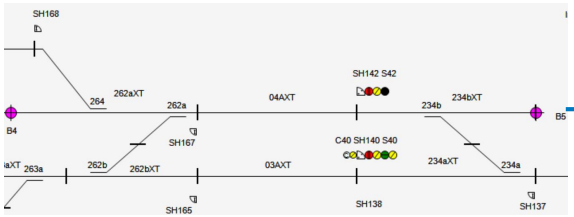
X_Signal

X_Switch

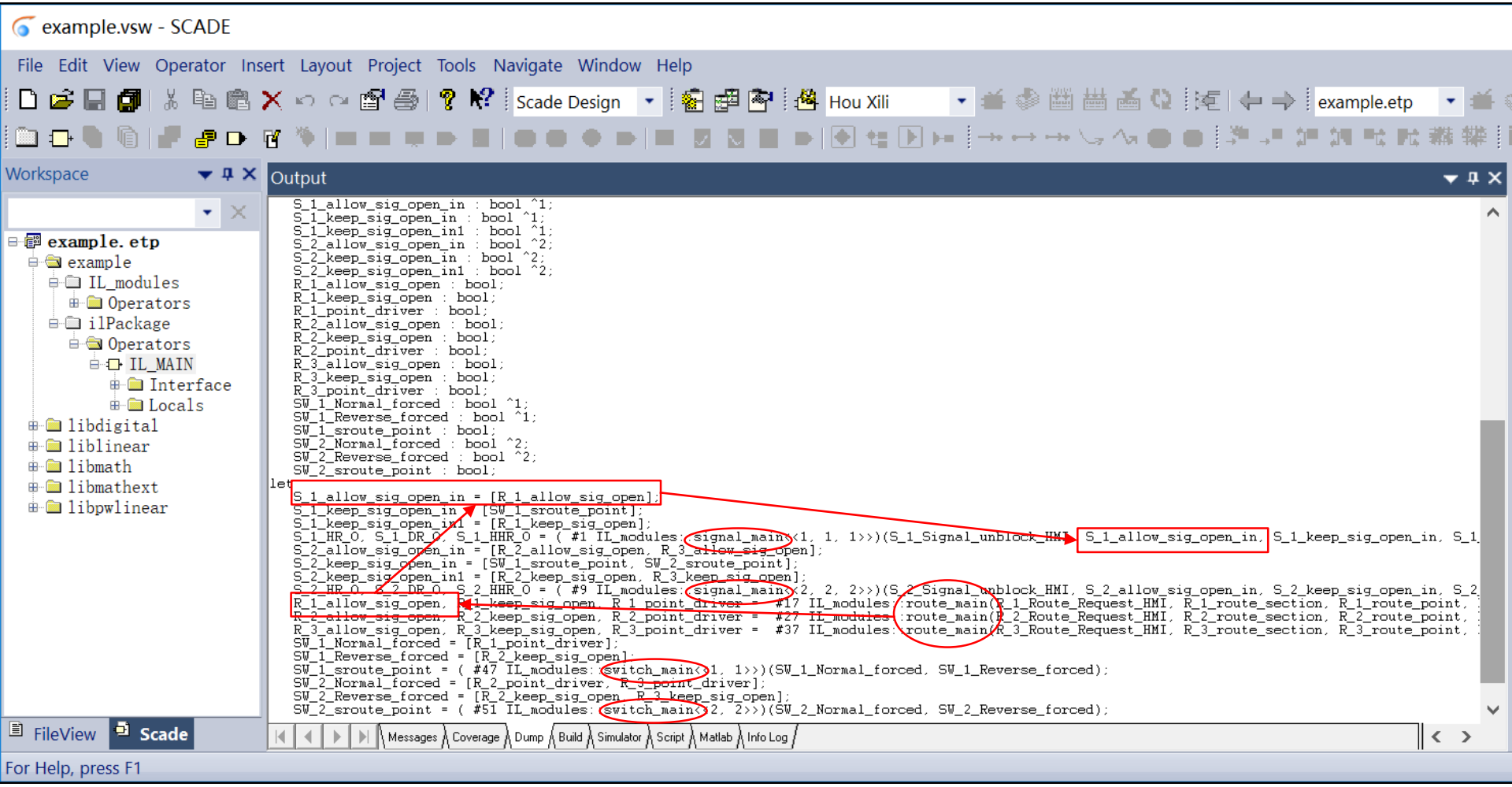
X_Section

X_Route

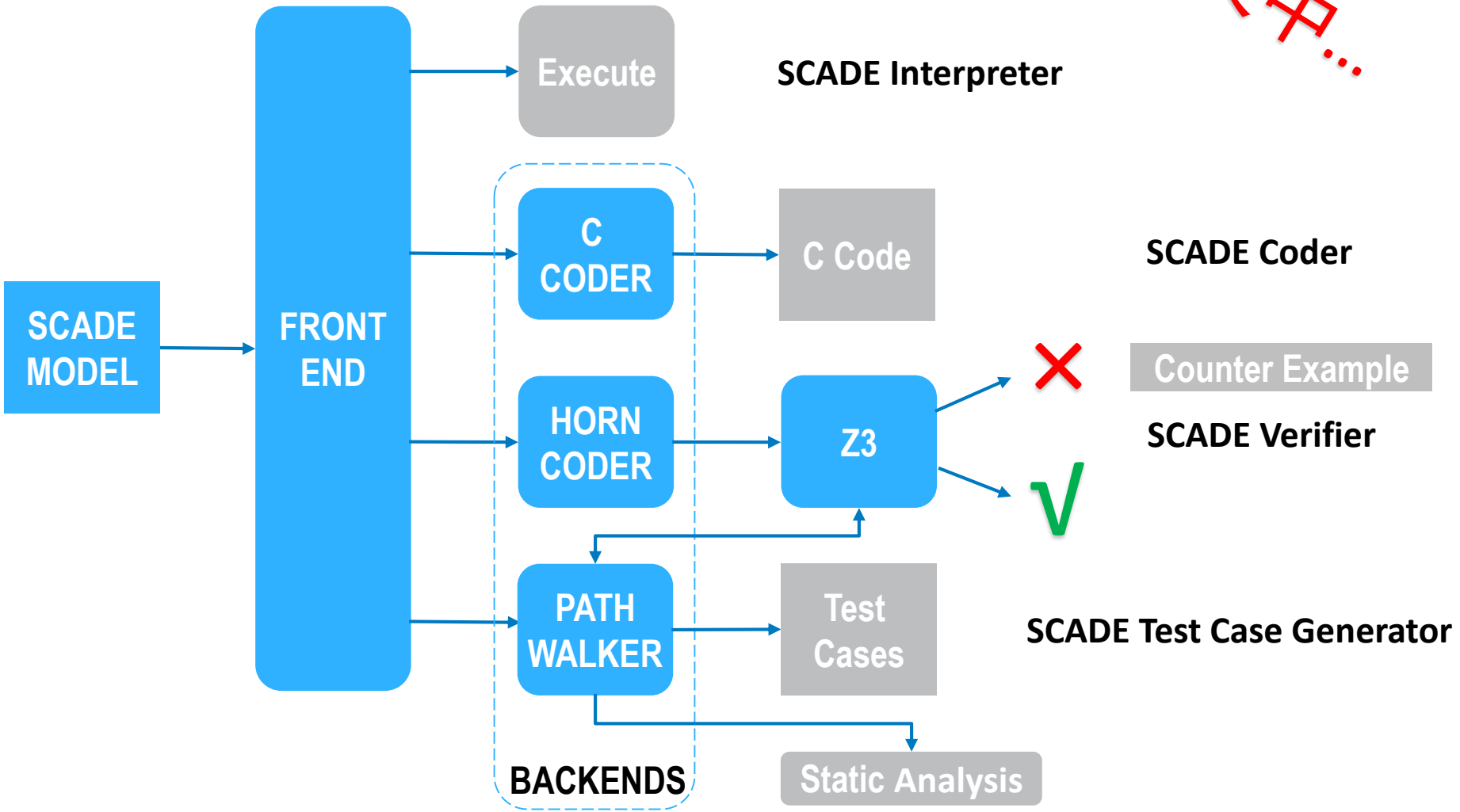
CI Project(.etp file + .xscade file)



辅助开发类：SCADE Interlocking Builder



辅助验证类：SCADE Interpreter/ Coder/Verifier/Test Case Generator

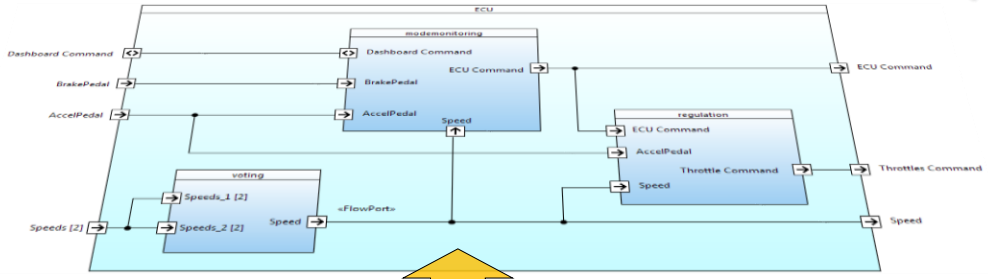


辅助验证类：SCADE Verifier For MBSE

开发中...

SCADE SYSTEM®

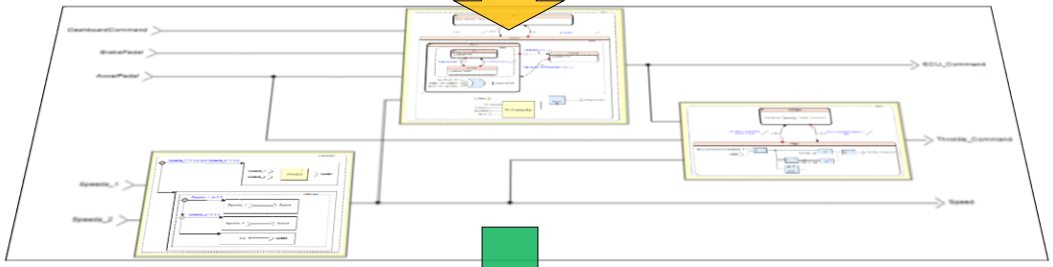
SW Architecture



Auto

SCADE SUITE®

SW Design



Auto

SCADE SUITE®

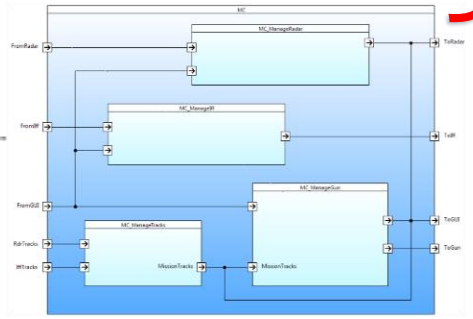
SW Coding

C

```
/* Architecture::Regulation/ */
void Regulation_Architecture(
  /* ECU_Command/ */
  tECU_cmd_Architecture *ECU_Command,
  /* AccelPedal/ */
  tPercent_Architecture AccelPedal,
  /* Speed/ */
  tVehicleSpeed_Architecture Speed, outC_Regulation_Architecture *outC)
{
 kcg_float32 tmp;
 /* SM1:Regul:_L3/ */
 kcg_float32 _L3_Regul_SM1;
 /* SM1: */
 SSM_ST_SM1 SM1_state_act;
/* SM1: */
kcg_bool SM1_reset_act;
/* SM1: */
switch (outC->SM1_state_nxt) {
 case SSM_st_NotRegul_SM1 :
  SM1_reset_act = (*ECU_Command).Status == ON_Architecture;
  if (SM1_reset_act) {
   SM1_state_act = SSM_st_Regul_SM1;
  }
  else {
   SM1_state_act = SSM_st_NotRegul_SM1;
  }
 break;
```


辅助验证类：SCADE Verifier For MBSE

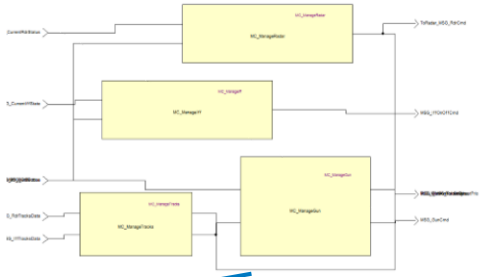
开发中...



Contracts:
Assume: <expr> ;
Guarantee: <expr> ;
--%PROPERTY ["<name>"] <bool_expr> ;

SCADE Interlocking Builder

Auto



assume_ID: expr
guarantee_ID: expr

Observer

bool

SCADE MODEL

FRONT END

HORN CODER

Z3

Counter Example

SCADE Verifier

感谢聆听！

ANSYS-China

ANSYS中国