

Integration of RT-LAB/MapleSim and RT-LAB/Carsim
for
efficient real-time simulation

Cybernet Systems Taiwan

Author : Gavin Liao / Clone Yung

Speaker : Anderson Liao

Introduction

CarSim

MapleSim

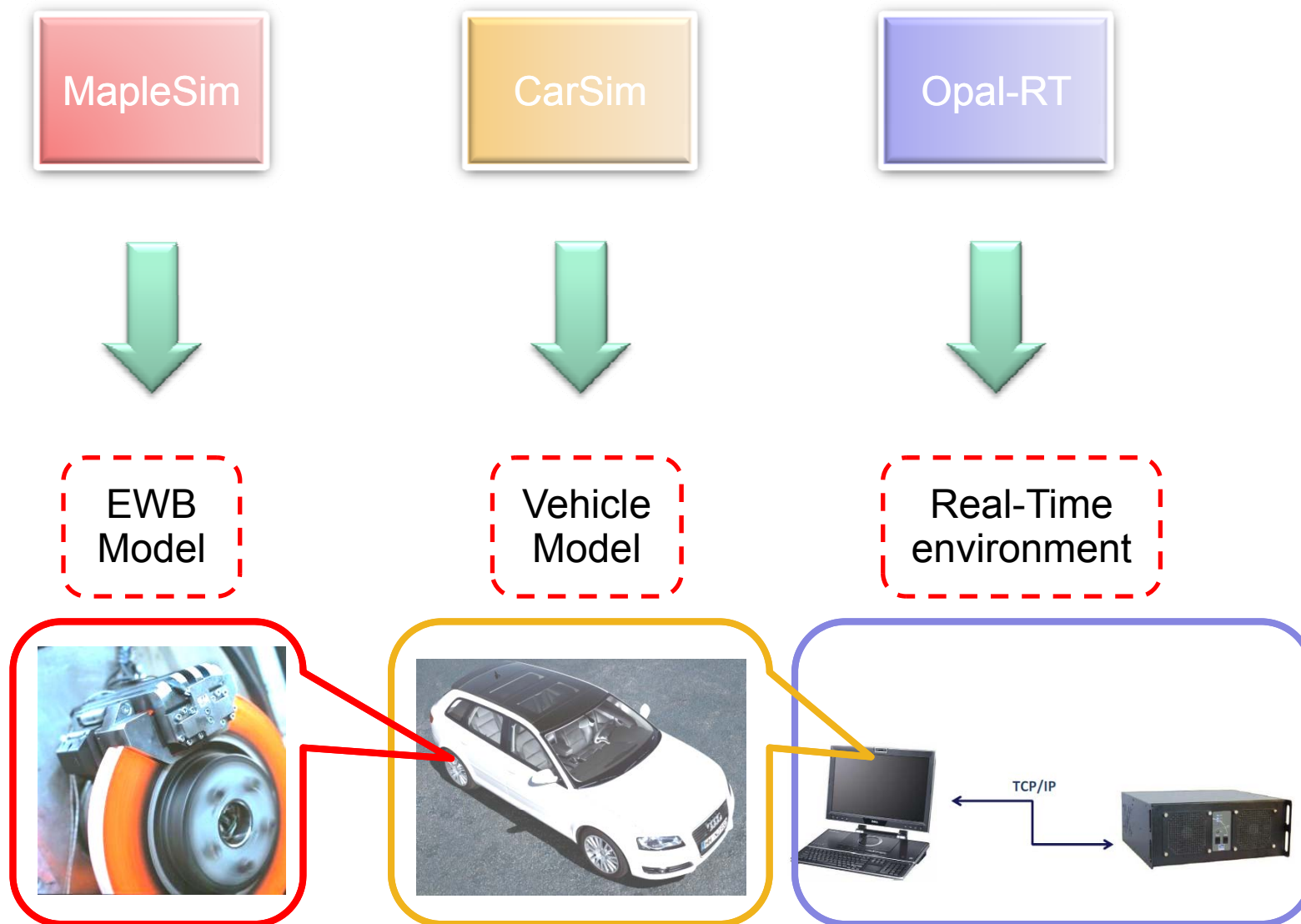
Integration

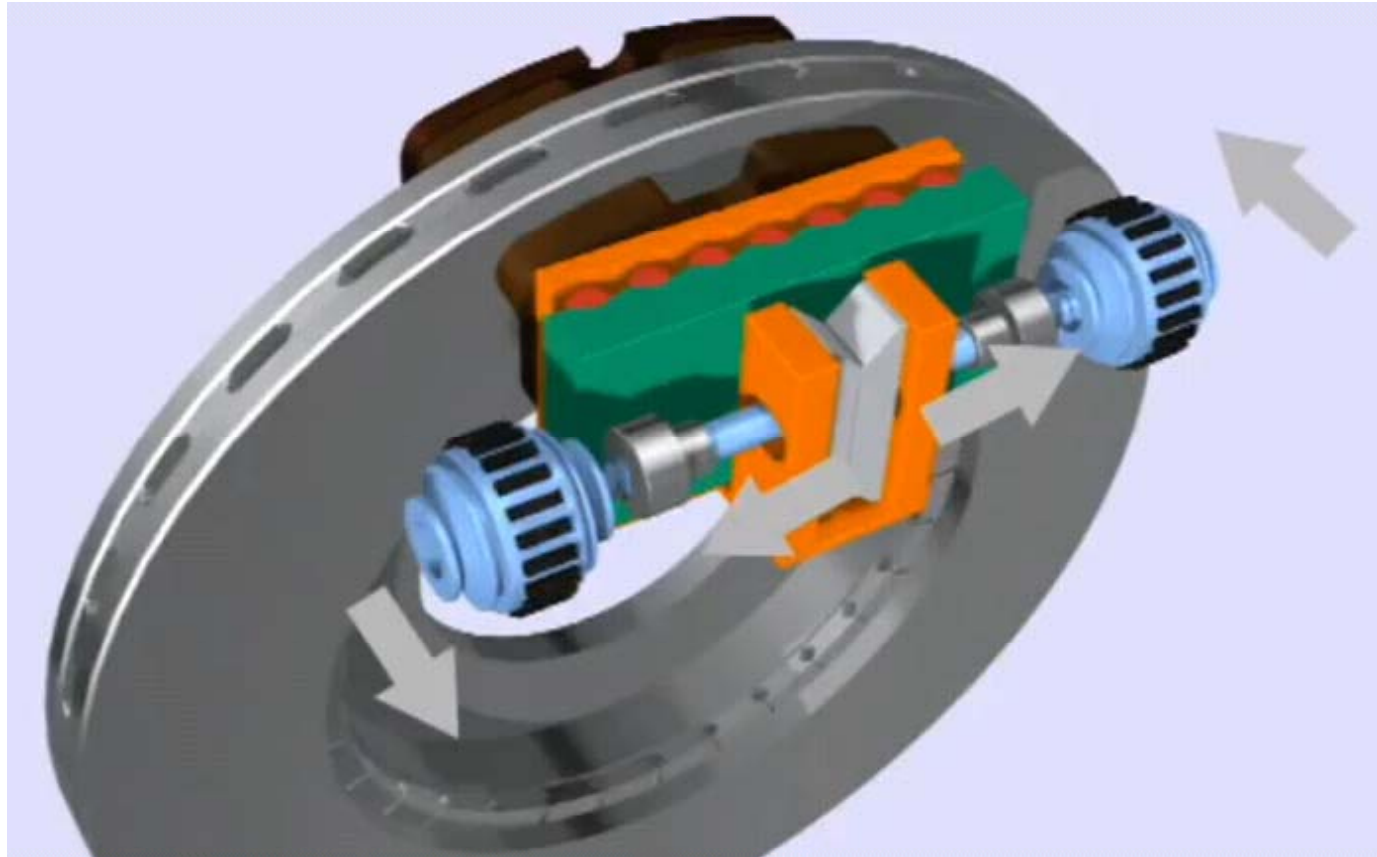
Introduction

CarSim

MapleSim

Integration





Introduction

CarSim

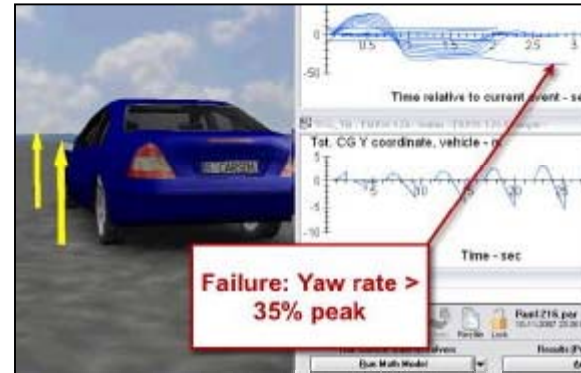
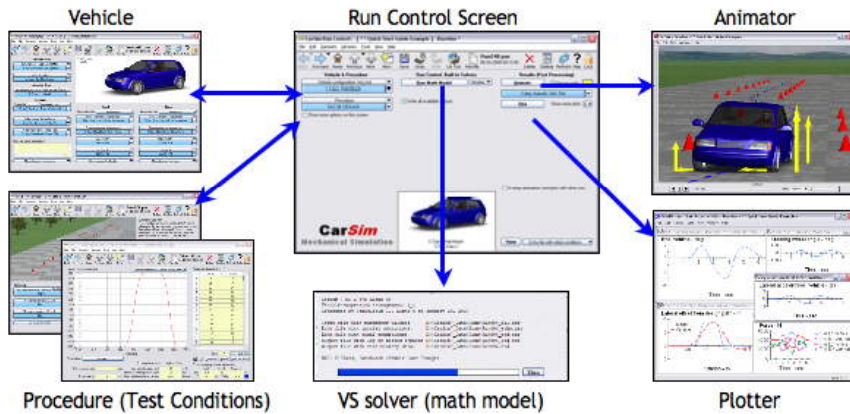
- What is CarSim
- Real-Time Simulation via RT-LAB
- Example

MapleSim

Integration

What is CarSim ?

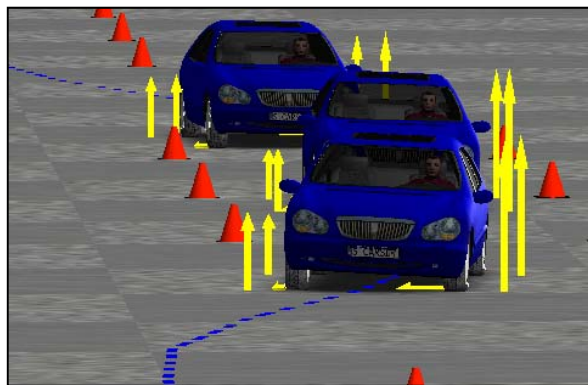
Computer Simulation of Vehicle Dynamics teleology



Easy to use

Accurate

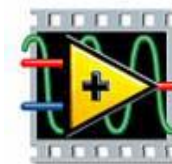
CarSim



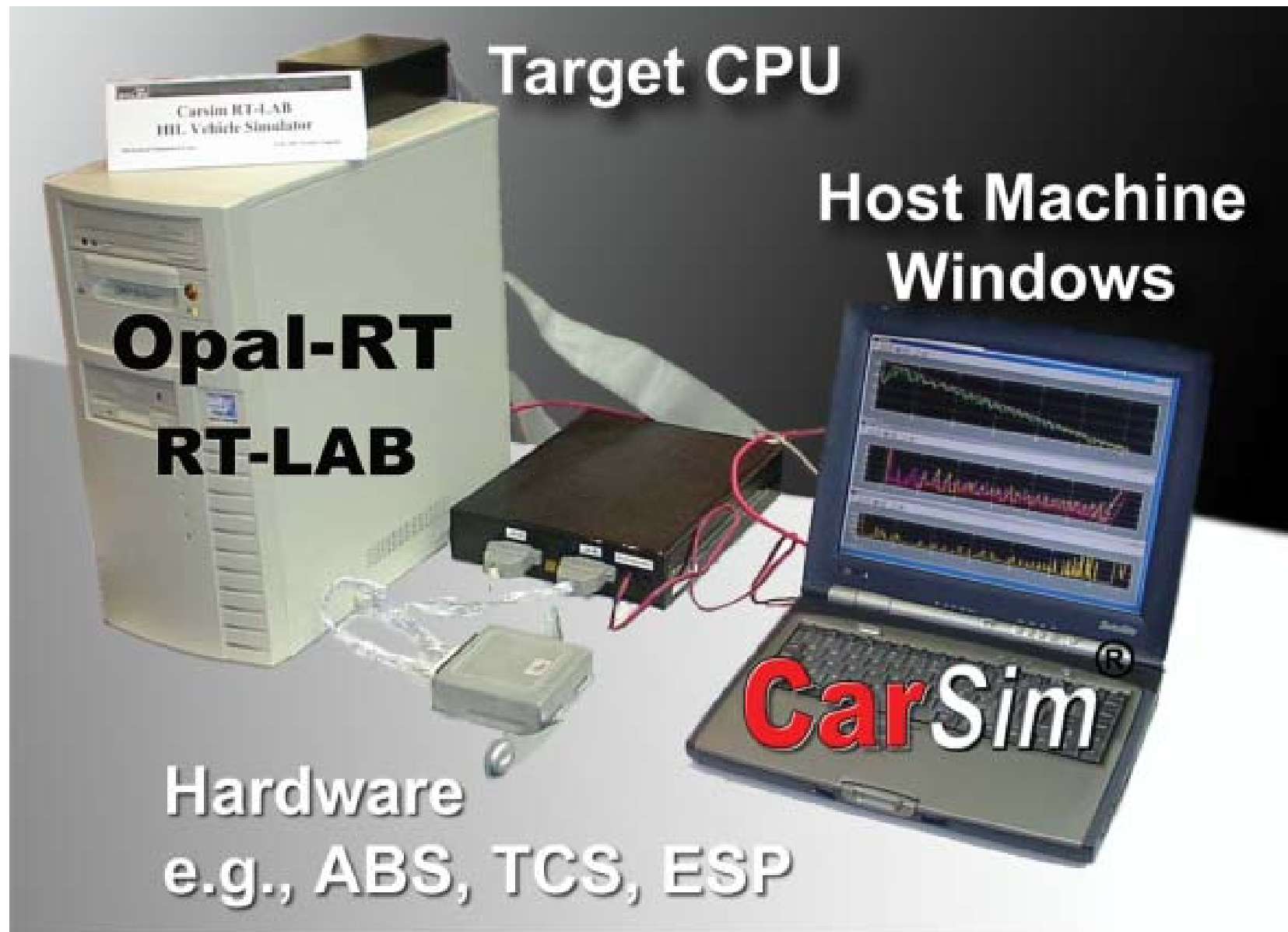
Animation Result



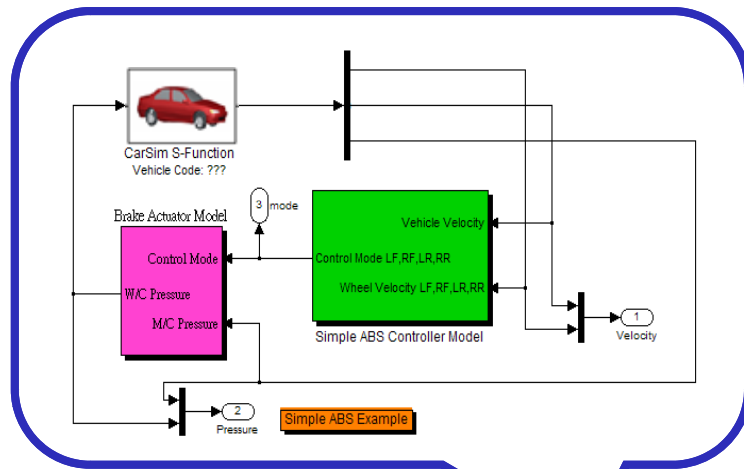
LabVIEW



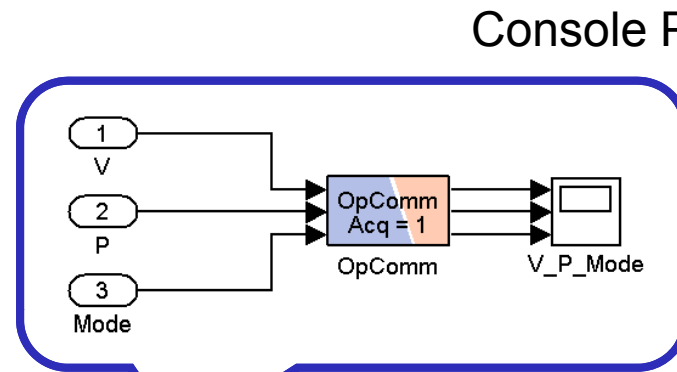
Extensible



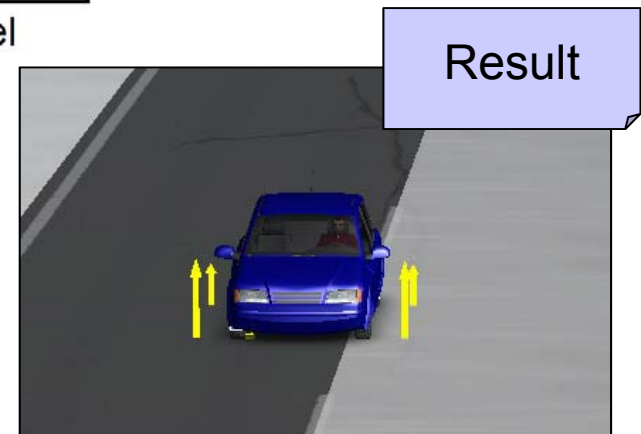
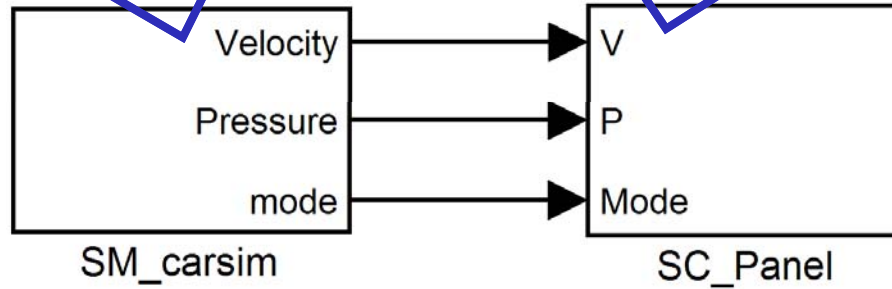
Example : ABS Controller



Target Part



Console Part



Introduction

CarSim

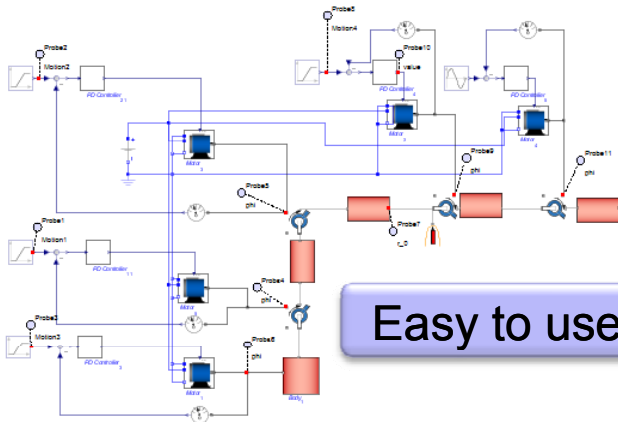
MapleSim

- What is MapleSim
- How MapleSim save our time
- Example

Integration

What is MapleSim ?

Symbolic Computation Technology

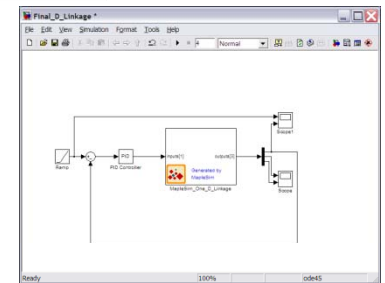


Easy to use



$$\left[F2(t) = -\frac{F1(t)}{m}, s2(t) = s1(t) m \right]$$

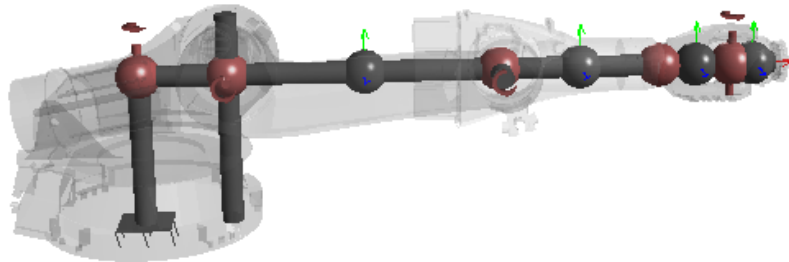
Custom component



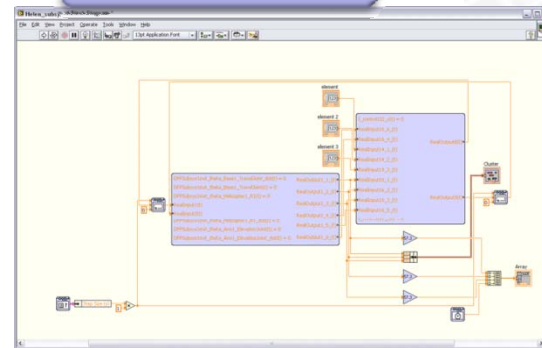
Maple™ 14

The Essential Tool for Mathematics and Modeling

3D Visualization

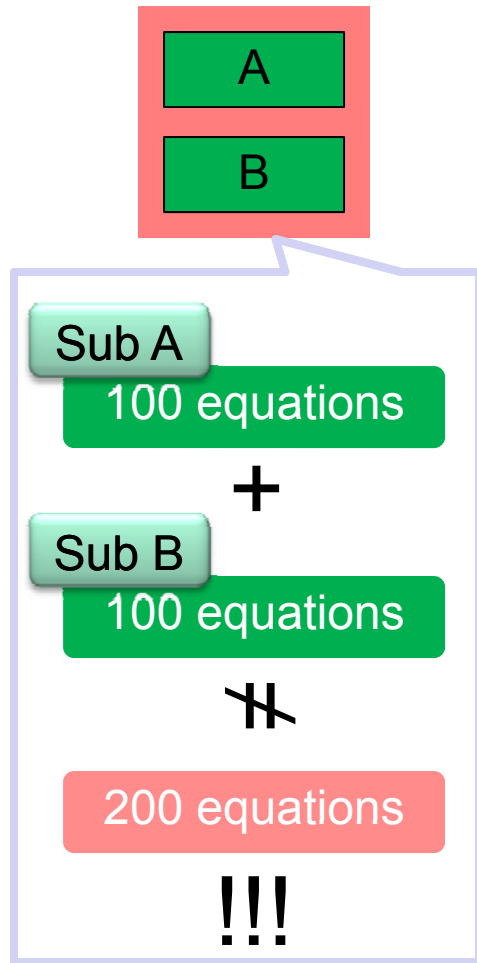


Connectivity



LabVIEW

How MapleSim improve performance



Example 1 (Combine)

$$y1=b+x^2$$

$$y2=y1+c$$

Input: x
output: y2

1 equation runs
faster than 2 equations!

Can be combined as $y2=b+x^2+c$

Example2 (exact solutions)

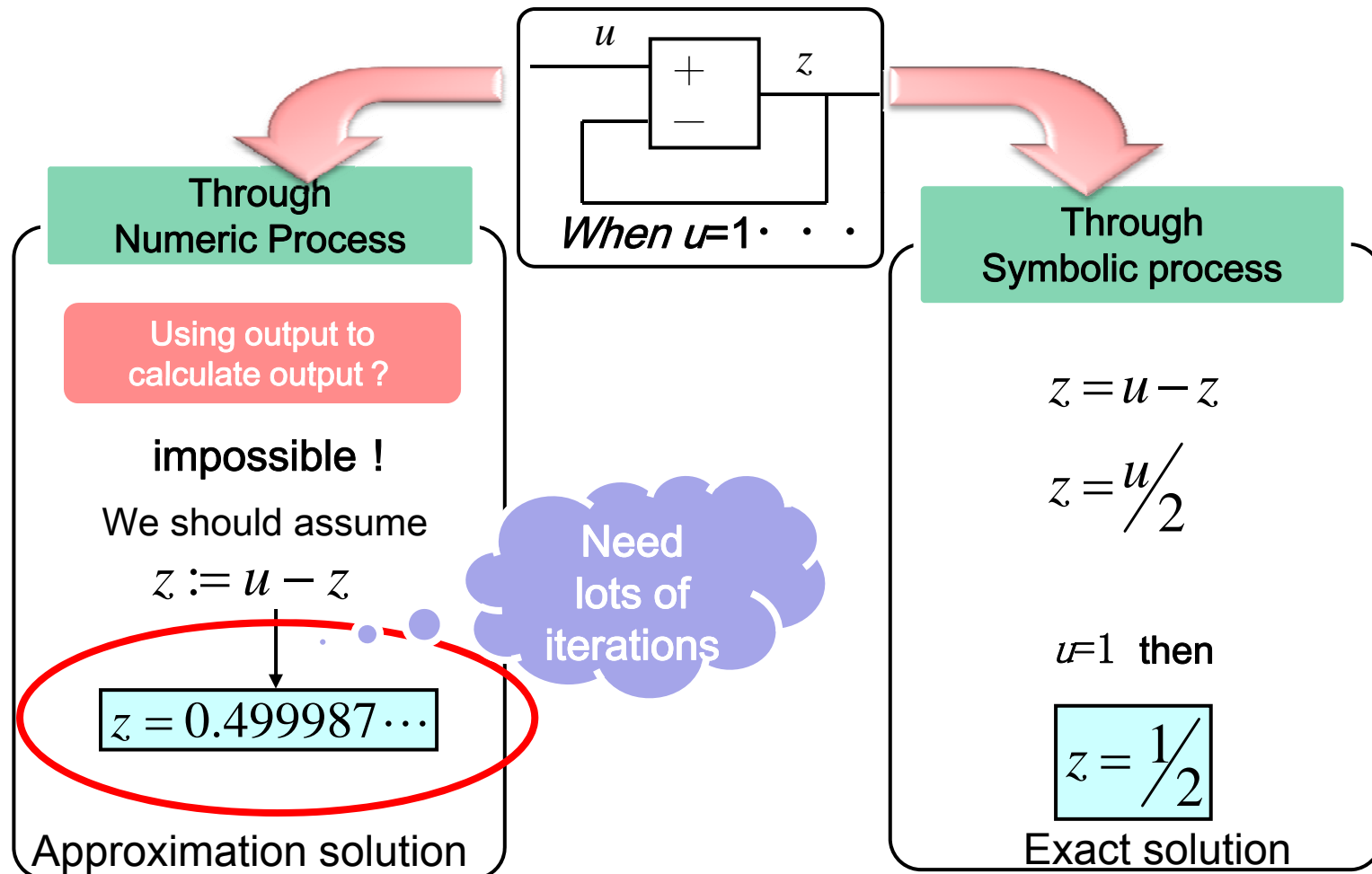
DEs: $dy(t)/dt=x(t), dx(t)/dt=-x(t)$
Conditions: $x(0)=1, y(1)=0$

Can be solved as $x(t)=e^{-t}, y(t)=-e^{-t}+1/e$

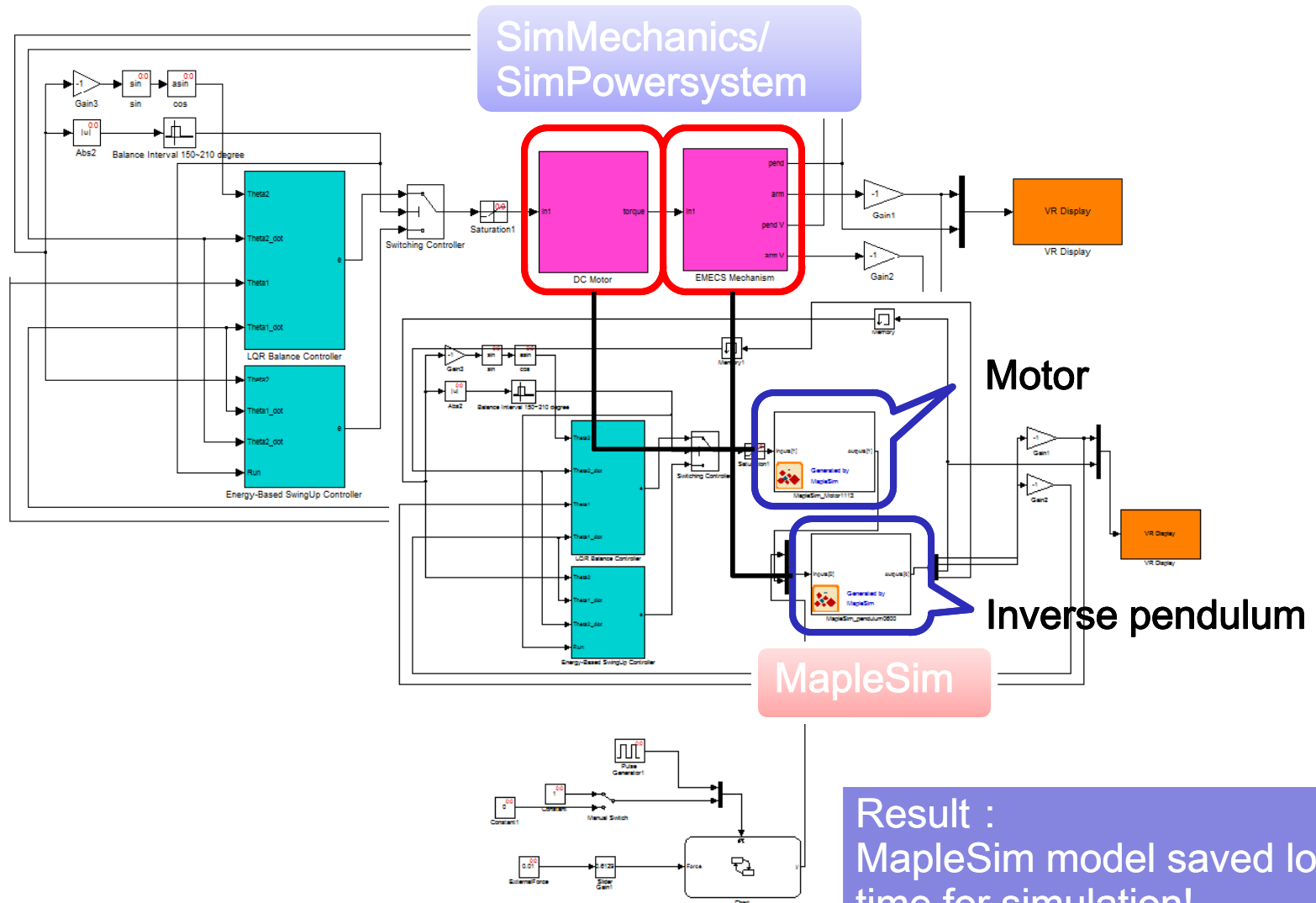
We don't need to solve the ODEs
in every simulating iteration!

These simplification processes will considerably save time for simulation!!

- Solve algebraic loop problem!!

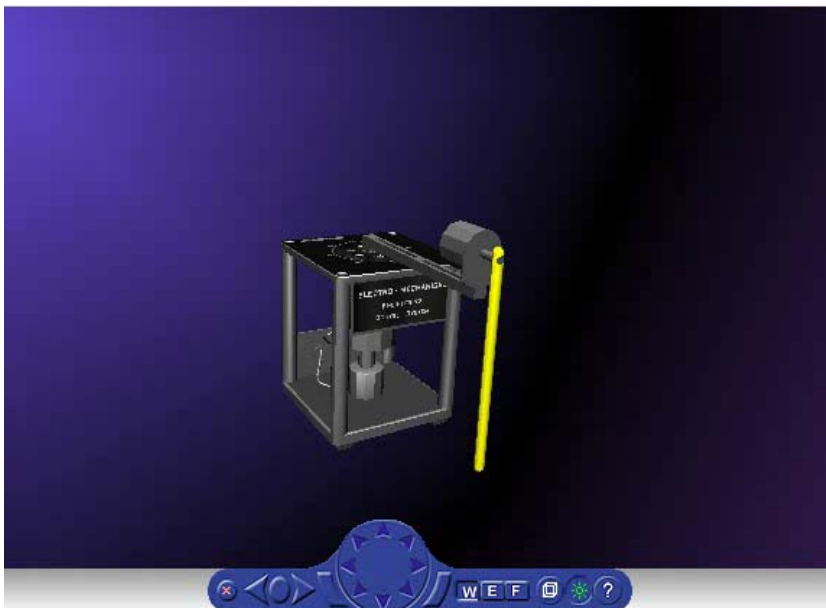


Example – Inverse Pendulum

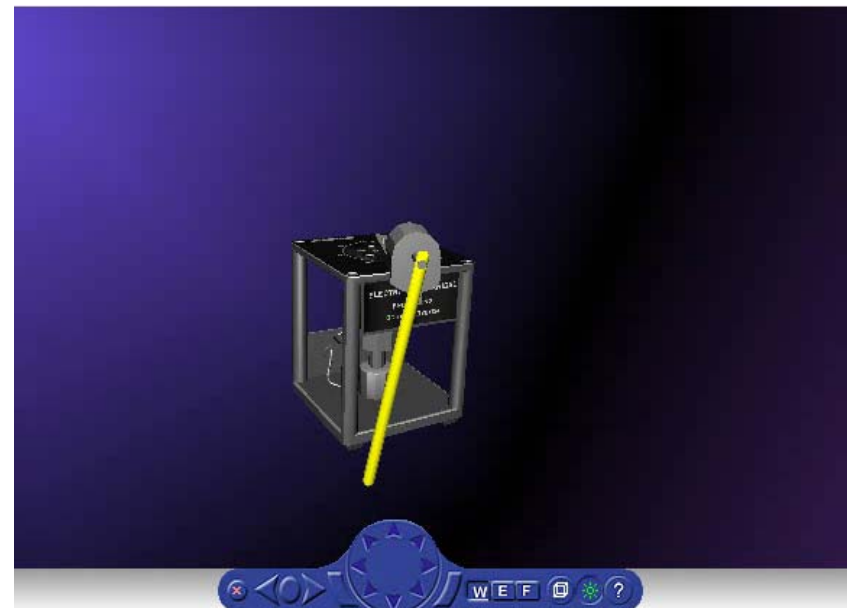


Result :
MapleSim model saved lots of time for simulation!

- Obviously, MapleSim Model took less than half time of the original Simulink model!



Before (SimMechanics)



After (MapleSim)

Introduction

CarSim

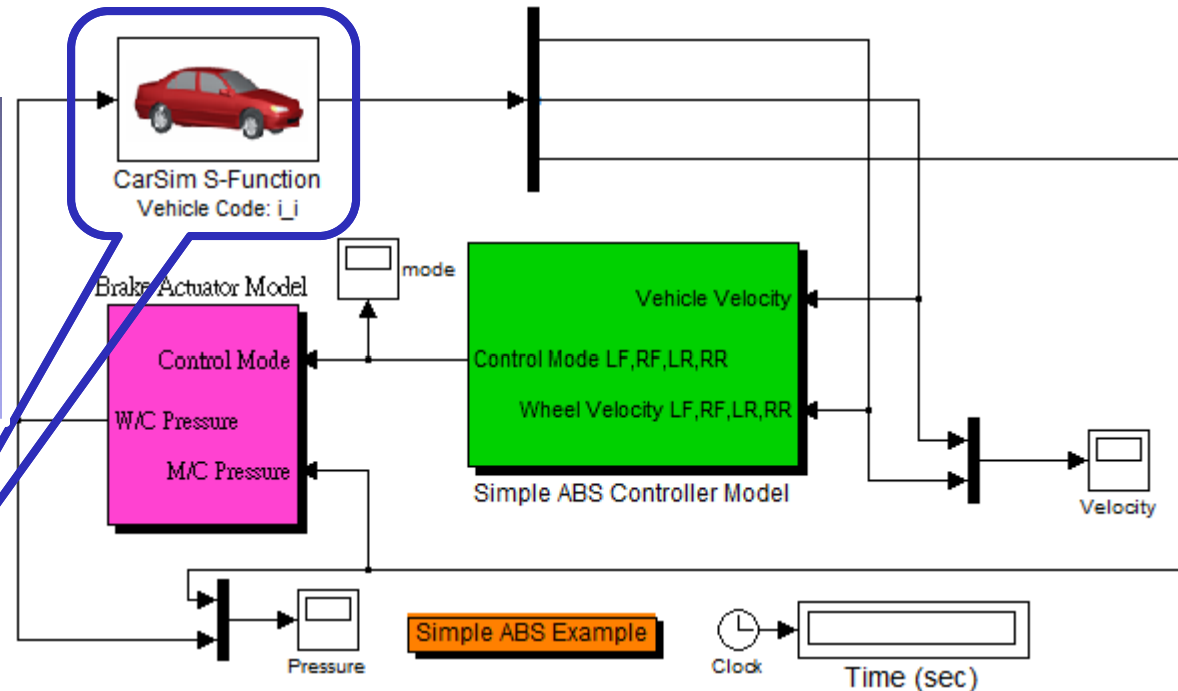
MapleSim

Integration

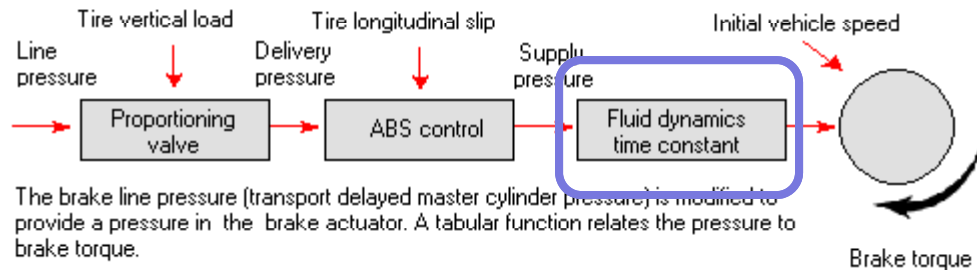
- Offline Design
 - Real Time Simulation
-

Problem:

The pressure signals will be sent into a fluid dynamics time constant first, which will cause a time delay for braking

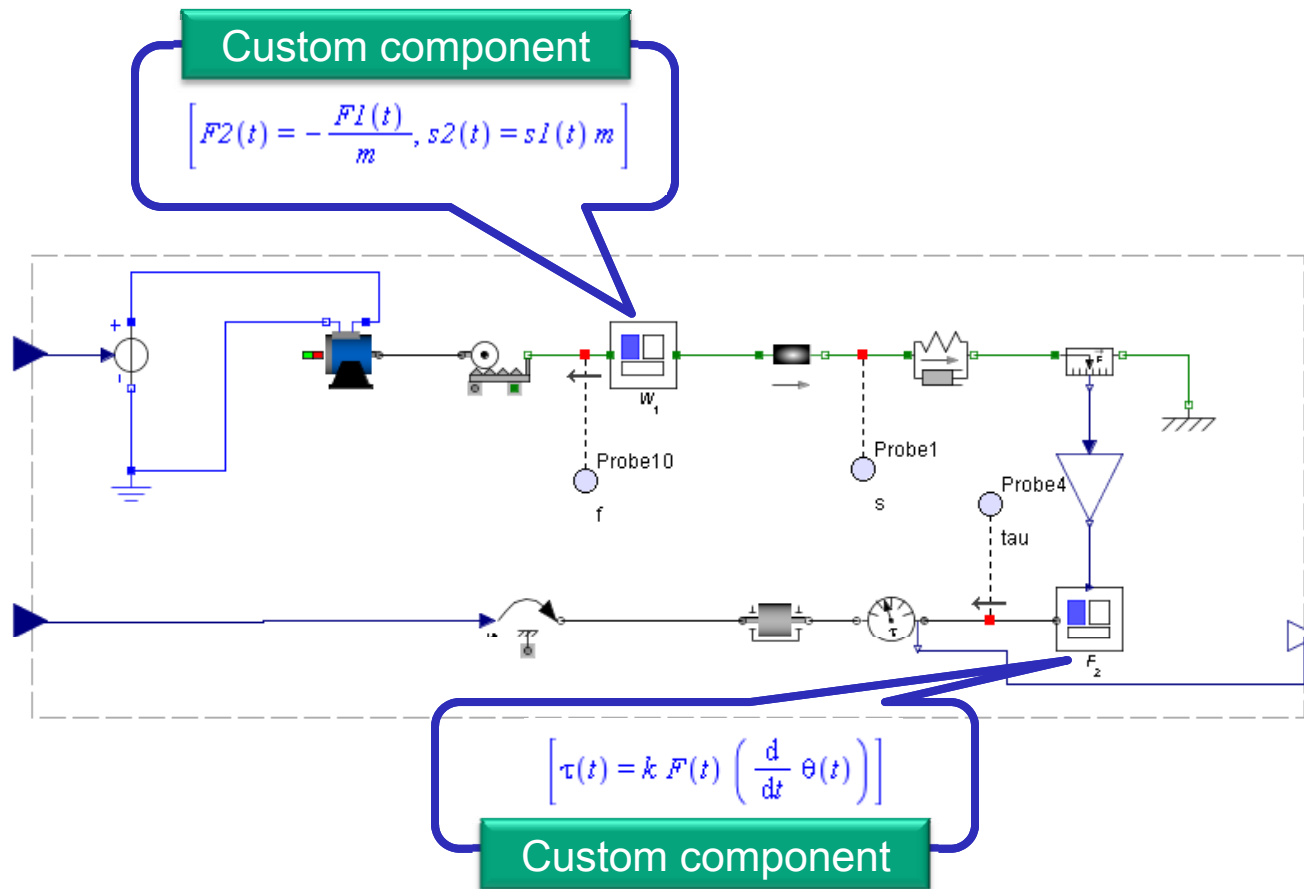


Overview of brake system for one wheel



The brake line pressure (transport delayed master cylinder pressure) is modified to provide a pressure in the brake actuator. A tabular function relates the pressure to brake torque.

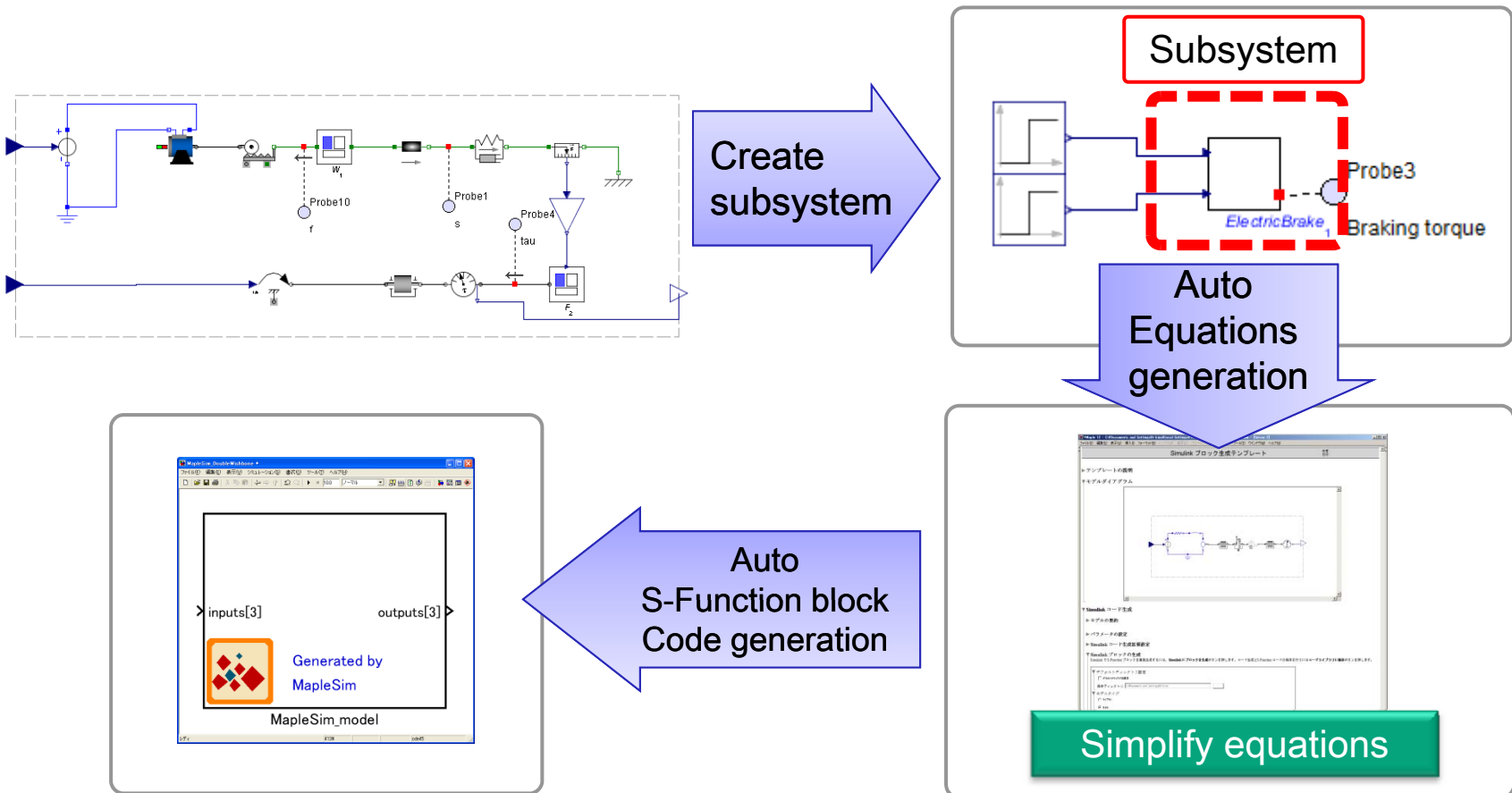
Goal :
Use a EWB directly to calculate the torque needed for braking



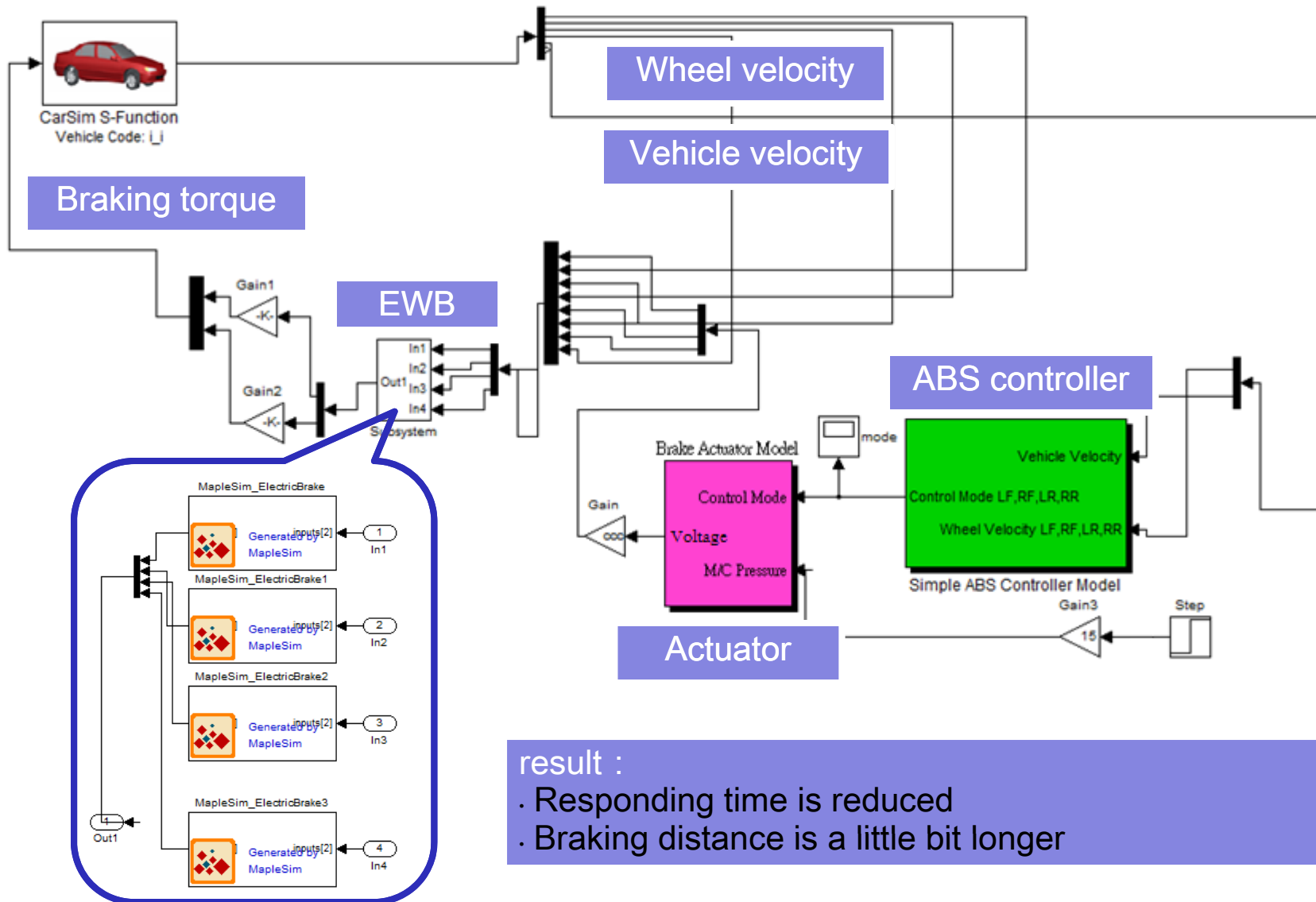
Advantage :

We can simply use some innovative build-in components to create an EWB model in less than one day! And we can create custom components just by input their governing equations in Maple environment. Everything is easy and intuitive!

- Simulink block generation



Replace the EWB model



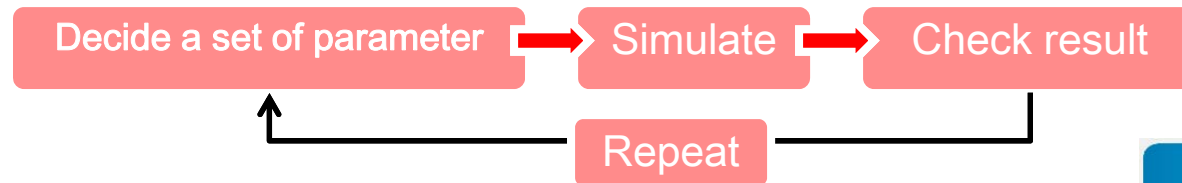
result :

- Responding time is reduced
- Braking distance is a little bit longer

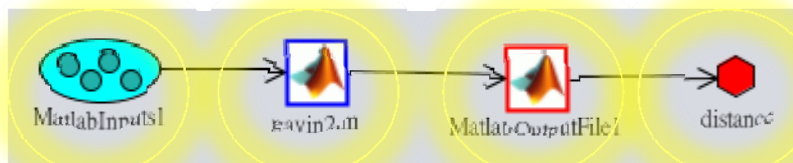
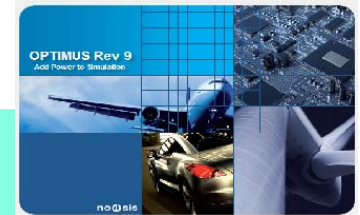
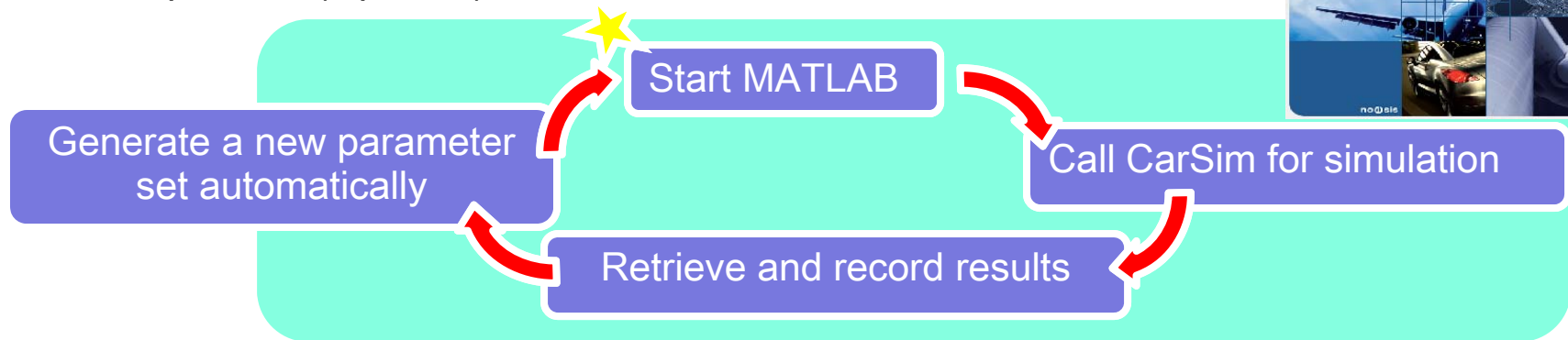
Optimize variables with Optimus

• Since we are not sure how much braking torque will cause the best result, we use Optimus to tune the gain values of braking torque.

• Traditional tuning process :



• New process (Optimus) :



Iter	gavln_a	gavln_b	gavln_c	distance	GOAL
1	1.1	1.1	2	112.14304	112.14304
2	1.23779	1.43055	3.00853	113.72086	113.72086
3	1.44395	1.21467	2.97569	114.04535	114.04535
4	0.5925	1.36782	1.25944	115.04399	115.04399
5	1.19515	1.02424	2.24938	250.99872	250.99872
6	0.81306	0.87269	1.40997	112.72006	112.72006
7	1.01967	0.9903	4.93415	379.59723	379.59723
8	1.07904	0.56319	1.65467	192.36557	192.36557
9	0.52043	0.80412	2.56032	137.0793	137.0793
10	1.33659	1.34778	4.21009	401.62509	401.62509
11	0.91693	1.14089	3.75799	115.55602	115.55602
12	0.96904	0.68249	4.13188	230.67723	230.67723
13	0.76075	0.757	3.47063	367.16486	367.16486
14	1.40671	0.64184	1.9424	398.75192	398.75192
15	0.66411	1.18846	4.53056	136.21797	136.21797
16	1.17709	1.23342	4.2146	252.03149	252.03149

Conditions:

- Both Start in 137km/hr
- Both are Braking at 1 sec

Start braking at 1sec



EWB car respond faster

Final result



EWB car need a shorter braking distance

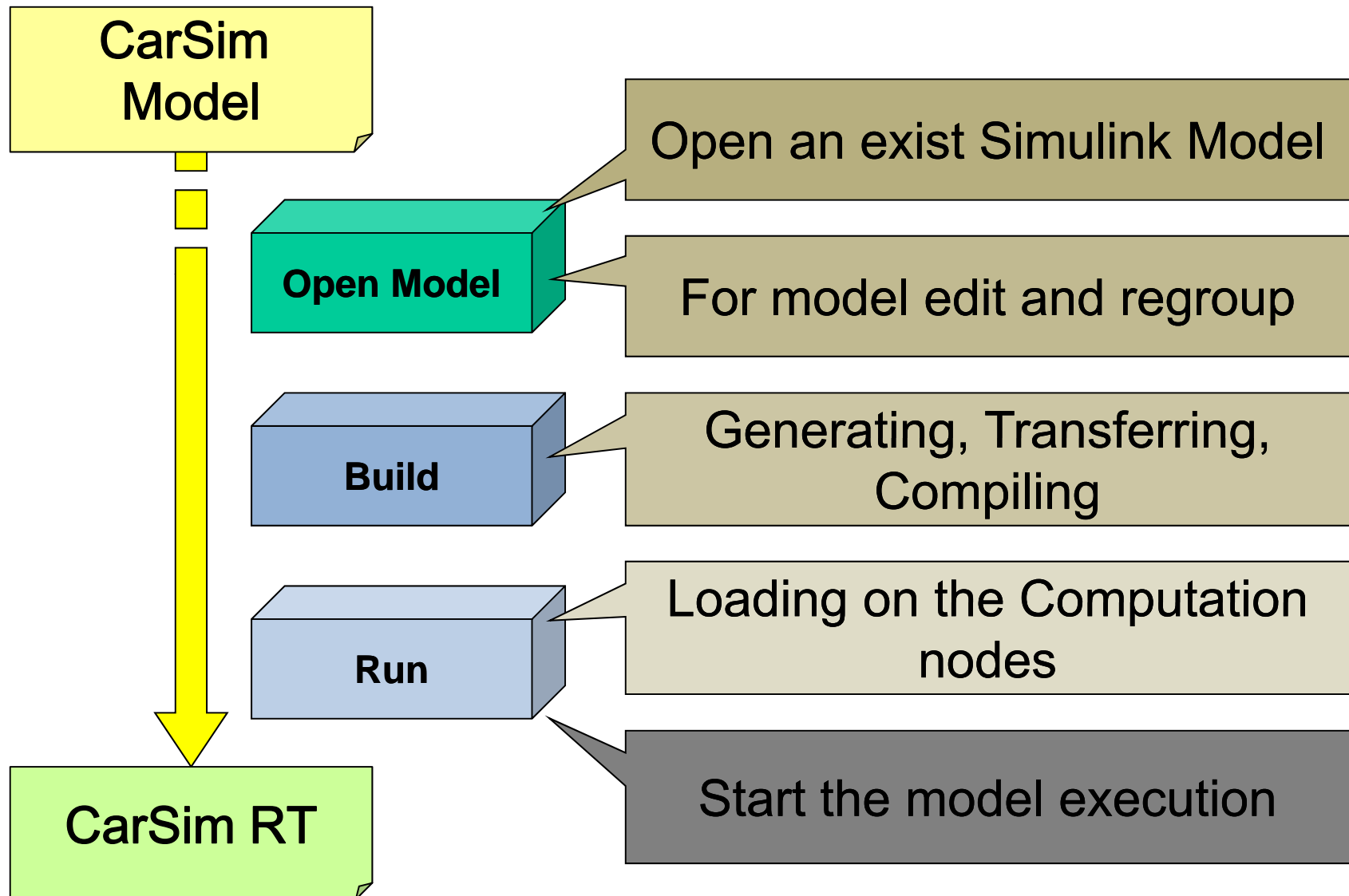


with hydraulic brake system



with electronic wedge brake system





Support

CarSim/OPAL_RT by Clone Yung and John Yung

Maple/MapleSim by Gavin.Liao and John Yung

Contact

Gavin Liao : Gavin.Liao@cybernet-ap.com.tw

Clone Yung : Clone.Yung@cybernet-ap.com.tw

John Yung : John.Yung@cybernet-ap.com.tw

Anderson Liao : Anderson.Liao@cybernet-ap.com.tw
