Institute for Software Integrated Systems
Vanderbilt University

Hardware-in-the-loop Simulation Testbed for Model-Based Control and Integration of Automotive CPS

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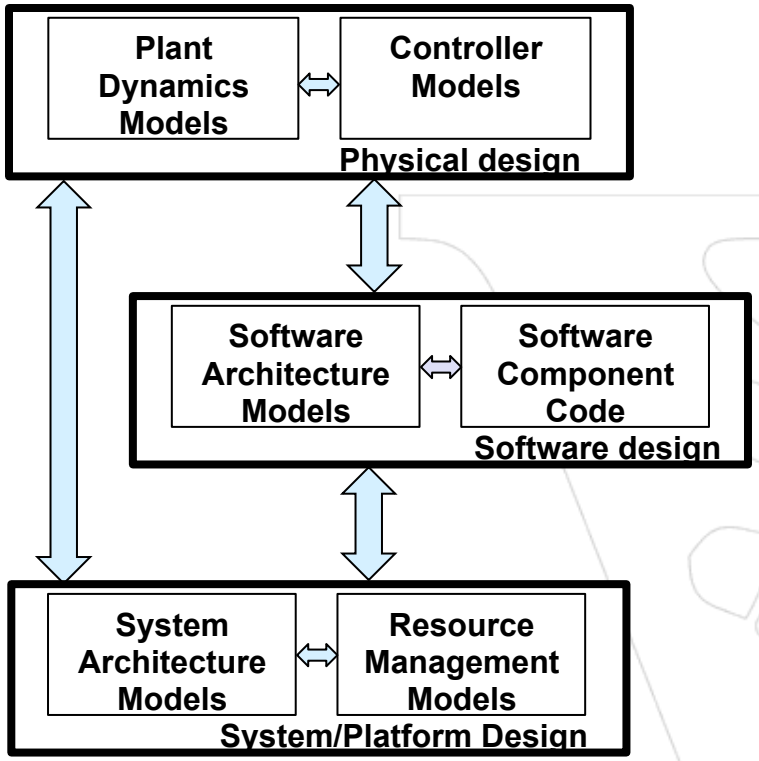
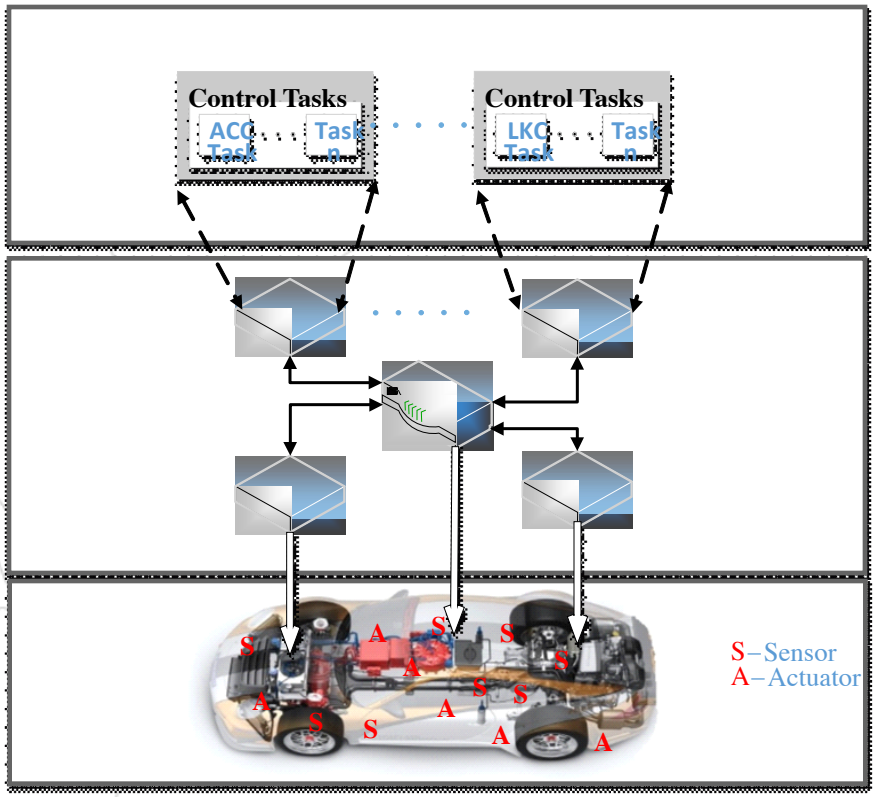
NSF CPS PI meeting
October 17-18, 2013

Control in Automotive CPS

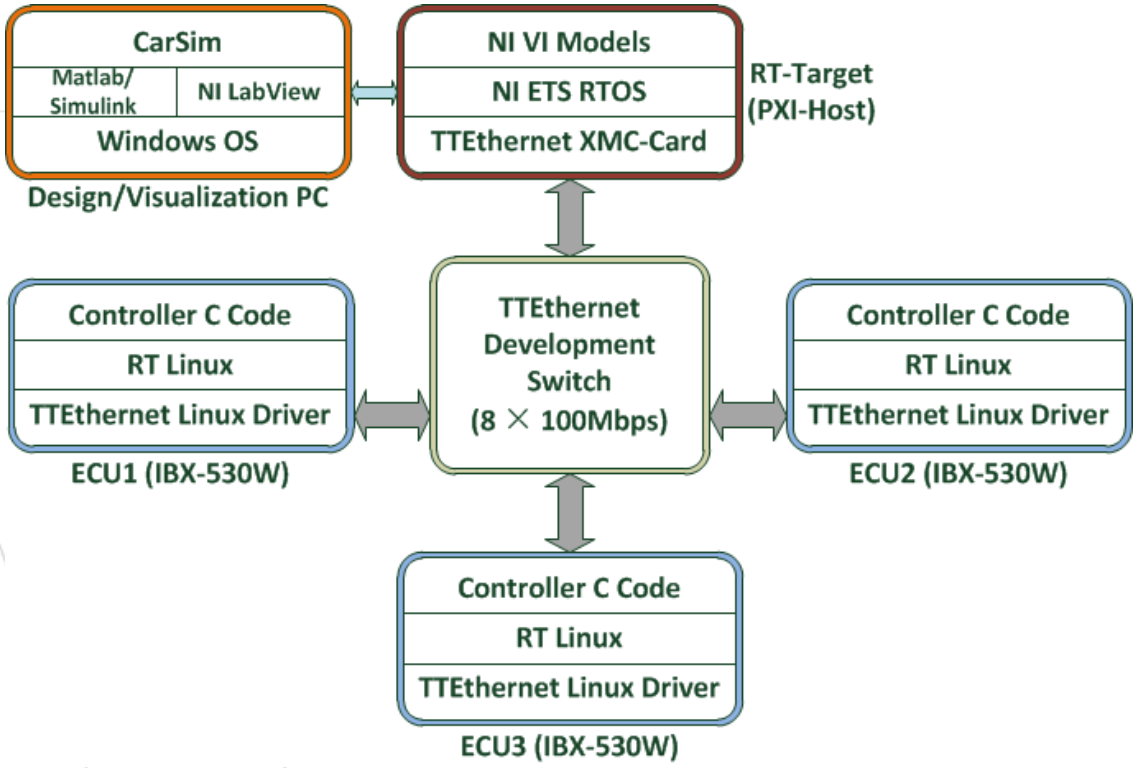




Science of System Integration:
Passivity-based design: Decouple stability from implementation side effects

Hardware-in-the-Loop Simulation Platform

- Design/Visualization PC
  - Vehicle modeling using CarSim
  - Controller design
- RT-Target
  - Represents automotive vehicle
  - CarSim model is deployed via VI models
  - NI ETS 2011 RTOS
  - TTTech PCIe-XMC card
- 8 × 100Mbit/s TTTech TTEthernet Development Switch
- ECU – IBX-530W boxes
  - Controller C code is deployed
  - RT Linux kernel
  - TTEthernet timer driver
  - TTEthernet driver for Realtek NIC

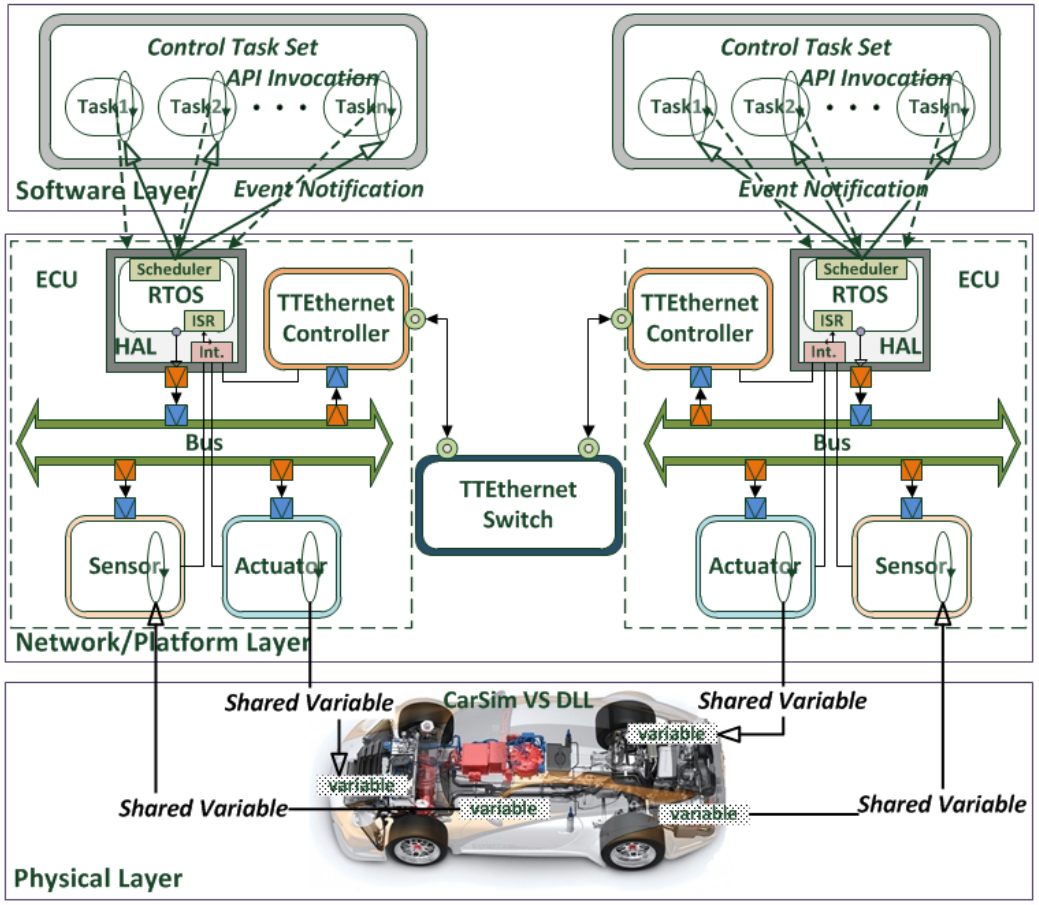


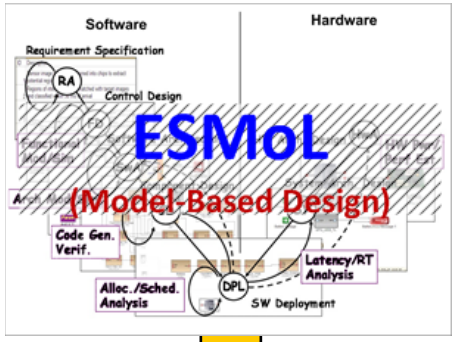
Virtual Platform

MATLAB SIMULINK

SYSTEM C

CarSim Mechanical Simulation



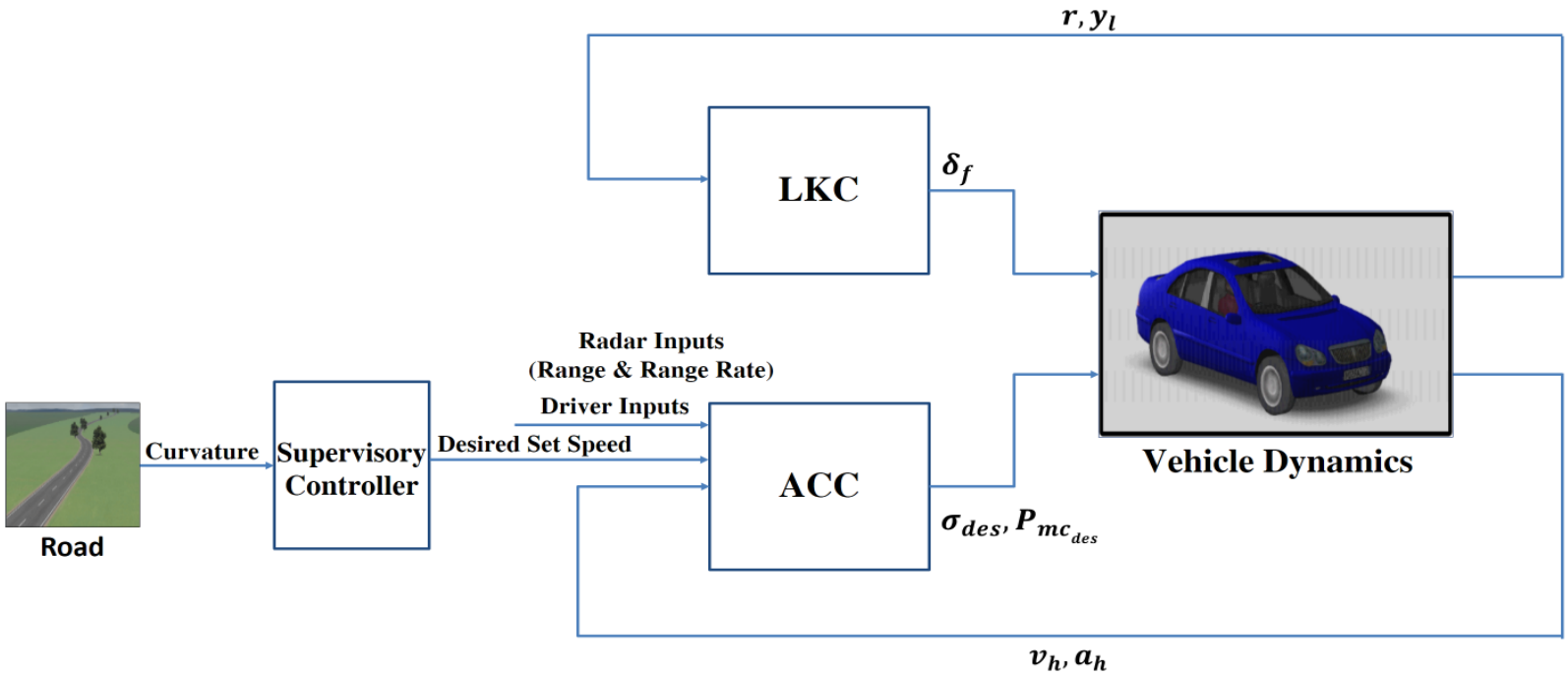


Auto Generate

Design Space Exploration

[Zhang et al. 2013] Co-Simulation Framework for Design of Time-Triggered CPS, ICCPS 2013.

Adaptive Cruise Controller/Lane Keeping Controller



ACC/LKC Interactions