Challenges in Satisfying the Need and Promotion of Modeling & Simulation Workforce

Panel, Winter Simulation Conference (WSC) 2021
Phoenix, AZ, USA. December 15, 2021
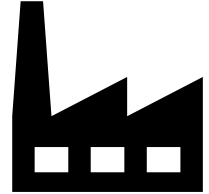
Akshay Rajhans, PhD
arajhans@mathworks.com
https://arajhans.github.io

About me

- Industry practitioner
  - Embedded controls and industrial automation for diesel engine manufacturing and applications at Cummins
  - Data-driven + model-based approach at Bosch
  - Model-based design problems from Toyota during PhD

- Academic researcher
  - Control, robotics, AI/ML, formal analysis, more during MS at Penn
  - Multi-formalism Model-Based Design, formal analysis during PhD at Carnegie Mellon
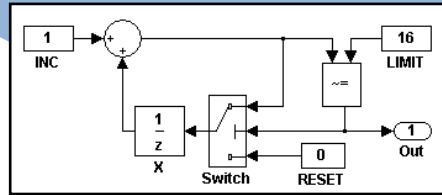 - Software and system architecture during PhD at Carnegie Mellon
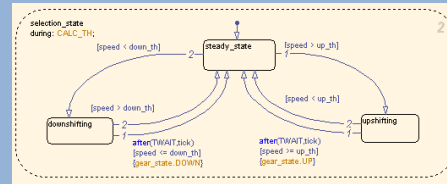
- Research Scientist
  - Work on building a modeling and simulation platform
  - Used by industry practitioners and academic researchers alike

[Modeling]: Model-Based Design and Systems Engineering

Simulink **Stateflow** **MATLAB** **C, C++ S-functions**

Unified representation

Graph level & algorithm level analysis

Modeling semantics level analysis

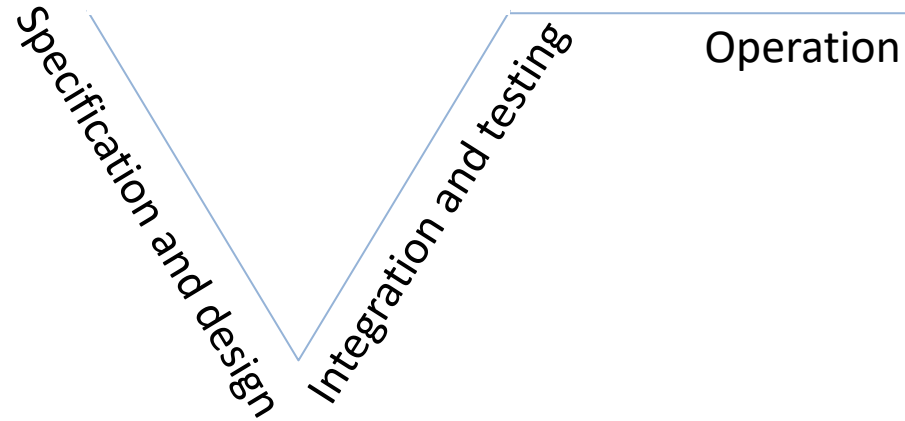Implementation level analysis

C code **C++ code** **HDL code** **PLC code** **GPU code**

[Modeling]: Model-Based Operation with Digital Twins

Specification and design
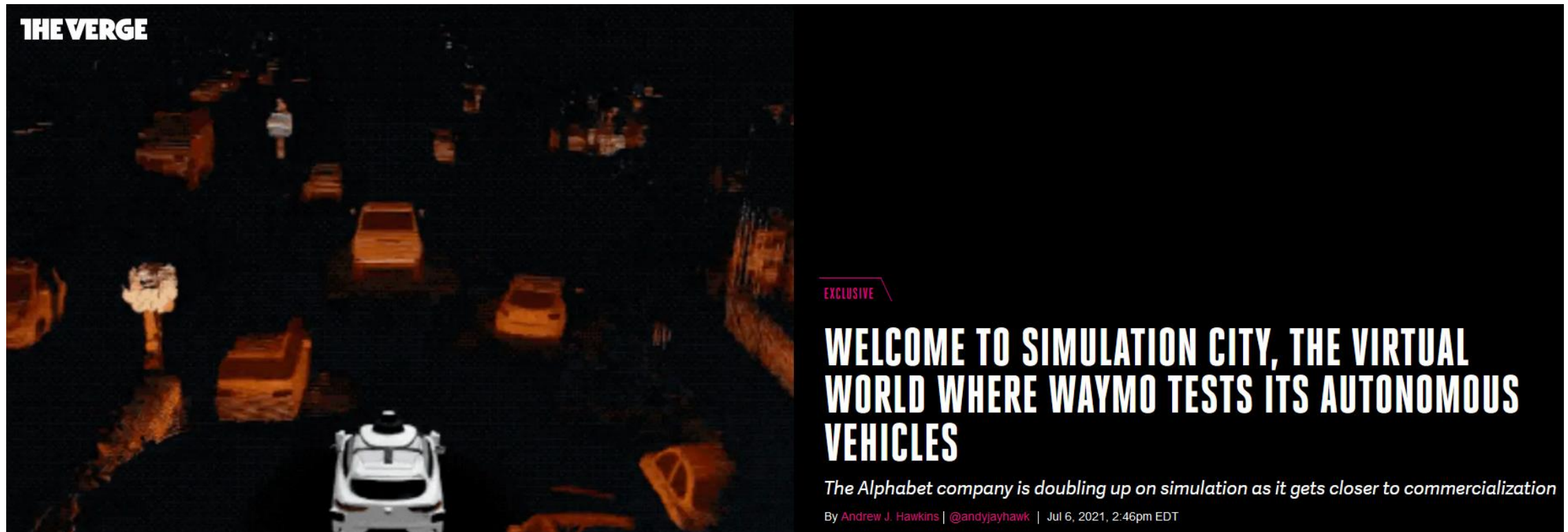
Integration and testing

Operation

Challenges in the Operation and Design of Intelligent Cyber-Physical Systems, S. Castro, P.J. Mosterman, **A.H. Rajhans**, and R.G. Valenti, book chapter, *Complexity Challenges in Cyber Physical Systems: Using Modeling and Simulation (M&S) to Support Intelligence, Adaptation and Autonomy*, S. Mittal and A. Tolk, eds., Wiley, 2019.

https://www.mathworks.com/discovery/digital-twin.html
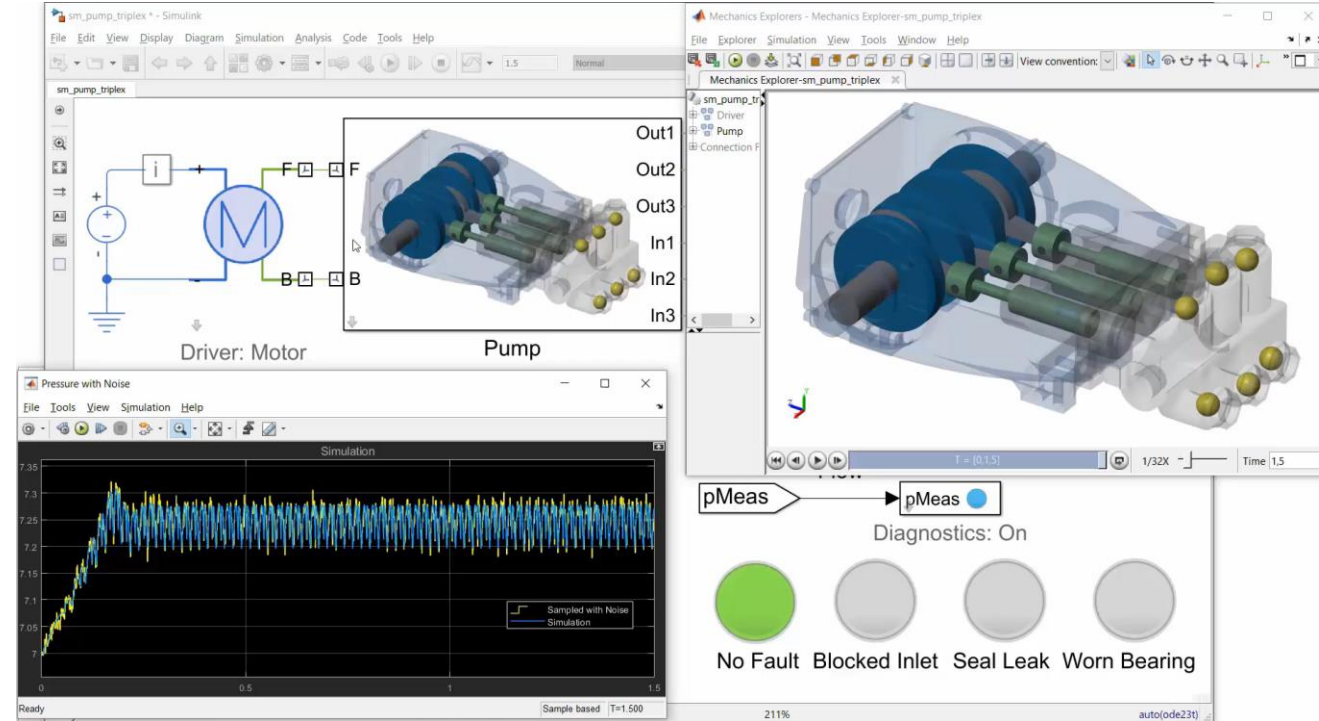
[Simulation] Increasing relevance (example):
Billions of 'Simulation miles' driven by autonomous vehicles

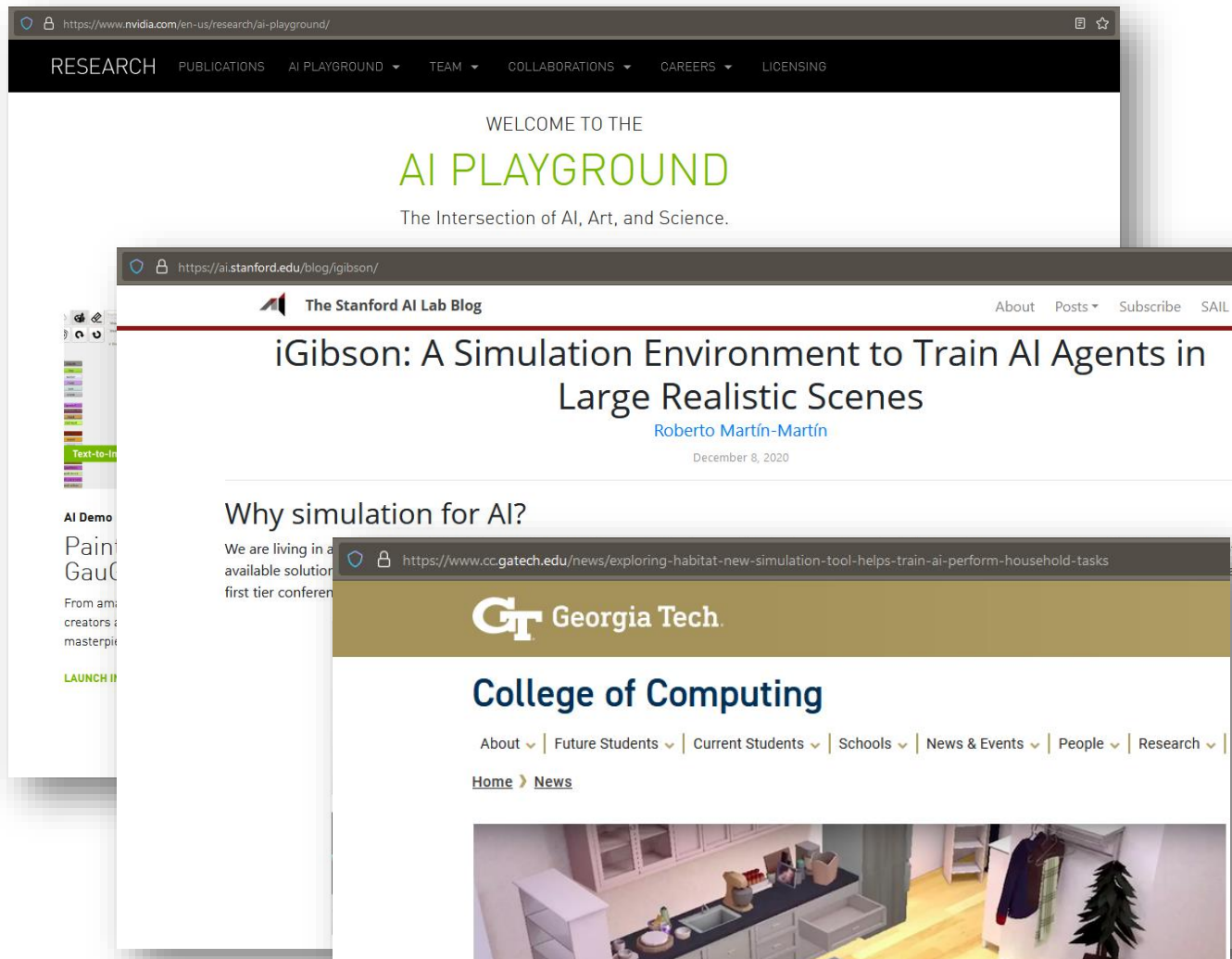

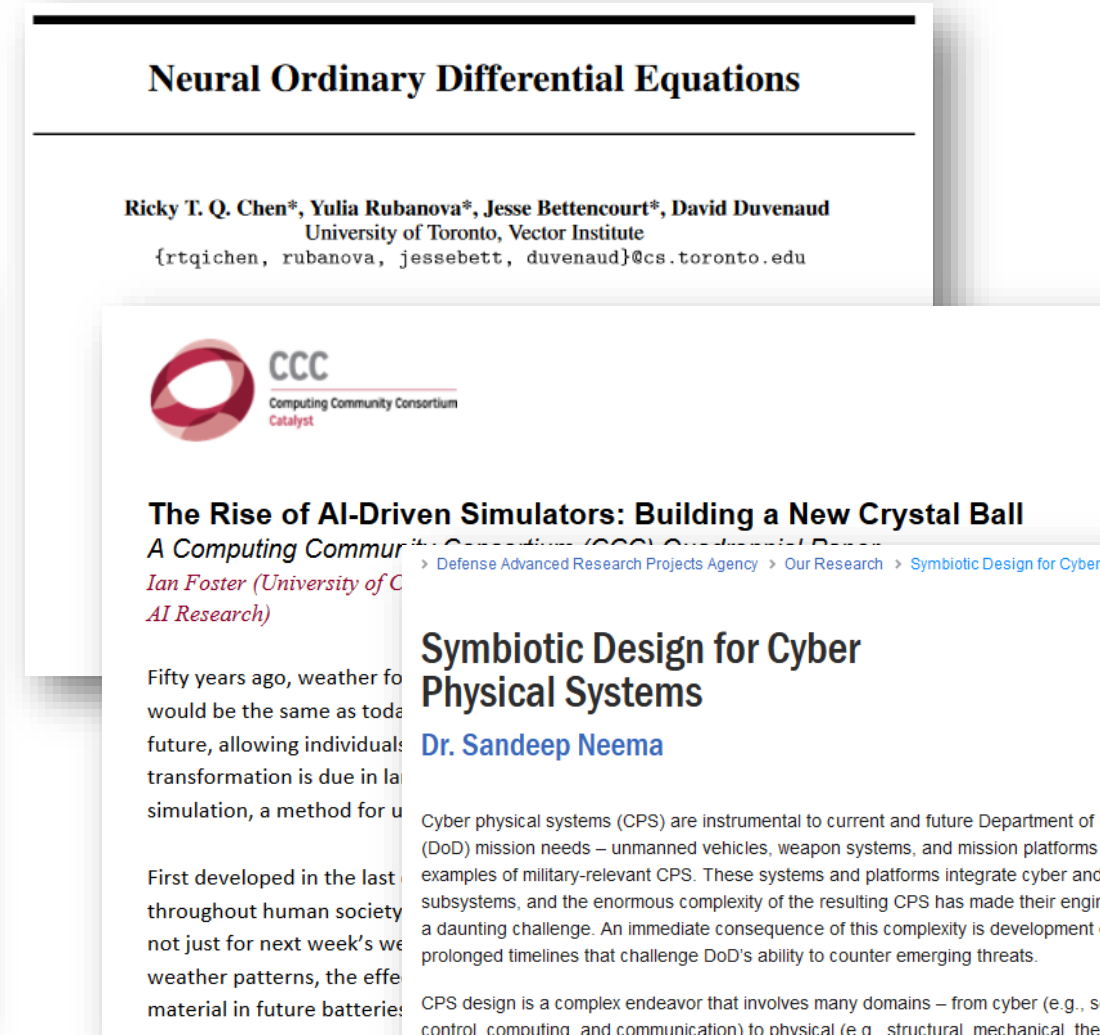https://www.theverge.com/2021/7/6/22565448/waymo-simulation-city-autonomous-vehicle-testing-virtual

https://techcrunch.com/2019/07/10/waymo-has-now-driven-10-billion-autonomous-miles-in-simulation/
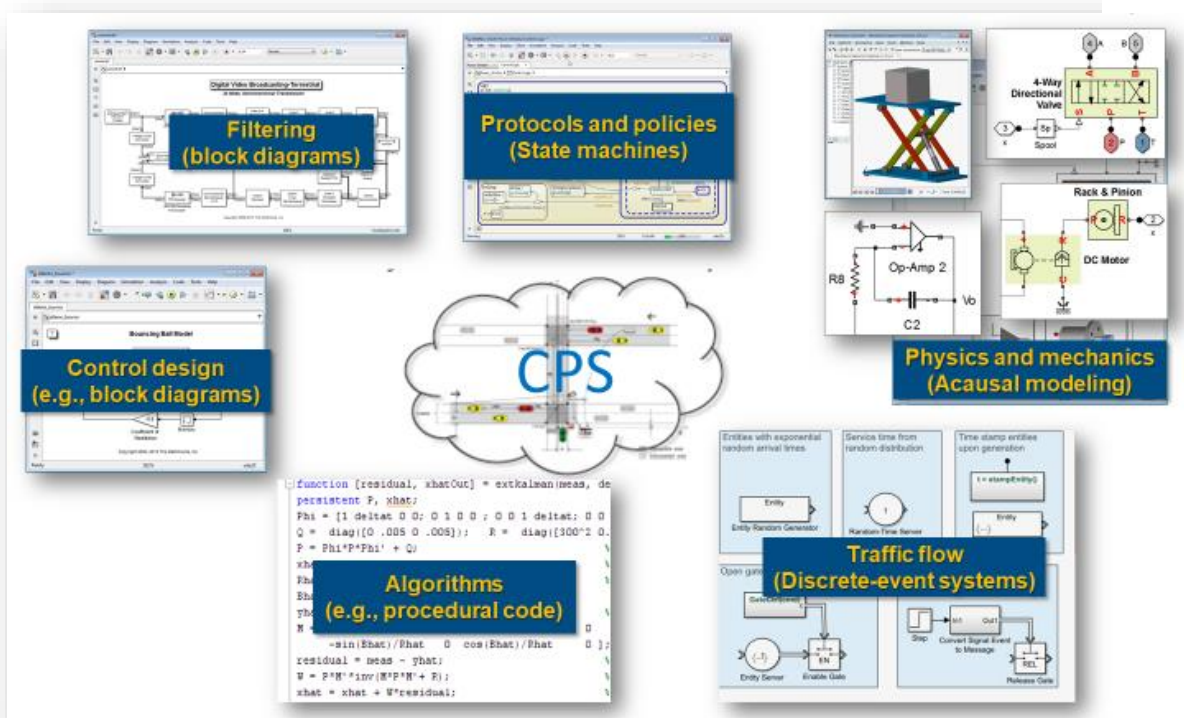
New paradigms with the advent of AI

Simulation for AI (examples)
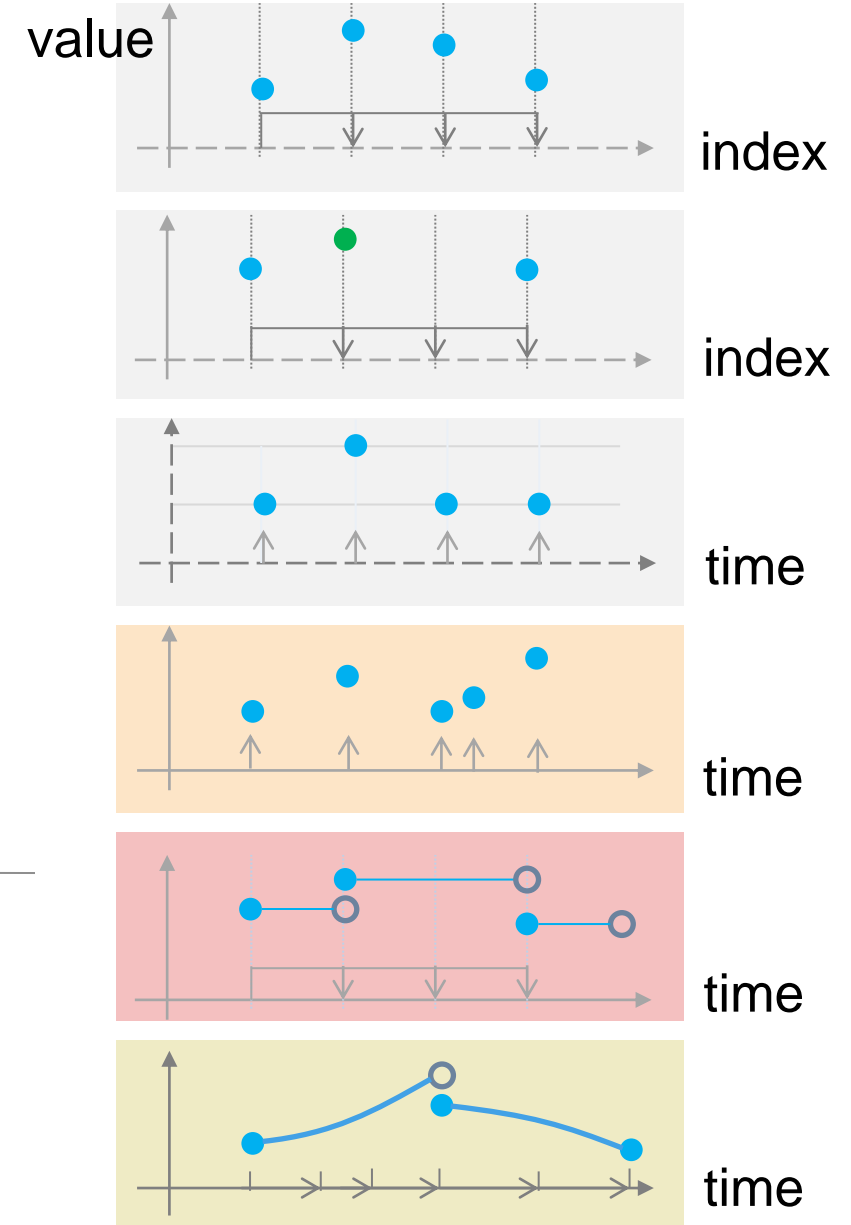

AI for Simulation (examples)

Research challenges (example): addressing heterogeneity

Multi-Model Heterogeneous Verification of Cyber-Physical Systems, **A. Rajhans**, PhD Thesis.

Simulation of Hybrid Dynamic Systems, P.J. Mosterman, **A. Rajhans**, A. Mavrommati, R.G. Valenti, Springer Encyclopedia of Systems and Control, Second Edition

Summary

- Modeling and simulation continues to play a pivotal role, from design time to operation time

- Deployment landscape increasingly complex with IoT scenarios

- New world of opportunities with the advent of AI

- Fundamental questions about multi-formalism multi-scale analysis still relevant

- Need for curricula and continued education in Modeling and Simulation