Control-Oriented Model Improvements for Hydrogen Fuel Cells

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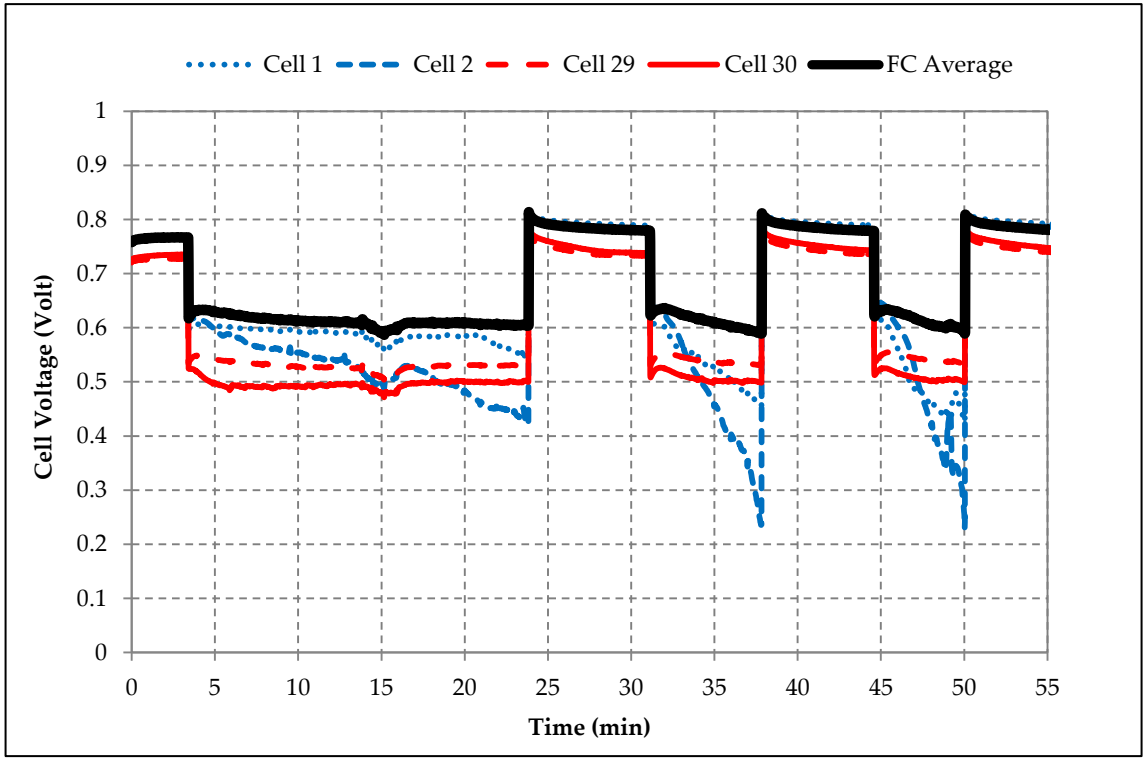
Mechanical Engineering 100 YEARS

Motivation

- **Proton-Exchange-Membrane (PEM) fuel cells are becoming more common**
  - Toyota, Hyundai, and Honda all have plans for fuel cell vehicles
- **Control of the fuel cell is challenging**
  - **High sensitivity to humidity and temperature changes**
  - Need comprehensive control-oriented models

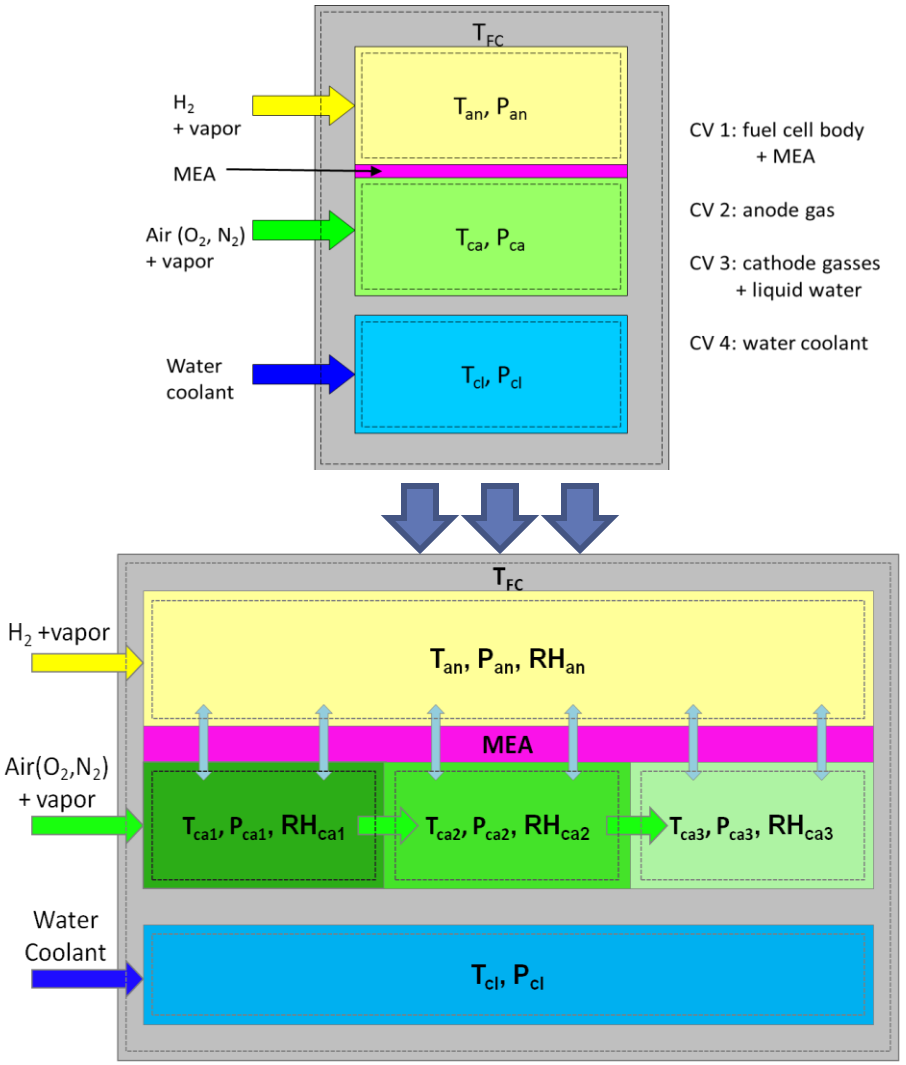
Current Modeling Techniques

- There are 2 major areas of research in fuel cell modeling
  - Computational Fluid Dynamics models
  - **Lumped value models**
- Lumped models lose key information
  - Inlet effects
  - Outlet flooding
  - Often these areas are limiting to performance

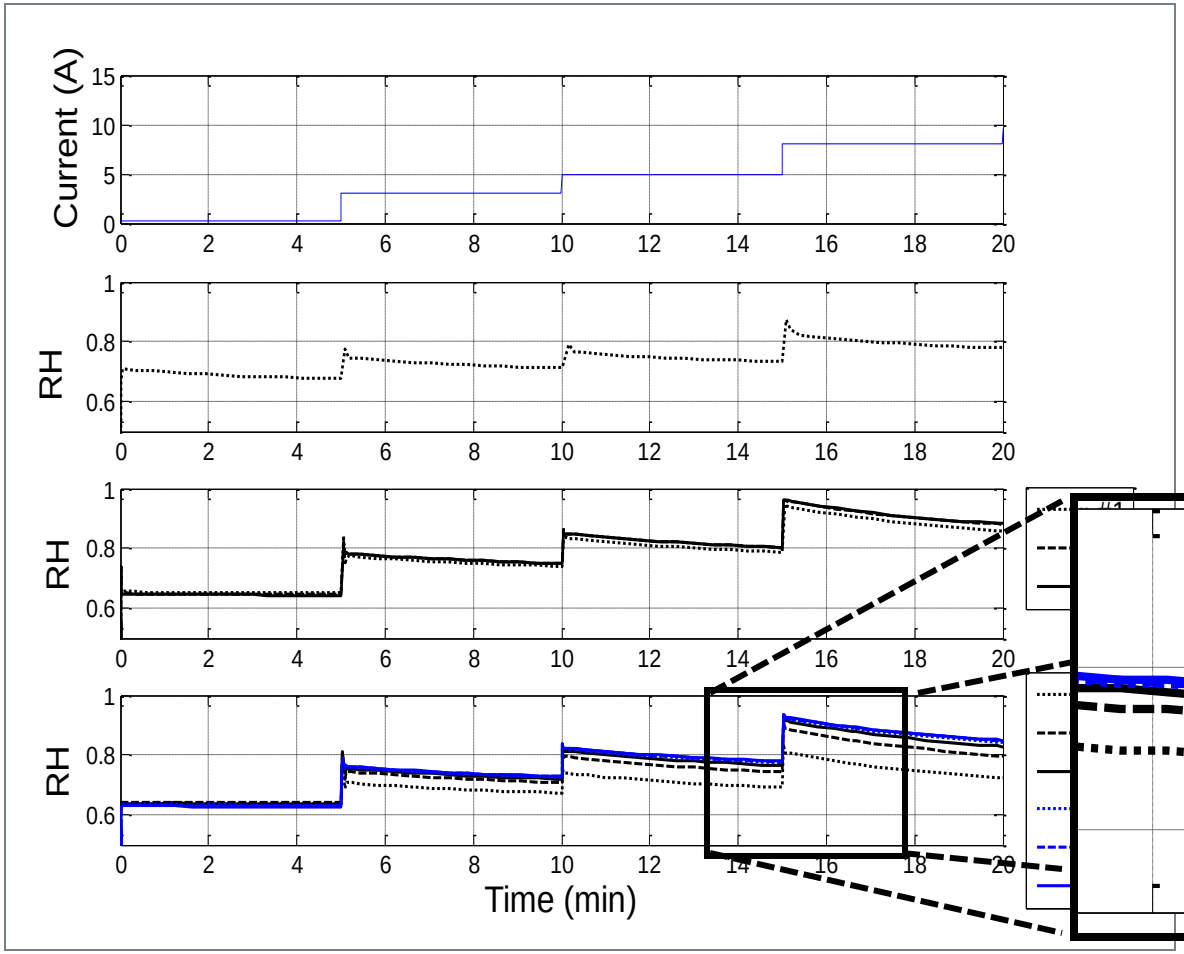


Hybrid Modeling Approach

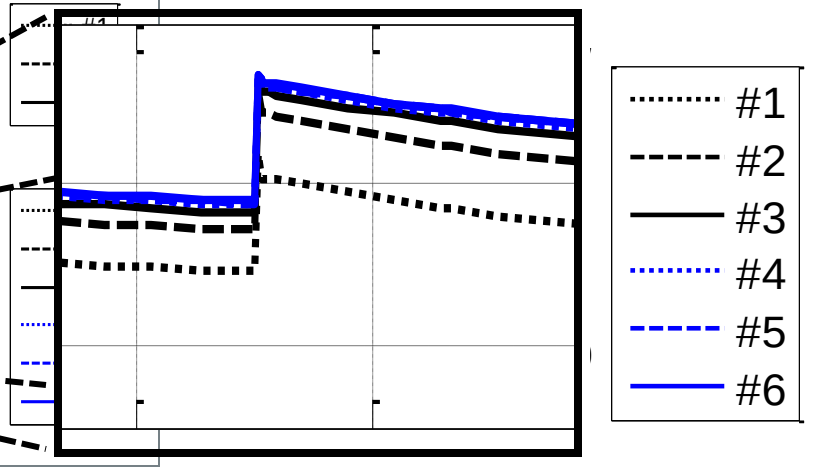
- **Relative Humidity can change significantly along the stack**
  - **Can have dehydration at the inlet, and flooding at the exit**
  - A single control volume (CV) is not a good representation
- **Use a series of control volumes**



Effect of Using Multiple CVs



# CVs	CPU Time (s)
1	2.12
3	2.78
6	5.68



Questions?