Dynamic Modeling and Control

- A collaboration between Control group (F. Jabbari) and Dynamics Modeling Program of NFCRC (J. Brower, …)

Challenge

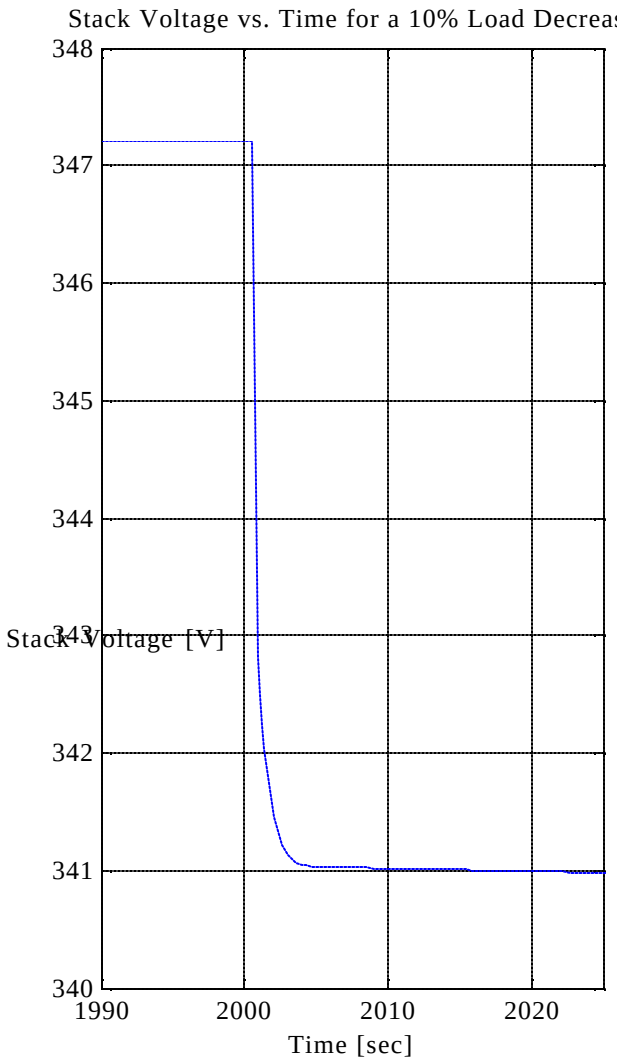
- High fidelity dynamic models for design of reliable and high quality distributed power generation
- Integration with power electronics for grid connection or direct supply
- Optimized performance

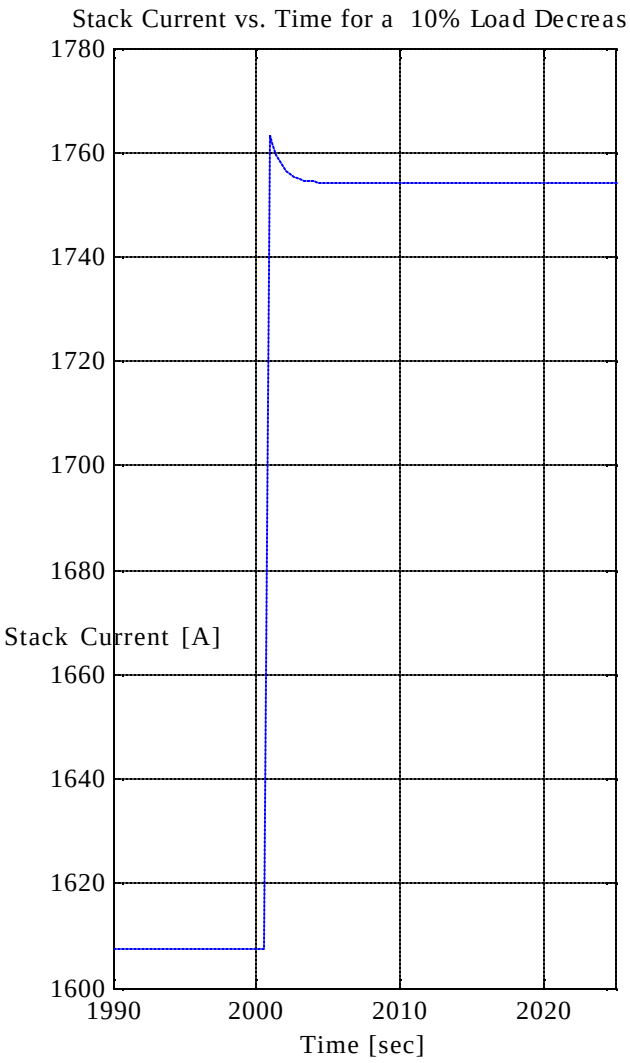
Control:

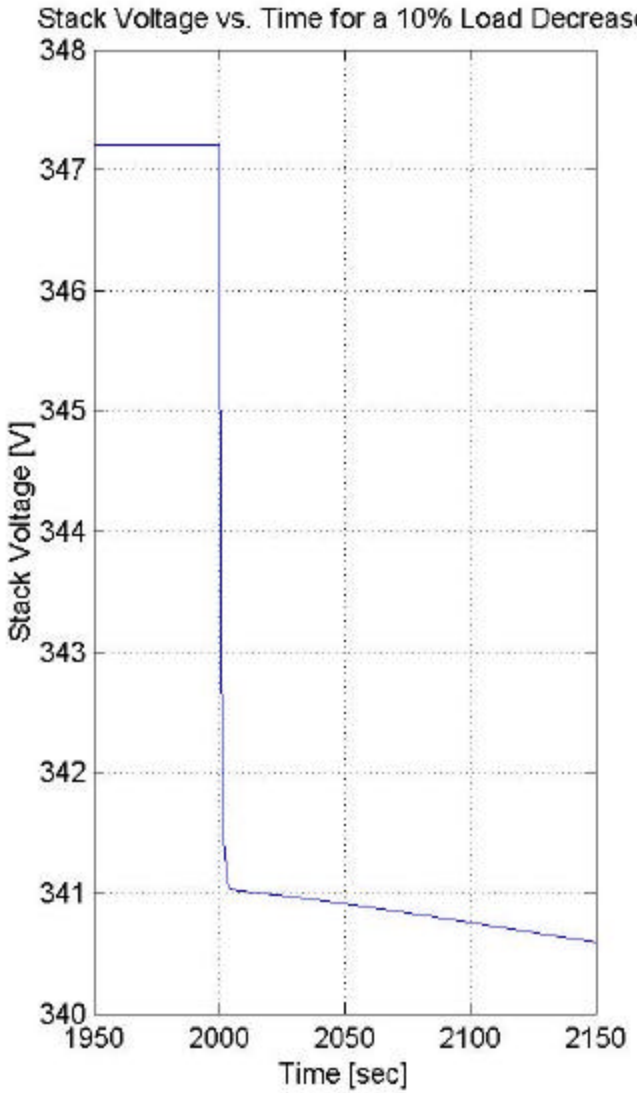
- Interactions with inverter/converter and load (specs)
- Study of FC sensitivities (actuators): fast dynamics (seconds)
  - Inlet conditions
    - flow rates
    - composition
- Long term thermal transient (runaway): stability, slow time scale dynamics (100’s second)

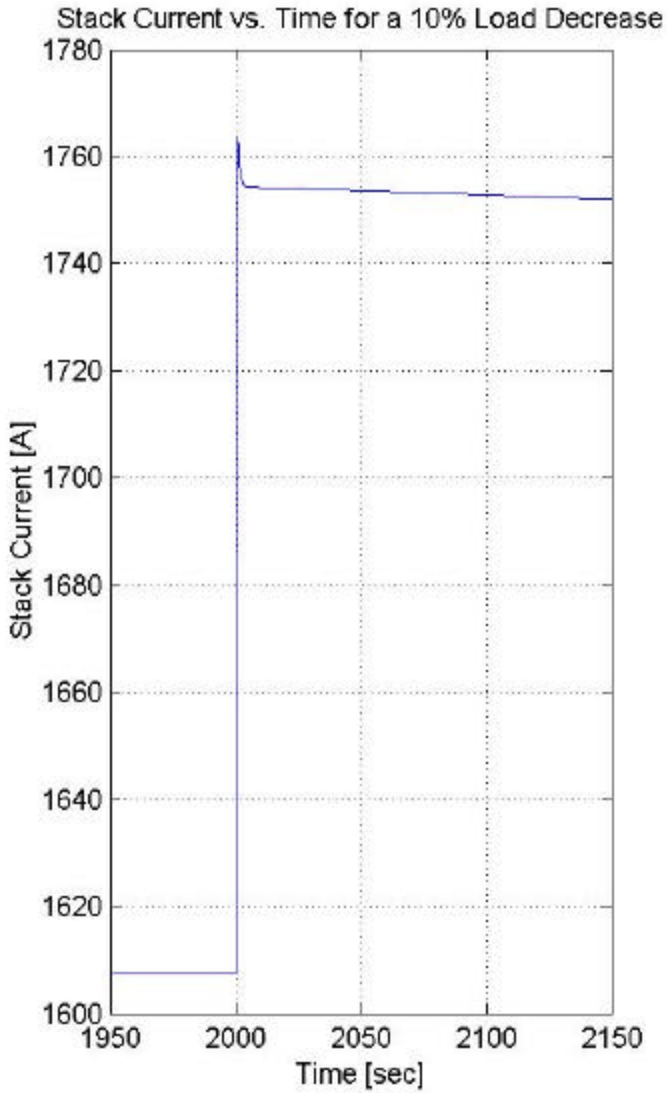
Status

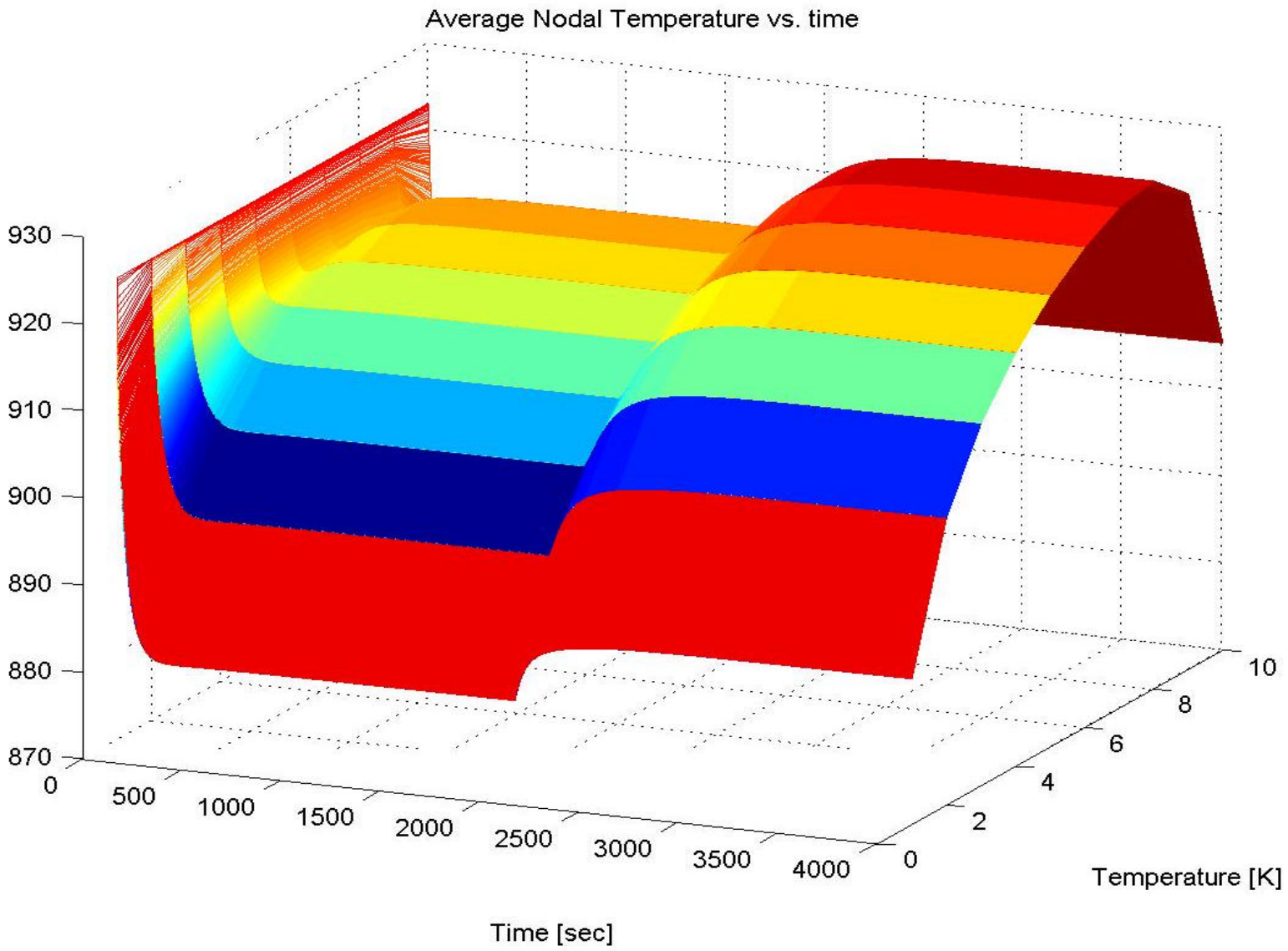
- SIMULINK environment
- Main assumptions: quasi-steady state electro-chemical (e.g., no intermediate species, etc)
- No turbulence! Focus on the the essential FC features (Nernst, voltage losses, species concentrations and momentum)


Stack Voltage vs. Time for a 10% Load Decrease
348
347
346
345
344
343
342
341
340
Stack Voltage [V]
1990
2000
2010
2020
Time [sec]

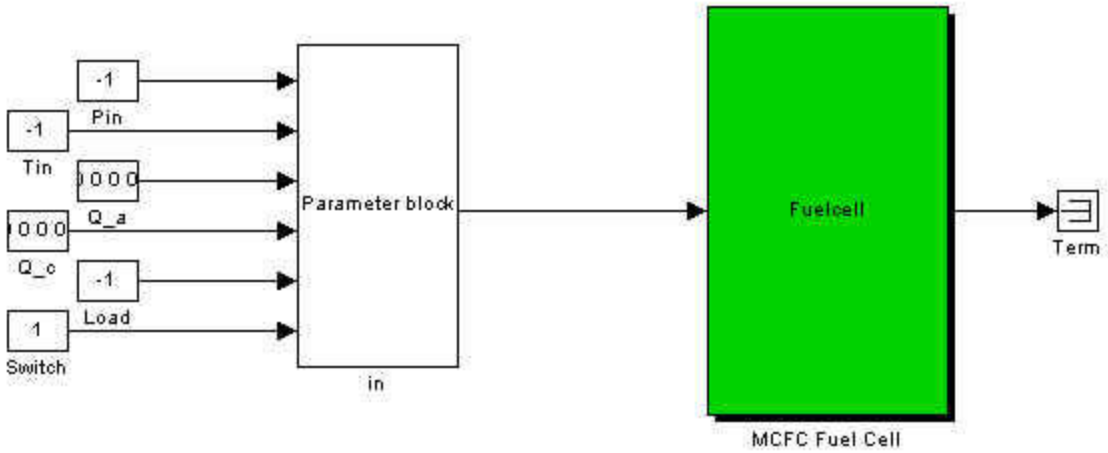

Stack Current vs. Time for a 10% Load Decrease
1780
1760
1740
1720
1700
1680
1660
1640
1620
1600
Stack Current [A]
1990
2000
2010
2020
Time [sec]


Stack Voltage vs. Time for a 10% Load Decrease
Stack Voltage [V]
348
347
346
345
344
343
342
341
340
1950
2000
2050
2100
2150
Time [sec]


Stack Current vs. Time for a 10% Load Decrease
Stack Current [A]
1780
1760
1740
1720
1700
1680
1660
1640
1620
1600
1950
2000
2050
2100
2150
Time [sec]

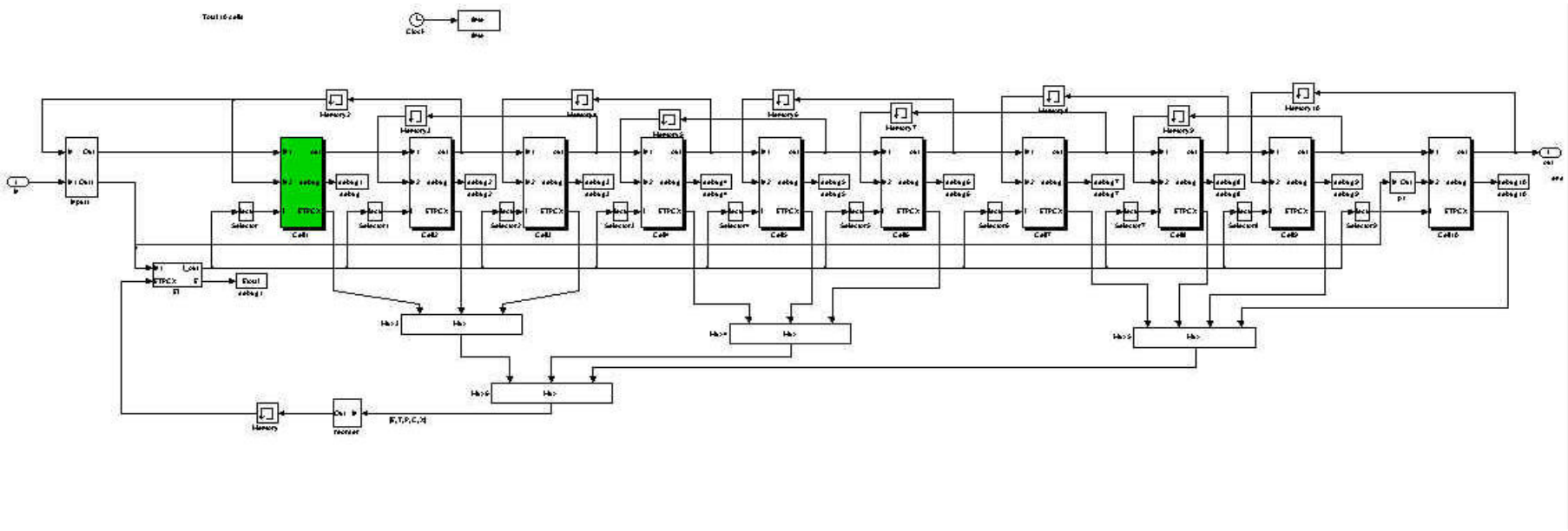

Average Nodal Temperature vs. time
930
920
910
900
890
880
870
0
500
1000
1500
2000
2500
3000
3500
4000
Time [sec]
0
2
4
6
8
10
Temperature [K]

GUI for Mode



Model Info
This MCFC Model includes convective heat transfer at the ends of the control volume, thus all control volumes are not interchangable, first and last control volumes are unique and must be change accordingly.
11-Sep-2000 16:34:22
Administrators: Jonathan Mason and Don Zhang
1.363

Nodal Layout of Model



Sub Nodal Components (Anode, Cathode, Electrolyte, etc)