

A system model of proton exchange membrane fuel cell for the study of the water/thermal management

4th U.S. – KOREA NanoForum
April 26, 2007

Sangseok Yu
Environment and Energy Research Division
Korea Institute of Machinery and Materials (KIMM)

Motivation and Objective

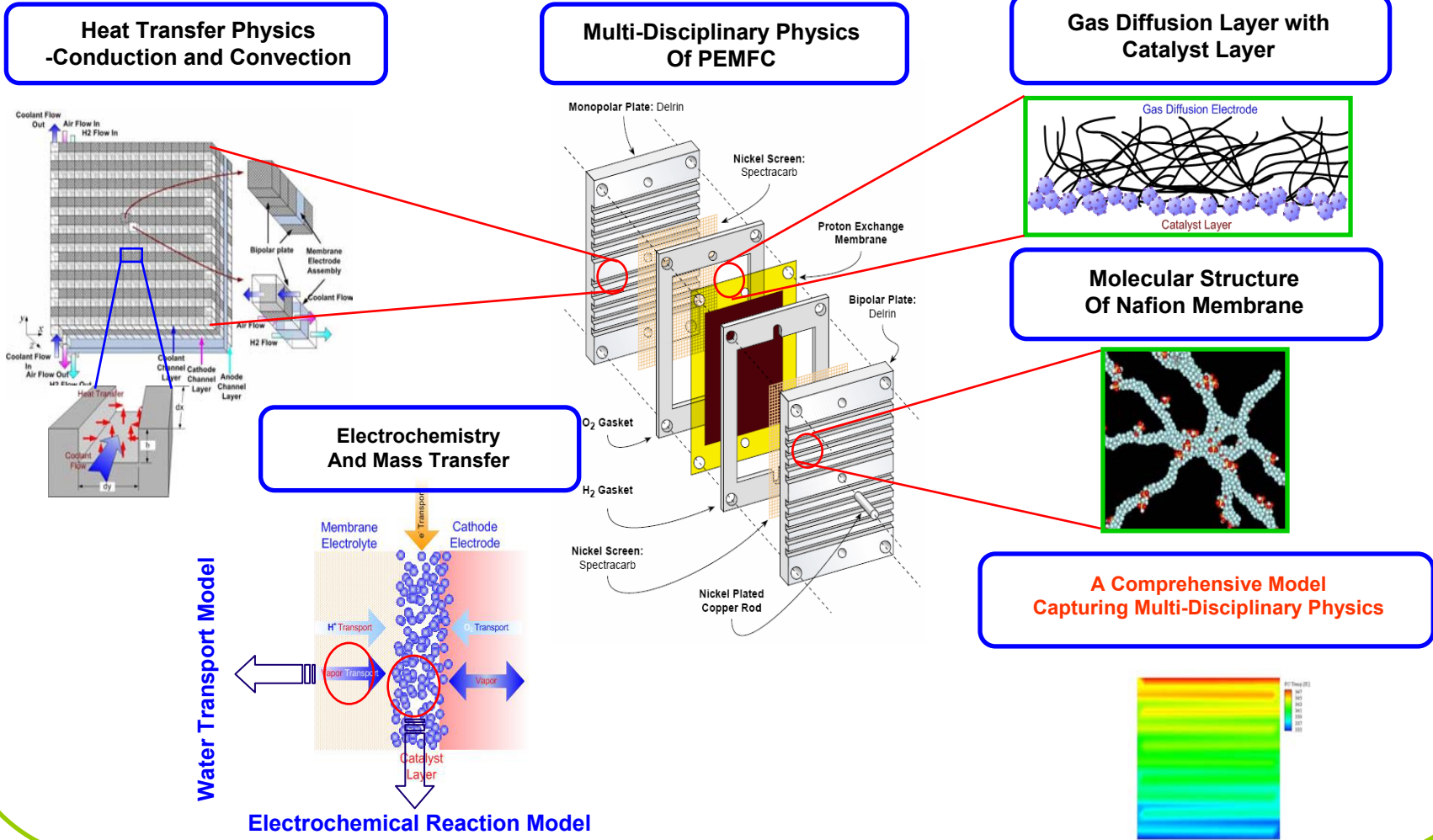
■ Motivation

- ▶ A Need for Investigation of the PEMFC System Performance over Various Parameters such as Material Parameters, Design Parameters, and Operating Parameters
- ▶ A Need to Develop a Multi-Purpose Model for the Investigation of PEMFC System Based on Theoretical Understanding

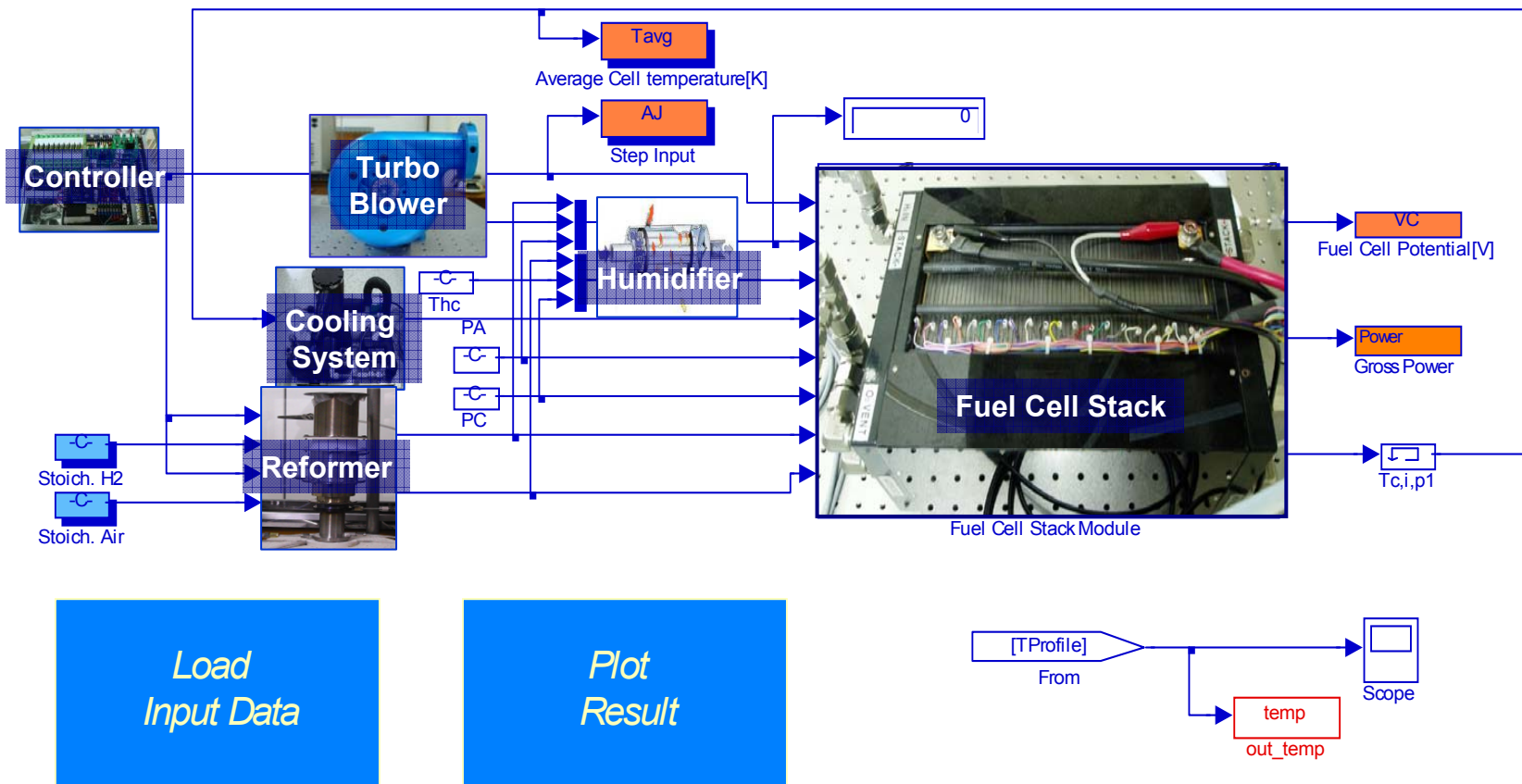
■ Objective

- ▶ To Develop High Fidelity Simulation Model for the Investigation of PEMFC Performance with Excellent Computational Efficiency
- ▶ To Find the Proper Methodology to Evaluate PEMFC System Performance
- ▶ To Optimize Operating Conditions of the PEMFC System by the Simulation Model

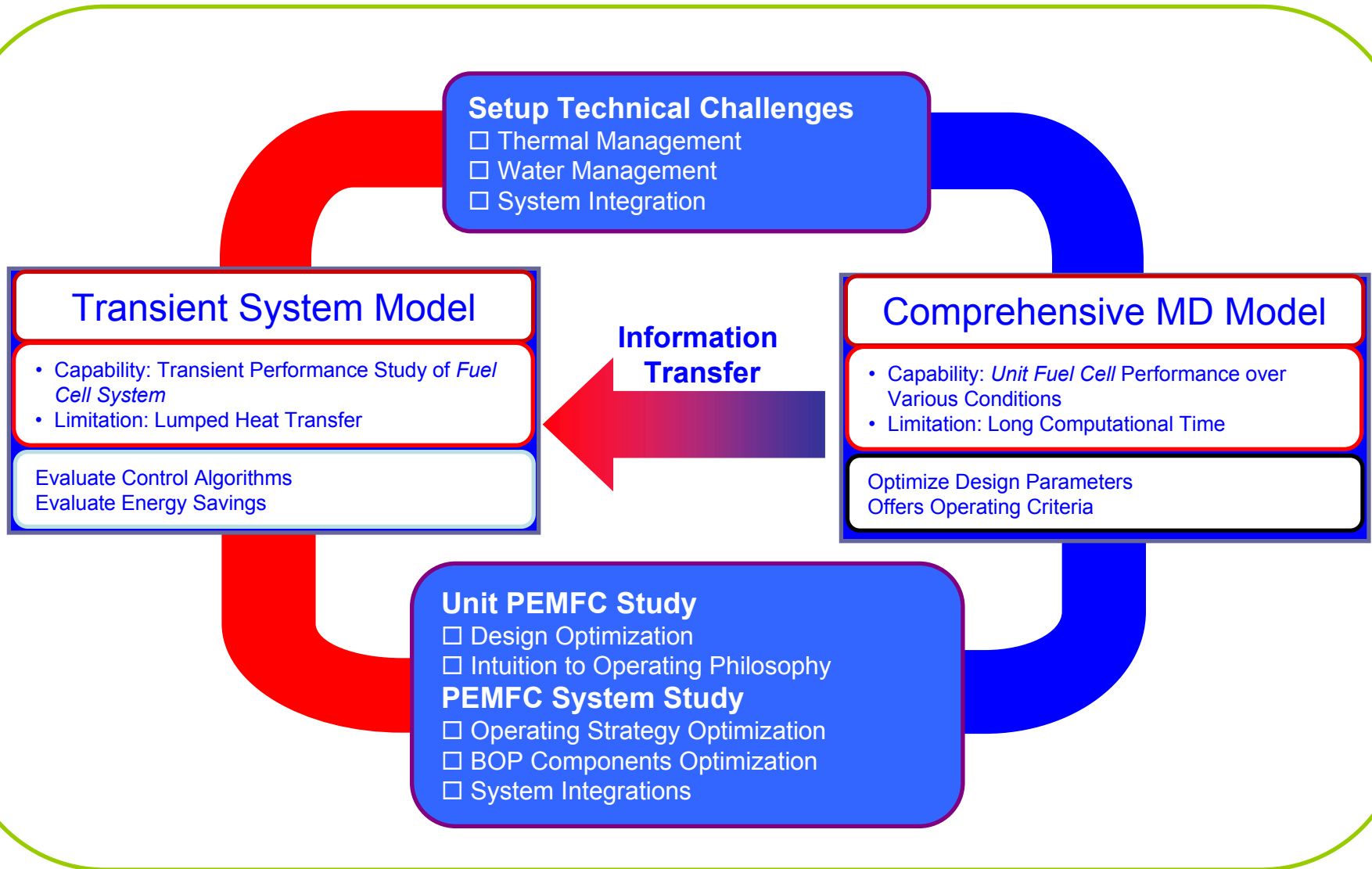
Multi-disciplinary Physics of Unit PEMFC



Dynamic System Model of PEMFC

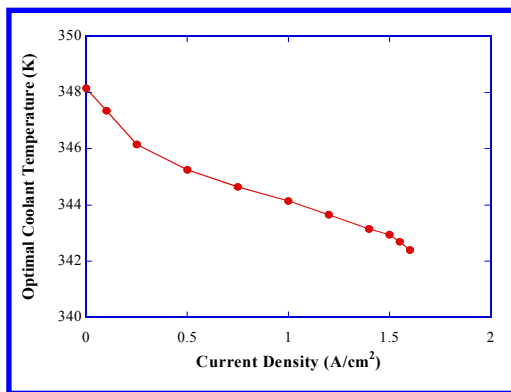


Systematic Analysis of PEMFC Performance

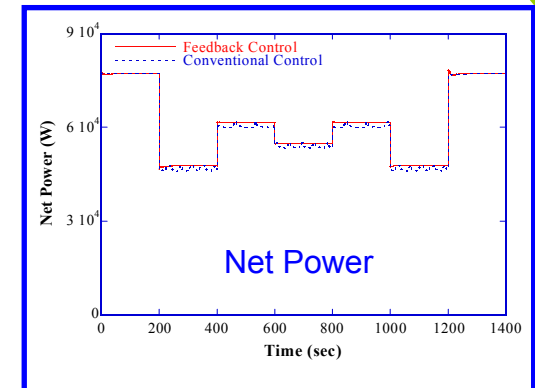
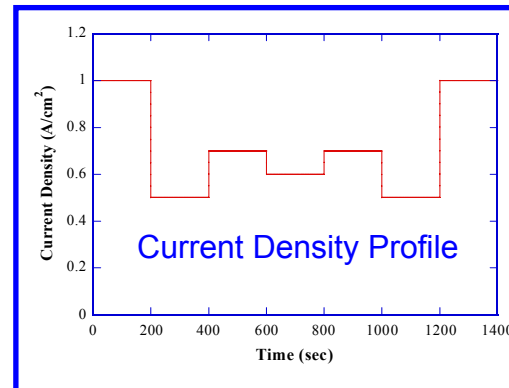


Control of Thermal Management System

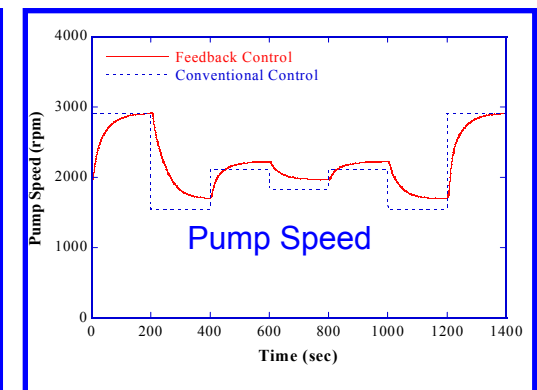
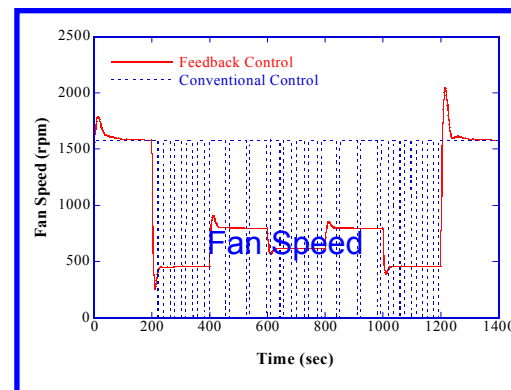
Operating Criteria By Unit FC Model



Coolant Temperature Control



60 % Reduction of Parasitic Loss & Improved 2% of System Efficiency by Control Algorithm

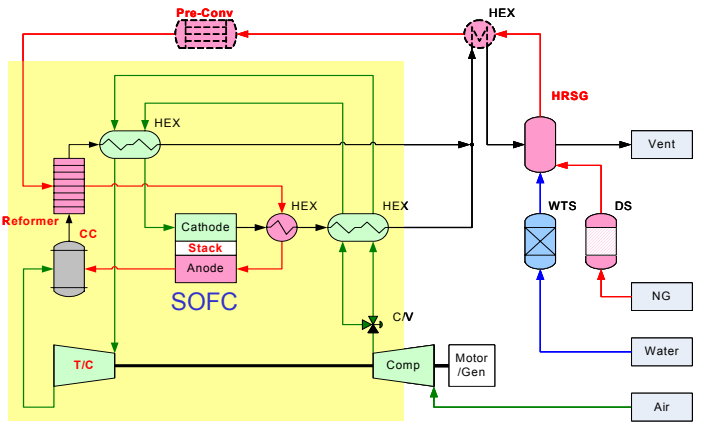


Conclusion

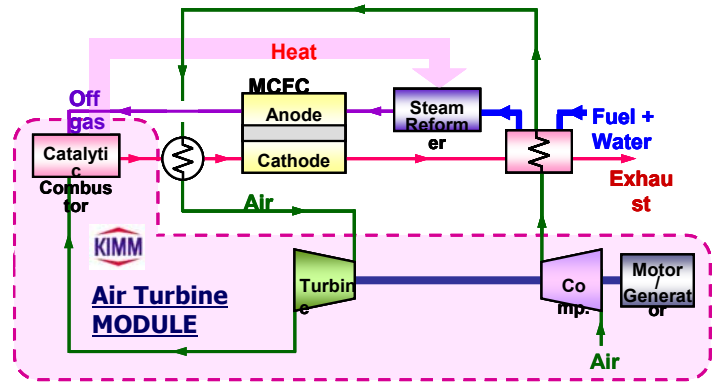
- A systematic analysis has been suggested to achieve the efficient numerical computation with high fidelity.
 - ▶ A comprehensive multi-dimensional model determines the operating criteria of large active area unit PEMFC with water cooling system.
 - ▶ A dynamic system model of PEMFC evaluates control algorithms for supporting the operating criteria.

On Going Works

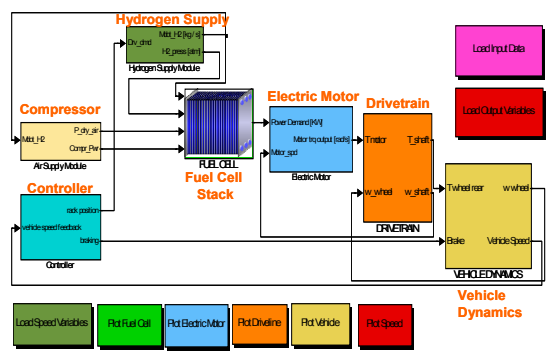
Integration and Optimization of 150 kW SOFC System



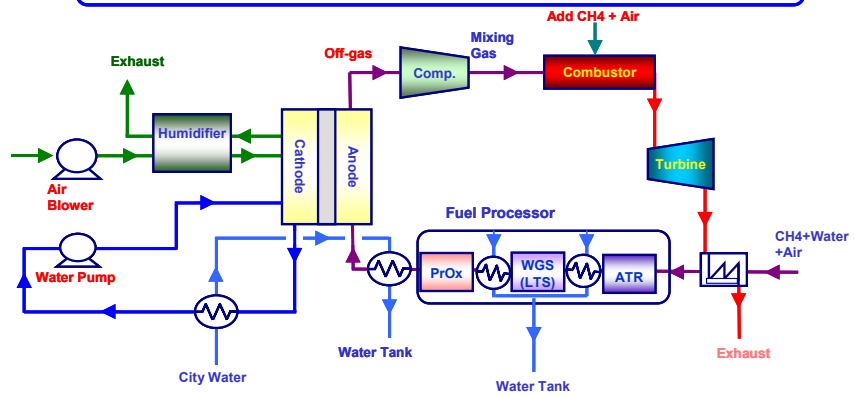
Design Optimization of 250 kW MCFC Hybrid System



A Dynamic Model of 80 kW SUV Powered by PEMFC



System Optimization of 1kW PEMFC RPG



Thank you !!!