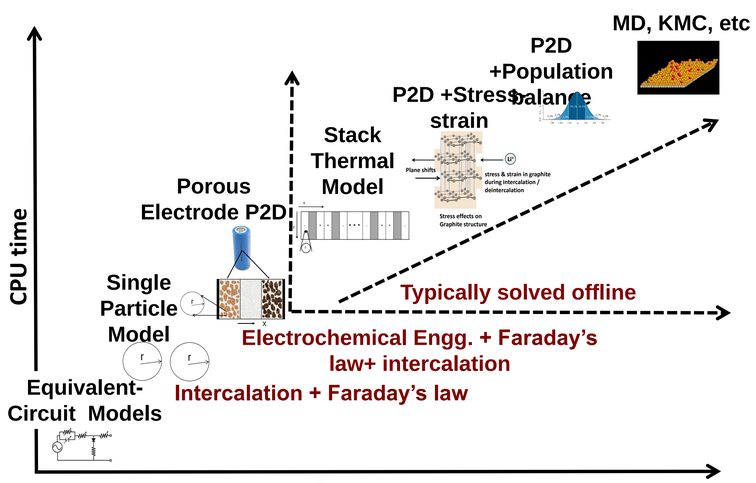
Optimal Operation & Management of Energy Storage Systems based on Real-Time Predictive Modeling and Adaptive Battery Management Techniques

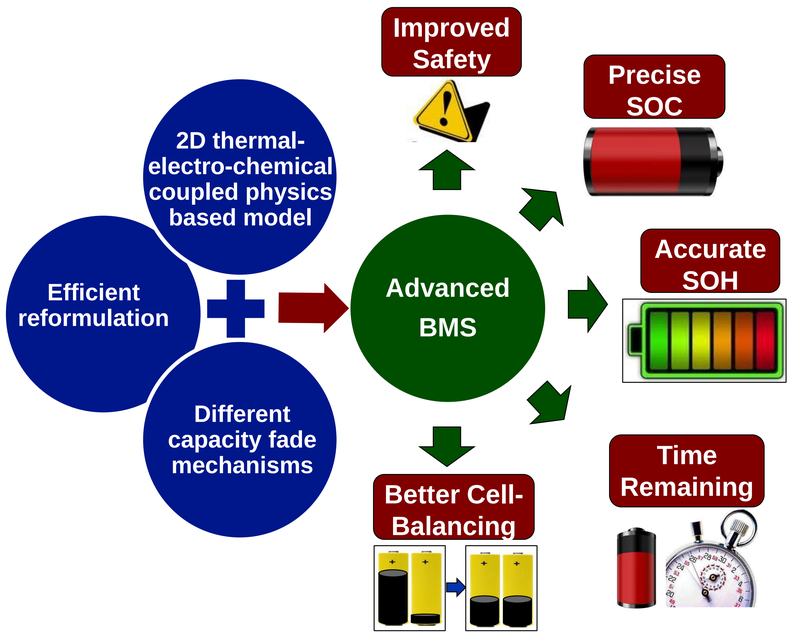
Venkat R. Subramanian
Department of Chemical Engineering, University of Washington, Seattle, WA

Shriram Santhanagopalan
Transportation and Hydrogen Systems Center, National Renewable Energy Laboratory, Golden, CO

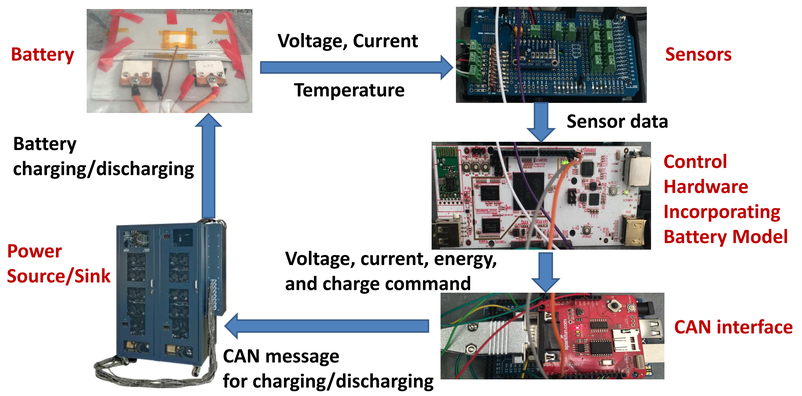
Wide Range of Phenomena Dictate Different Computational Demands



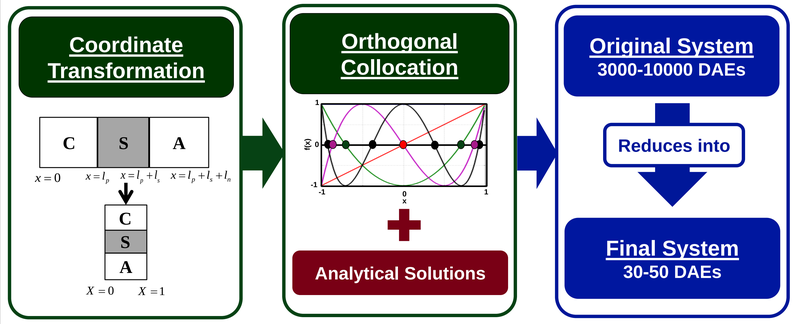
Technology



BMS Implementation



Mathematical Reformulation



Recent Publications and Codes

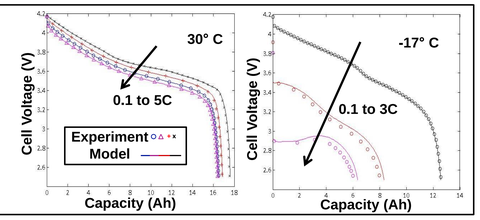
- P.W.C. Northrop, M. Pathak, D. Rife, S. De, S. Santhanagopalan and V.R. Subramanian, "Efficient Simulation and Model Reformulation of Two-Dimensional Electrochemical Thermal Behavior of Lithium-Ion Batteries", J. Electrochem. Soc., (Under Review)
- M. Lawder, P.W.C. Northrop and Venkat R. Subramanian, "Model-Based SEI Layer Growth and Capacity Fade Analysis for EV and PHEV Batteries and Drive Cycles", J. Electrochem. Soc., 161(14), A2099-A2108 (2014).
- B. Suthar, P. W. C. Northrop, R. D. Braatz and Venkat R. Subramanian, "Optimal Charging Profiles with Minimal Intercalation-Induced Stresses for Lithium-Ion Batteries Using Reformulated Pseudo 2-Dimensional Models, J. Electrochem. Soc., 161(11), F3144-F3155 (2014).
- P. W. C. Northrop, B. Suthar, V. Ramadesigan, S. Santhanagopalan, R. D. Braatz and Venkat R. Subramanian, "Efficient Simulation and Reformulation of Lithium-Ion Battery Models for enabling Electric Transportation", J. Electrochem. Soc., 161(8), E3149-E3157 (2014).

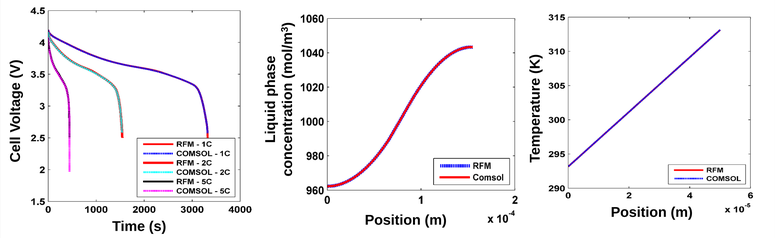
Acknowledgements

- Manan Pathak and Dayaram Sonawane, University of Washington, Seattle
- Matt Lawder and Bharat Suthar, Washington University in St. Louis
- Myungsoo Jun, Aron Saxon and Mitchell Powel, National Renewable Energy Laboratory, Golden, CO

Thermal Model Results

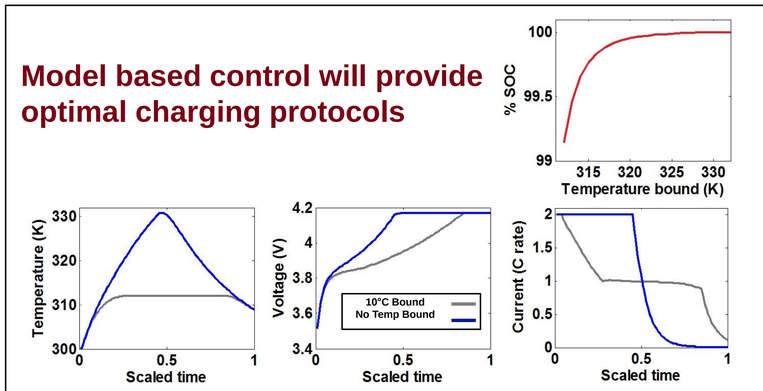
Model validated at different operating temperatures





Reformulated model validated with COMSOL for low aspect ratios

Model based control will provide optimal charging protocols



Contact Information

PI: Venkat Subramanian
Washington Research Foundation Associate Professor of Chemical Engineering and Clean Energy,
Department of Chemical Engineering,
University of Washington Seattle, WA
Phone: +1 – 206-543-2271
Email: vsubram@uw.edu
Website: http://depts.washington.edu/maple

UNIVERSITY of WASHINGTON
U.S. DEPARTMENT OF ENERGY
arpa·e
Award: DE-AR0000275