Process Research and Intelligent Systems Modeling Group

Process Systems Engineering
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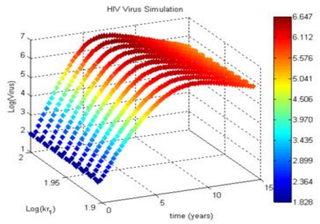
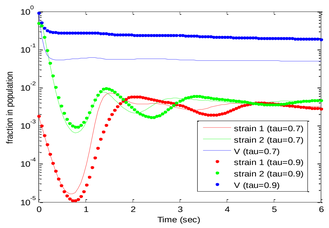
Biological and Medical Systems

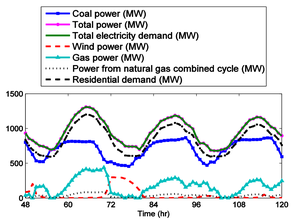
Biomedical research has generated a vast amount of experimental data that can reveal reaction pathways, molecular transport, and population dynamics. While simulations of these biological systems have been successfully applied for many years, the alignment to available measurements for complex systems continues to be a challenge.

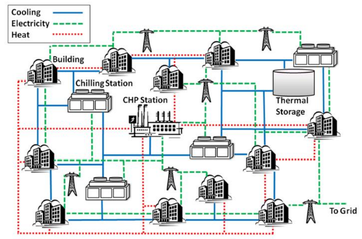




The aim of this project is to apply the most advanced solution techniques from the hydrocarbon processing industry to computational biology by using APMonitor, a cutting-edge software package for large-scale models of differential and algebraic equations (DAEs).

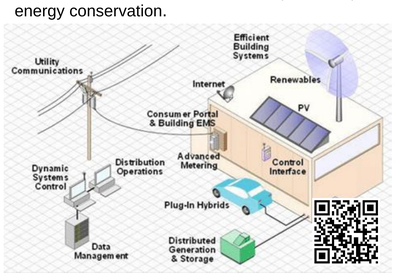
Smart Grid Energy Systems



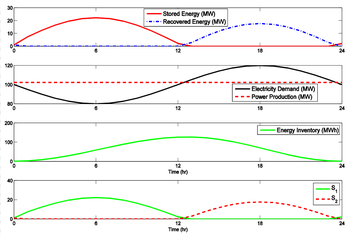


One of the major drawbacks to solar or wind energy is the intermittent nature of the supply. Energy storage allows an intermittent source of energy to be harvested and re-distributed in accordance with some demand schedule. The aim of this research is in creating models and novel algorithms for Model Predictive Control and optimization of energy generating systems such as combined heat and power plants (CHP) and solar power plants. The optimization is targeted at better integrating energy storage, demand and weather forecasts, and economic constraints to increase profitability and energy conservation.

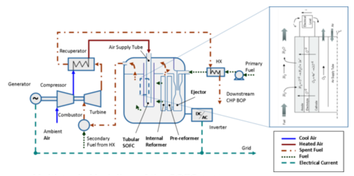
"Developments in optimization and advanced control of energy generation systems will enable the launch of a **"smart grid"** to bring the nation's electricity delivery system into the 21st century" – US Department of Energy



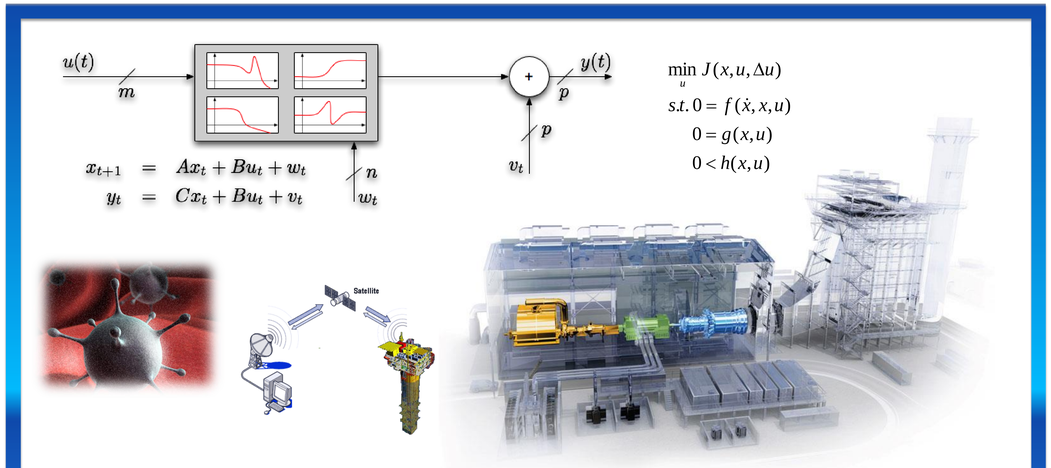
Schematic of potential components in a "smart" grid operation



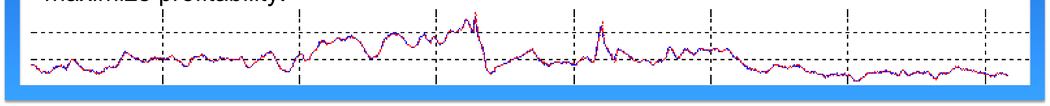
A solid oxide fuel cell (SOFC) produces electricity directly from oxidizing a fuel at high temperatures. The largest challenge is preserving oxide integrity and fuel cell lifetime. SOFC modeling is used to maintain performance and operational integrity subject to load-following, efficiency maximization, and disturbances.



Multi-scale Modeling of the SOFC system

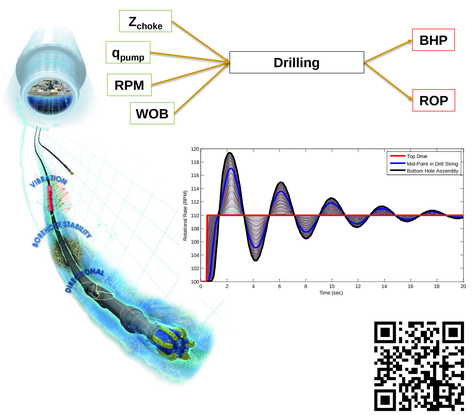


Process Research and Intelligent Systems Modeling (PRISM) is developing a world class collaborative research group for the application of innovative advanced process control and optimization techniques. This involves the development of novel algorithms and techniques for large-scale and complex systems. These applications improve safety, reduce environmental impact, and maximize profitability.

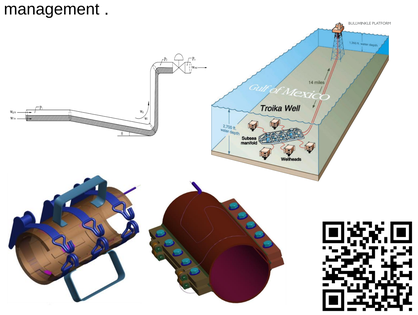


Drilling Automation and Flow Assurance

Drilling automation is advanced diagnostics, estimation, and multivariate control to maintain borehole pressure and maximize the rate of penetration.



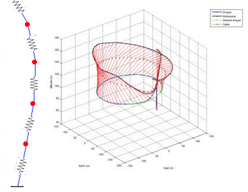
Petroleum exploration and production critically depends on pipelines to bring oil from remote and often inhospitable locations in a safe and environmentally friendly manner. To ensure the flow of these valuable resources, advanced process monitoring promises a real-time holistic view of critical data and provide smart notifications for early leak detection, reductions of unplanned shutdowns, and abnormal situation management .



APMonitor Optimization Suite

The APMonitor Optimization Suite is software for differential and algebraic equations. It is coupled with large-scale nonlinear programming solvers for data reconciliation, real-time optimization, dynamic simulation, and nonlinear predictive control. It is available as a web service through APM MATLAB, APM Python, or with a browser interface at http://apmonitor.com.

Unmanned Aircraft Systems

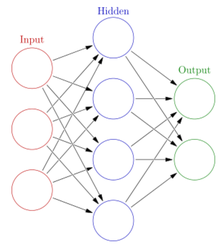


Unmanned aerial systems may consist of multiple agents with coordinated actions. Modeling and control of the system leads to increasingly complex systems that may be posed as an optimization problem. Complex dynamic systems can perform coordinated and optimal actions to achieve a shared objective.

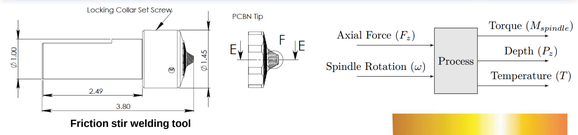
C-UAS CENTER FOR UNMANNED AIRCRAFT SYSTEMS

Reservoir Optimization

Input-output modeling of a hydrocarbon reservoir defines the dynamic relationship between injectors and producers. Additional resources are extracted by maximizing this production network with dynamic modeling and optimization strategies.

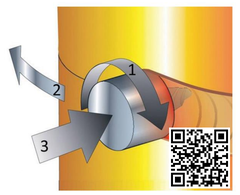


Friction Stir Processing

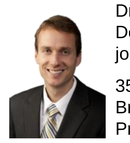


Friction stir welding tool

BYU is the lead institution for the Center for Friction Stir Processing, a multi-institutional National Science Foundation Research Center (I/UCRC). The PRISM group is collaborating with the CFSP to provide advanced modeling and control technology for improved start-up, temperature, and depth control of Friction Stir Welding.



Contact Information



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