Smart Grid as the Swarm

http://terraswarm.org/

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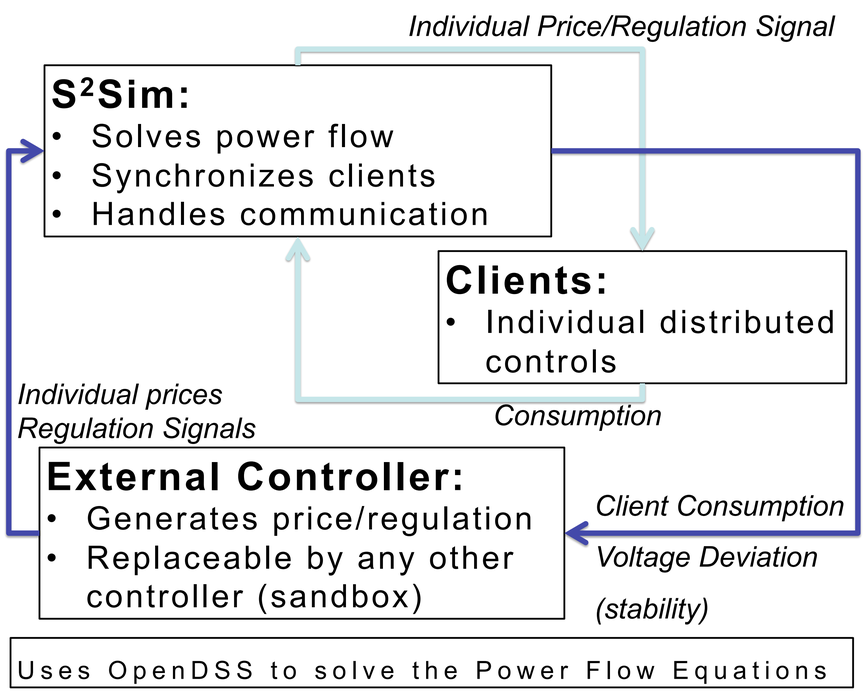
Motivation

Distributed sensing:

- Power-line measurements
- Personal sensors
- Context information

Distributed control and actuation:

- Building, HVAC control
- Storage, demand response control



S²Sim:

Smart Grid Swarm Simulator

Motivation:

Greedy, heterogeneous distributed control may lead to instability. Eg.: sharp increase in consumption at low price intervals and sharp decrease at higher prices.

Goal:

Design a test-bed that can simulate distributed control and give feedback to the controllers over sensed information, while observing the stability of the system for further study.

Our Solution:

- S²Sim: distributed SmartGrid Simulator, power flow solution based on OpenDSS
- Distributed client control and external grid controller
- Price and regulation signals are fed back to the controllers to guide them within stable bounds
- Price and regulation signals calculated in a smart way based on stability or set statically as Time of Use

TESLA:

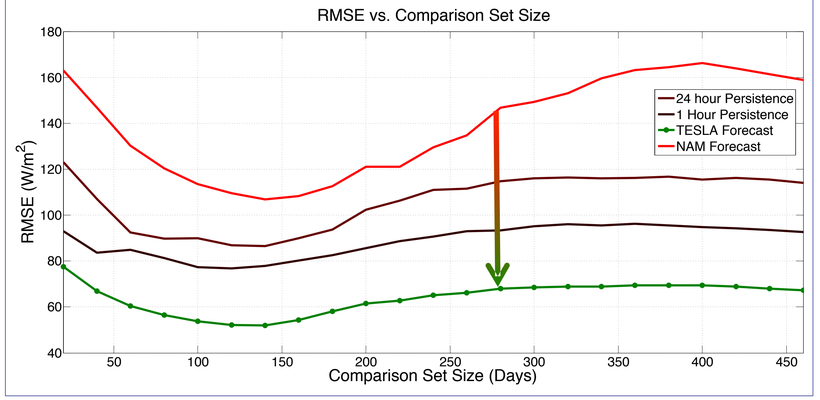
*T*aylor *E*xpanded *SoL*ar *A*nalog Forecast

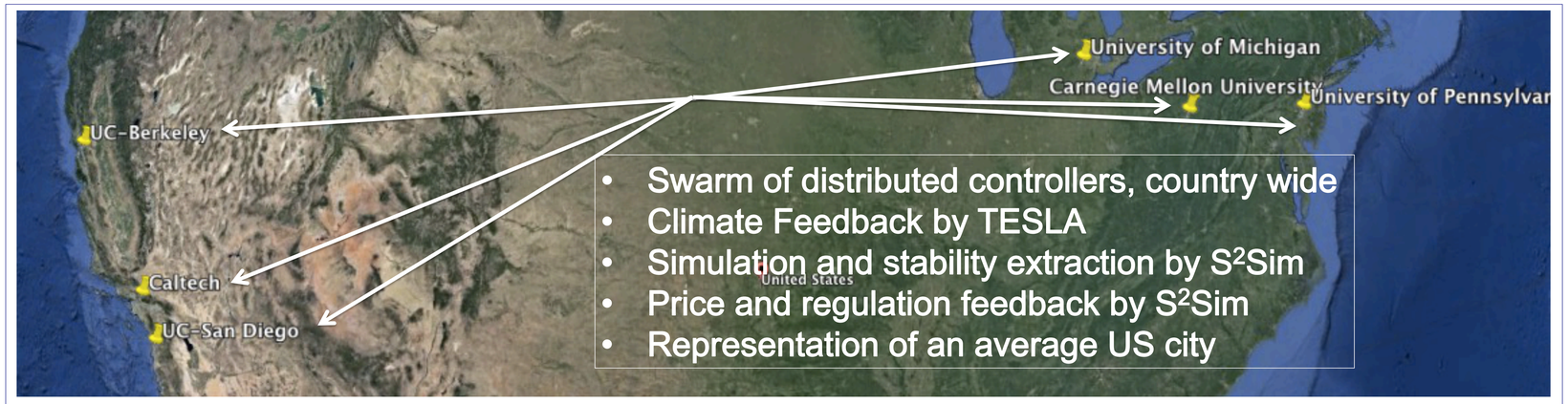
Motivation:

Quality of a control algorithm is affected greatly by the quality of its inputs. Solar energy is one of the high uncertainty and important distributed resources.

Our Solution:

- TESLA is Analog based forecast method
- Very fast ($O(N^2)$) forecast output
- Adjustable forecast horizon (+48 hours ahead)
- Up to 50% improvement over Persistence Forecast





Sponsored by the TerraSwarm Research Center, one of six centers administered by the STARnet phase of the Focus Center Research Program (FCRP) a Semiconductor Research Corporation program sponsored by MARCO and DARPA.