



Adaptive Learning Controls for demand-responsive electricity management

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Adaptive Learning Controls

Optimization

Out-of-box Initial Defaults

Two-way Learning









Leverage Technologies

***** Integrated sensors

- Temperature, relative humidity, current, occupancy, solar radiation
- Wireless network developments
- * Smaller, faster microprocessors and radios
- * Local and remote databases
 - for adaptive learning and system testing



DREAM Goals: Increase Functionality











Optimization: Cost & Comfort

Simple user-influenced optimization of cost and comfort will create control system more acceptable to users than automatic scheduled approach and will assure adoption of demand-response enabling technology





Optimization



* Economic Index:

cost of energy vs. thermal comfort



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Out-of-box performance and default settings

- Respond to price signals
- Respond based on whether house is occupied
- Optimized by pre-set economic index for comfort and cost
- Adapt to local climate
- Internal model predicts behavior of house

will reduce peak energy and provide better comfort than would a programmable thermostat





Hypotheses (3)

Two-Way Learning:

- Machine Learning will improve optimization
 - Occupant schedule pattern
 - House physical properties:
 - Learn power and energy required for comfort for better cost estimate for optimization
 - Learn house dynamics for effective use of HVAC equipment (i.e., precooling)
 - Occupant thermal preferences
- Educating Occupant: Informing and advising occupant of price and energy consumption will increase residential involvement in demand response









Recommendations

- Sensor development (temperature, RH, motion, radiation, CO2, pressure etc) vital to informationrich system
- Sensor design integration: Position and orientation of sensor critical to accurate measurement
- Resolution of sensor important for optimal control
- Communication design needed for low-power drain
- Field testing of technology necessary





Adaptive Learning Controls

Optimization

Comfort and cost

Out-of-Box Defaults

Automatically responds to price, occupancy, occupant economic index, local climate, basic house model

Two-way Learning

Machine AND people learn!



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