



Reducing Sensing Equipment for Water Heaters

Single inlet-temperature sensor plus MPC learns usage to shift water-heating loads, protecting panels/transformers and lowering bills.

Residential electric water heaters usually only measure the temperature of water within the tank. However, as the demand for water and associated water heating increases, so does the necessity for water heaters to modulate responses appropriately to protect external elements such as local power distribution equipment (electric panels) or utility level power distribution equipment (transformers) via adjustments of water heating schedules. This can be accomplished by tracking household water usage patterns. Current methods rely on installing water flow meters on the water heater, which is both time-consuming and costly, so there is a need for more efficient systems to be developed.

Researchers at Purdue University have developed a novel MPC algorithm coupled to a water usage sensor that can track water usage patterns to predict expected water heating usage with only a single additional temperature measurement on the water inlet line. This data will inform a water usage profile per household, from which a forecast profile can be developed to allow for more controlled water heating patterns to balance power usage from power distribution equipment and maintain user comfort. Thus, this technology has the potential to lower residents' energy bills and help utility companies protect local and utility power transmission equipment.

Technology Validation:

-5-day field test in cold climate with two-story, single-family home to evaluate computational model on predicted water heating demand and heater efficiency

Advantages

-Balance total home power consumption with electricity panel's rated limits

Technology ID

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Category

Computing/Internet of Things (IoT)

Energy & Power Systems/Grid Modernization & Smart Grids

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-Protecting local electrical infrastructure

-Reducing unnecessary water heating to lower energy bills and reduce greenhouse gas emission

Applications

-Widespread use of MPC algorithm coupled to water usage sensor for each residential unit or per local region

Related Publications:

https://www.researchgate.net/profile/Levi-Reyes-Premier/publication/393006585_A_Minimal-Sensing_Predictive_Control_Strategy_for_Heat_Pump_Water_Heaters_Field_Insights_from_Cold_Climate_Operation/links/686e712739c3583512082405/A-Minimal-Sensing-Predictive-Control-Strategy-for-Heat-Pump-Water-Heaters-Field-Insights-from-Cold-Climate-Operation.pdf

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Intellectual Property:

Provisional-Patent, 2025-03-03, United States

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