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Model Predictive Control of Solar Thermal System with Borehole Seasonal Storage

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Abstract

This work addresses the model predictive controller design for a complex solar boreal thermal storage system which models a real Drake Landing Solar Commercial Community. The overall discrete system is obtained from a coupled finite and infinite dimensional subsystems of solar collector, heat exchanger, hot tank and gas boilers without any spatial approximation or model reduction. The novel model predictive control addresses a house heat regulation by constrained optimization problem with the manipulation constraints, and accounts for possible unstable system dynamics and disturbances arising from solar and geothermal radiations. The realistic output regulation is considered by the inclusion of an observer which constructs finite and infinite dimensional states. The proposed model development and control regulation can successfully account for the long range variability in environmental and/or economic conditions associated with the overall operational costs of the large scale solar energy community. Finally, the controller performance is assessed by numerical simulations.

Keywords: Solar Thermal System, Borehole Seasonal Storage, Model Predictive Control, Output Observer, Coupled PDEs-ODEs System

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