Time & Location: June 28, 2010 at 1:00 PM in HEC 113
Title: An Optimal Control Approach for Determination of the Heat Loss Coefficient in an ICS Solar Domestic Water Heating System

Water heating in a typical home in the U.S. accounts for a significant portion (between 14% and 25%) of the total home’s annual energy consumption. The objective of considerably reducing the home’s energy consumption from the utilities calls for the use of onsite renewable energy systems. Integral Collector Storage (ICS) solar domestic water heating systems are an alternative to help meet the hot water energy demands in a household. In order to evaluate the potential benefits and contributions from the ICS system, it is important to be certain that the parameter values included in the model used to estimate the system’s performance are as accurate as possible. The overall heat loss coefficient (Uloss) in the model plays an important role in the performance prediction methodology of the ICS. This work presents a new and improved methodology to determine Uloss as a function of time in an ICS system using a systematic optimal control theoretic approach. This methodology is based on the derivation of a new nonlinear state space model of the system, and the formulation of a quadratic performance function whose minimization yields estimates of Uloss values that can be used in computer simulations to improve the performance prediction of the ICS system, depending on the desired time of the year and hot water draw profile. Simulation results show that predictions of the system’s performance based on these estimates of Uloss are considerably more accurate than the predictions based on current existing methods for estimating Uloss.

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Approved for distribution by Dr. Marwan Simaan, Committee Chair, on June 13, 2010.

The public is welcome to attend.