Nonlinear inversion-based control of a distributed parameter heating system
László Richárd Tóth*, Lajos Nagy, Ferenc Szeifert

Corresponding author contact information
Department of Process Engineering, Faculty of Engineering, University of Pannonia, 8200 Veszprem, Hungary
tothl@fmt.uni-pannon.hu

Abstract
In this work the control of a pilot-scale water heating equipment was studied. The water flows through a tube, in which it was heated by electric power. The outlet temperature was controlled by the flow rate, compensating heat duty and inlet temperature disturbances. This device shows resemblance to solar collectors and heat exchangers, thus making it a useful tool to carry out controller experiments for similar objects.

The method of constrained inversion was applied. This control strategy is based on the first principle model of the process and feed-forward control. Two different approaches were compared in handling the distributed parameter system. To eliminate steady-state error, a feedback compensation was needed, which was implemented in an IMC structure. Experimental results showed that both controllers were superior to the conventional PI controller. Compensation of dead time, nonlinearity and measured disturbances are the key factors in the success of the model-based controller.

Highlights
► The dynamic, first principle model of a tube-like water heater was constructed. ► A control strategy based on model inversion was applied. ► The experimental results show superior performance to conventional PI controller. ► Compensating dead time and nonlinearity are key factors in the better performance.

Keywords
Control; Modeling; Constrained inverse; IMC; Distributed parameter system