Title:

Linear Control design of an ethanol steam reforming process for PEM fuel cell applications

Authors & affiliations:

V. García*[1], M. Serra[1], J. Llorca[2], J. Riera[1]

[1]Institut de Robòtica i Informàtica Industrial. Consejo Superior de Investigaciones Científicas – Universitat Politècnica de Catalunya, Spain; [2]Institut de Tècniques Energètiques. Universitat Politècnica de Catalunya, Spain;

vgarcia@iri.upc.edu

Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Bio-ethanol, a CO_2 neutral fuel, is suited to diminish the use of the conventional fossil fuels based on petroleum and natural gas. In previous contributions [1-2] the authors reported results addressing the dynamic modeling and controllability analysis of a low temperature catalytic ethanol steam reformer for fuel cell hydrogen feeding. In this work, the design of linear controllers suitable for this ethanol reformer is reported and a comparative analysis between different controllers is performed through simulation. The control objectives considered are to keep hydrogen and CO flowrates at their nominal optimal values. This nominal operating point maximizes hydrogen yield and minimizes CO production, what is necessary because CO poisons the catalyst of PEM fuel cells.

The dynamic modeling [1] is based on a non-linear model of the reformer, which operates in three separate stages: ethanol dehydrogenation to acetaldehyde and hydrogen, acetaldehyde steam reforming and water gas shift reaction. It consists on a one-dimensional, pseudo homogeneous model based on mass and energy balances. It has been selected for control-oriented applications in order to reduce the solving time of the simulation system.

Based on the controllability analysis made in [2], the set of the best linear control structures is selected. Basically, this control structures selection consists in the selection of two manipulated variables among the six possible manipulated variables. For each control structure, decentralized 2x2 PI controllers are implemented. The tuning of the controller parameters is analyzed and the performance of the different controllers is compared though simulation.

[1] V. M. García, E. López, M. Serra and J. Llorca, Dynamic modeling of a three-stage low-temperature ethanol reformer for fuel cell application, J. Power Sources 192 (1) (2009) 208-215.

[2] V. M. García, E. López, M. Serra, J. Llorca and J. Riera, Dynamic modeling and controllability analysis of an ethanol reformer for fuel cell application, J. Hydrogen Energy (2009) .

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