



ELSEVIER

Available online at www.sciencedirect.com

SCIENCE @ DIRECT®

Control Engineering Practice 13 (2005) 1425–1437

CONTROL ENGINEERING
PRACTICE

www.elsevier.com/locate/conengprac

Experimental validation of a methodology to control irrigation canals based on Saint-Venant equations[☆]

Xavier Litrico^{a,*}, Vincent Fromion^b, Jean-Pierre Baume^a, Carina Arranja^c, Manuel Rijo^c

^a*Unité de Recherche Irrigation, Cemagref, B.P. 5095, 34033 Montpellier Cedex 1, France*

^b*Laboratoire d'Analyse des Systèmes et Biométrie, INRA, 2 place Viala, 34060 Montpellier, France*

^c*Universidade de Évora, Departamento de Engenharia Rural, Colégio da Mitra, Apartado 94, 7002-554 Évora, Portugal*

Received 19 April 2004; accepted 22 December 2004

Available online 3 February 2005

Abstract

This paper exposes and validates a methodology based on a classical hydraulic model (Saint-Venant equations) to design efficient automatic controllers for an irrigation canal pool. The method is applied on a laboratory canal located in Portugal. First, the full nonlinear hydraulic model is calibrated, using a single steady-state experiment, then it is validated on other hydraulic conditions. The control model is obtained by linearizing the Saint-Venant equations and using a numerical method to compute the frequency response of the system. Simple controllers are designed and analyzed using the linearized models. The experimental results show that such a method is able to accurately predict the closed-loop system behavior in terms of stability, robustness and performance.

© 2005 Elsevier Ltd. All rights reserved.

Keywords: Irrigation channels; Environmental systems; PI control; Time Delay Systems
