

Título:

Model based fault tolerant control based on subspace methods of water network canal systems

Orientadores

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Enquadramento (Indicar adicionalmente Ramo/Área de Especialidade caso aplicável):

The present dissertation is proposed in the context of the AQUANET FCT project and aims at contributing to the development of control algorithms for optimizing the management of water conveyance and delivery in multipurpose open-channel systems, with the goal of minimizing the use of energy and water spills. Water delivery channel networks are complex systems that require special modeling and control techniques. In this dissertation it is proposed to apply fault detection and isolation (FDI) and fault tolerant control (FTC) algorithms based on subspace methods to the NuHCC (Núcleo de Hidráulica e Controlo de Canais - Universidade de Évora) canal system.

Objetivos:

The objectives of this dissertation are:

- To develop FDI and FTC algorithms for a computational model of the open-water canal system.
- To implement the FDI and FTC algorithms on the NuHCC canal system.

Descrição:

The modeling and control of water canal networks are engineering areas that have been attracting increasing attention since recent years [1,2]. This type of systems present several challenges and require advance modeling and control techniques: water canals are complex multivariable systems that consist of large number of interconnected elements, such as gates, level and gate sensors, transmitters, etc.

The task on FDI will be concerned with the development and implementation of methodologies able to cope with different kinds of faulty scenarios occurring in the experimental water delivery canal of the Núcleo de Hidráulica e Controlo de Canais (NuHCC) from University of Évora. After a fault has been detected in the process under supervision, the fault detection system will generate a signal that will trigger a fault isolation approach responsible to locate and characterise the fault or faults being detected. The fault will be handled using FTC algorithms based on subspace methods [3,4] that will provide the safe operation of the canal system, or otherwise its shutdown if the fault is too severe.

Performance indexes will be defined and evaluated in order to assess the performance of the FDI and FTC schemes during the on-line experiments, considering all the faults as abrupt, incipient and multiple simultaneous.

[1] Su Ki Ooi, M.P.M. Krutzen, and E. Weyer (2005) On physical and data driven modelling of irrigation channels. *Control Engineering Practice* (13) pages 461-471

[2] J. M. Igreja and J. M. Lemos (2009) Nonlinear Model Predictive Control of a Water Distribution Canal Pool. *Nonlinear Model Predictive Control, Lecture Notes in Control and Information Sciences*. Springer. Pages 521-529

[3] José Borges (2007). *State-Space System Identification: New Developments and Applications*. Ph. D. thesis, Instituto Superior Técnico/UTL.

[4] José Borges, Isaías Tavares, Miguel Ayala Botto, "Modeling of a water canal system using a weighted composition of local linear state space models", *Proceedings of the 18th IFAC World Congress*, 6 páginas, Milão, Itália, Agosto 2011

Requisitos (e.g. média, disciplinas concluídas):

Controlo de Sistemas, Sistemas Inteligentes.

Resultado esperado:

- Implementation of a toolbox with FDI and FTC algorithms based on subspace methods.
- Experimental validation of the FDI and FTC algorithms on the NuHCC canal system.
- Interpretation and evaluation of the control algorithms.

URL da descrição detalhada da dissertação:

Observações:

Este trabalho está inserido no projecto da Fundação para a Ciência e para a Tecnologia "AQUANET - Decentralised and Reconfigurable Control for Water delivery Multipurpose Canal Systems", PTDC/EEA-CRO/102102/2008.

Localização da realização da dissertação:

IST - Centro de Sistemas Inteligentes/IDMEC.

Núcleo de Hidráulica e Controlo de Canais - Universidade de Évora