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EDITORIAL

Special issue on linear parameter varying systems

SUMMARY

This special issue contains six papers on the topic of linear parameter varying systems. The papers consider quite different theoretical problems, although four are related to either fault-detection and fault-isolation or fault-tolerant control. These theoretical ideas are demonstrated on applications taken from the areas of aerospace, automotive and renewable energy engineering. Copyright © 2014 John Wiley & Sons, Ltd.

KEY WORDS: linear parameter varying systems; doubly fed induction generator; fault detection and isolation; fault reconstruction; fault-tolerant control; aerospace systems

It is almost two decades since linear parameter varying (LPV) techniques first appeared in the control systems literature. The approach formalised some of the popular but ad hoc methods of gain scheduling and sought to provide rigorous techniques for extending linear control laws, based on linearizations around operating points, to provide guaranteed performance over a wide operating envelope. Many significant developments have taken place in the intervening years to mature the underlying theory, both in terms of modelling and control law synthesis. Furthermore, the practicality of the LPV methodology has caught the attention of practitioners outside of academia, and interest in the LPV approach is evident by the application of such methods to aerospace and many other fields of engineering. This special issue aims to present some of the latest advances in the field of LPV systems in terms of theory, development and application. This special issue contains six papers described in the following text.

The first paper by Wang and Weiss [1] proposes a control method for a doubly fed induction generator driven by a wind turbine, whose rotor is connected to the power grid via two back-to-back pulse-width modulation power converters. The scheme is based on a two-loop hierarchical control structure, and stability and high performance have been achieved over the entire operating range of the doubly fed induction generator in the wind turbine.

Alwi and Edwards [2] present a robust fault detection and isolation scheme using a sliding mode observer based on a LPV system representation. The scheme is employed for both actuator and sensor fault reconstruction in the presence of a certain class of uncertainty and corrupted measurements. An application in the field of aerospace engineering is provided.

The paper by de Oca *et al.* [3] proposes a fault-tolerant control (FTC) design method based on LPV gain-scheduling theory. Both passive and active FTC formulations are developed—the latter assuming the availability of online fault estimation. In both cases, the associated controller synthesis methods are based on the well-established LPV-LMI framework.

Dong *et al.* [4] present a fault detection approach for discrete-time affine LPV systems with additive faults. The new methodology they propose avoids projecting the residual onto a parity space, which in real time, requires at least quadratic computational complexity. A real-time experiment is carried out to demonstrate the viability of the proposed method.

The paper by Köroğlu [5] considers the problem of synthesising an observer-based linear parameter-varying controller for a general linear parameter-varying plant. The synthesis problem is considered with respect to $\mathscr{L}_2$-gain and $\mathscr{H}_2$-type performance objectives. The procedure includes a line search performed over a positive scalar to obtain the best achievable performance with an observer-based controller.

Last but not least, Casavola *et al.* [6] propose a fault detection and isolation filter design method for internal combustion spark ignition engines. A novel LPV model approximation is derived on the basis of a judicious convex interpolation of a family of linearized models. A filter structure consisting of a bank of LPV observers is then considered to isolate potential faults.

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