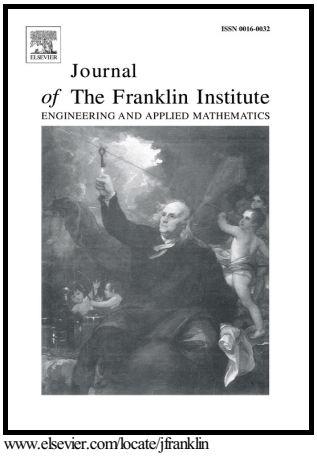

www.elsevier.com/locate/jfranklin

Event Triggered of Microgrid Control with Communication and Control Optimization

Magdi S. Mahmoud, Mohamed Saif Ur Rahman

PII: S0016-0032(16)30268-X
DOI: http://dx.doi.org/10.1016/j.jfranklin.2016.08.003
Reference: FI2683

To appear in: *Journal of the Franklin Institute*

Received date: 30 September 2015
Revised date: 7 July 2016
Accepted date: 4 August 2016

Cite this article as: Magdi S. Mahmoud and Mohamed Saif Ur Rahman, Ever Triggered of Microgrid Control with Communication and Control Optimizatior *Journal of the Franklin Institute* http://dx.doi.org/10.1016/j.jfranklin.2016.08.003

Event Triggered of Microgrid Control with Communication and Control Optimization

Magdi S. Mahmoud , Mohamed Saif Ur Rahman

Abstract

In this paper, an optimized event triggering scheme and a LQG controller design is proposed for a linearized wind turbine model in a microgrid system. The system is modeled as an event triggered system based on asynchronous-sampled data system (ASDS) approach. Networked induced delays are considered in the communication channel. Particle Swarm Optimization (PSO) is employed to optimize control and communication cost, while reducing the event rate. Simulation results are included to elucidate the proposed controller design. A comparative analysis is also presented to demonstrate the significance of optimization in event sampling.

Index Terms

Event-triggered, Networked control system, Wind turbine, Asynchronous-sampled data system (ASDS).

I. Introduction

Networked Control Systems (NCSs) are now ubiquitous in the literature and have been investigated in detail in the past decade. They can be broadly classified into periodic and aperiodic systems. Majority of the networked control systems are based on periodic schemes and substantial design methodologies are available. However, periodic networked control systems which are based on time triggering, tend to overload the communication channel by transmitting even if there is no requirement. This results in inefficient utilization of network and increases communication cost. To overcome this issue, aperiodic schemes such as event triggering and self triggering can be employed. They considerably reduce the load on the communication channel by transmitting only when needed, thereby ensuring optimal performance of the NCS.

[1] presents a comprehensive review of aperiodic triggering for networked control systems. Theoretical results from numerous papers have been compiled and remarks on future extension have also been made. In [2], a model based predictive control based on event triggering is proposed for networked control systems. The effectiveness of the control methodology is demonstrated on a ball and beam system. In [3], the stabilization of quantized event triggered networked control systems is discussed. A networked control system is designed which considers plant uncertainty, quantization, packet losses and event triggering mechanism. Lyapunov functions and linear matrix inequalities are used to derive sufficient stabilization conditions. A review of periodic and aperiodic triggering schemes for networked control systems is provided in [4]. Considering the vast published literature, an attempt has been made to compare and analyze event, self and time triggering schemes for networked control systems. In [5], an event triggered scheduling based on an error-dependent scheme is proposed for multi-loop control systems which possess a common channel for data transmission. Packet dropouts are considered in the channel to demonstrate its robustness. In [6], the H_∞ control problem is studied for networked control systems, where a Markovian jump system is used to describe the communication infractions such as delay and packet dropouts. Sufficient conditions are also derived to ensure stability of the system. A hybrid event triggered scheme for the intelligent control of microgrid based on multi agent systems is explained in [7].

Microgrids are gradually gaining a lot of popularity in the distributed generation domain. There has been an increasing interest in proposing control strategies for microgrids. Particularly, networked control has been receiving considerable attention. A robust networked control scheme for microgrids is presented in [8]. A distributed networked-based scheme is proposed for control of an islanded microgrid in [9]. The stability issue in networked microgrids has been addressed in [10]. In [11], a networked controlled model is presented for multi-inverter systems. A distributed scheme for detection and protection of networked control systems with applications to power systems is introduced in [12]. A distributed cooperative control based control methodology is proposed for the secondary level of microgrid control in [13]. The methodology is implemented through a communication network. Moreover, optimization techniques like the Particle Swarm Optimization (PSO) have also been used in microgrids for various purposes and applications [14]-[16]. In [21], continuous-time predictor-based control of networked control systems is designed under large time–varying communication delays and based on state feedback with sampled measurements. The effectiveness of the design was demonstrated on simulation of an inverted pendulum on a cart. Recent work on event-triggered sliding mode control were reported in [22]–[31]. where adaptive schemes are examined in [22], [23], Network-based approach for singular systems with quantizations is studied in [24], distributed control scheme for freeway networks is developed in [25]

Manuscript **MsM-KFUPM-Saif-Rev.tex**

M. S. Mahmoud and M. Saif Ur Rahman are with Systems Engineering Department, King Fahd University of Petroleum and Minerals, P. O. Box 5067, Dhahran 31261, **Saudi Arabia**, e-mail: msmahmoud,mdsaif@kfupm.edu.sa.