Dynamics of Continuous, Discrete and Impulsive Systems
Series **A:** *Mathematical Analysis* **13 (2006)** 165-176
Copyright ©2006 Watam Press

A NEW FAULT DETECTION APPROACH BASED ON NON-DECIMATED WAVELET PACKET TRANSFORM AND PARITY RELATION

Rui He, Hao Ye*, Maiying Zhong

Department of Automation
Tsinghua University, Beijing, 100084, P.R. China
* Corresponding author: haoye@tsinghua.edu.cn

Abstract. In traditional Parity Relation (PR) based Fault Detection systems, a high order means a good performance index and good robustness to unknown inputs but a high computational load. The so-called Stationary Wavelet Transform (SWT) based method can provide a good performance index and good robustness by using a low order parity vector and a bank of SWT based filters which lead to a low online computational amount. However, the performance index of the SWT based method becomes worse when the optimal parity vector moves from low frequency band to high frequency band. So in this paper, by introducing the so-called Non-decimated Wavelet Packet Transform (NWPT), a new kind of PR based residual generator and the corresponding optimization approach are proposed. The new approach keeps all advantages of the SWT based method, but can further provide ideal performance index and robustness even when the parity vector is located in high frequency band and therefore solves the problem of the SWT based method.
Keywords. Fault detection, Parity Relation method, robustness, Non-decimated Wavelet Packet Transform

1 Introduction

As one of the important approaches for robust Fault Detection (FD), the so-called Parity Relation (PR) based optimization approach gives an efficient way to design robust residual generators ([1]-[6]).

It has been shown in [7] that there is a certain relationship between the optimal performance index of a Parity Relation based system and its order, *i.e.* the index gets better with the increase of the order.

Since the optimal performance index is a kind of measurement of the robustness of a PR based FD system to unknown inputs, a low order PR based FD system means an easy online implementation but a bad performance index and poor robustness, while a PR based system of high order induces a difficult online implementation in spite of its good performance index and good robustness [7][10].

Further, since [8] and [9] has shown that an optimal parity vector is in fact a narrow band filter in frequency domain, and being narrower in