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A FREQUENCY DOMAIN PARITY SPACE APPROACH TO FAULT DETECTION

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Abstract. The Parity Space Approach (PSA) in time domain and the H_2 approach in frequency domain are two important approaches to design robust Fault Detection (FD) systems. Compared with the H_2 approach, the PSA is simpler in design but has a poorer performance index unless it adopts a parity vector of a very high order, which will lead to an unacceptable computational load. In this paper, a new approach to design a PSA based FD system in frequency domain is proposed, in which the optimal performance index of the H_2 approach can be realized with a low order PSA based residual generator and a simple narrowband filter. The new approach ensures a simple design form similar to that of the PSA, an optimal performance index as good as that of the H_2 approach, a low computational load and an easy online realization simultaneously.
Keywords. Fault detection, H_2, optimization, parity space approach, robustness.

1 Introduction

The Parity Space Approach (PSA) is an important approach for designing robust fault detection (FD) systems in time domain, which has been studied by many authors [1,4-8].

Since Ding et. al. [2] has proved that the optimal performance index of a PSA based FD system gets better with the increase of its order, there is a tradeoff when we select the order of the PSA based FD system, i.e. achieving a good performance index requires a high order, but ensuring a low calculation load needs a low order. Some efforts have been made to realize a better performance index with a lower order PSA based FD system compared with the standard PSA by Ye et. al. [9-11]. Literature [11] has further demonstrated the importance of ensuring a good performance index. However, no quantitative analysis has been given on how much improvement in the performance index can be made by these improved PSAs compared with the standard PSA of the same order, and what is the best order for them to achieve that improvement.

The H_2 optimization approach is another important FD approach in frequency domain studied by Ding and Frank [3], which ensures a better per-