Fault Detection in Networked Control Systems. A Robust Approach

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Keywords: Set-membership state estimation, fault detection, zonotopes,

Introduction

Networked Control Systems (NCSs) are spatially distributed systems in which the controller and/or other elements are connected through a network. They have been used in a wide variety of applications, due to the lower cost of implementation and the growing trend in the Internet of Things (IoT). Aperiodic measurements have been proven useful to decrease the traffic in the network, mechanisms such as self/event-triggered are the most used. On the other hand, the problem of fault detection and isolation (FDI) is still an issue in this type of structure. Many techniques have been applied for FDI. In general, these are classified into active or passive techniques. In this work, we propose a framework to zonotope state estimation in an NCS subject to the event-triggered mechanism for robust FDI. The framework takes measurements from the past to improve the reduction of the feasible set, ergo, FDI. The framework is tested over a well-known FDI method over a double spring-mass system. The results show that the framework improves FDI by 20% compared to the traditional method without the framework.

General Structure

The principle of FDI using zonotope is simple. After performing the reachability step on a standard zonotope state estimation, the output measurement is taken to construct an output set that intersects with the reachable set to reduce the final feasible set. However, if this intersection is empty, it will imply that a fault or an attack has occurred. The framework adds virtual output sets in this intersection.

Acknowledgement

The authors acknowledge the contribution of the Slovak Research and Development Agency under the project APVV-20-0261 and by the Scientific Grant Agency of the Slovak Republic under the grant VEGA 1/0691/21.

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