4th International Symposium on Materials and Sustainable Development ISMSD2019
Boumerdes - Algeria, November 12-14, 2019

Robust Fault Diagnosis using Uncertain Hybrid Bond Graph Model:
Application to Controlled Hybrid Thermo-Fluid Process

Yacine Lounici[1], Youcef Touati[1], Smail Adjerid[1], Djamel Benazzouz[1].

[1]Solid Mechanics and Systems Laboratory, Department of Mechanical Engineering, Faculty of Engineering Sciences, M'hmed Bougara University, Boumerdes 35000, Algeria.
Corresponding author's e-mail address: y.lounici@univ-boumerdes.dz

Abstract: The continuous increase in engineering systems complexity and industrial safety requirements has led to a rising interest in the development of new Fault diagnosis algorithms. This paper addresses the fault diagnosis problem of uncertain hybrid systems containing both discrete and continuous modes using a hybrid bond graph (HBG) approach. The latter provides through its properties, an automatic Global Analytical Redundancy Relations (GARRs) generation. The numerical evaluation of GARRs yields fault indicators named residuals, which are used to verify the coherence between the real system behavior and reference behavior for real-time diagnosis. In fact, the residual is compared to its adaptive thresholds to detect the actual faults. In addition, the Global Fault Signature matrix (GFSM) allows making a decision on fault isolation. The main scientific interest of the proposed method remains in integrating the benefits of the HBG with the approach for adaptive thresholds generation for systems having uncertain parameters and measurements. For this task, first, the HBG model is obtained to model the hybrid system using the controlled junctions taken into consideration discrete modes changes. Secondly, the parameter and measurement uncertainties are modelled directly on the HBG in preferred derivative causality for residuals and adaptive thresholds generation. The proposed methodology is studied under various scenarios via simulation over a controlled hybrid thermo-fluid two-tank system.

Keywords: Automation engineering, Diagnosis, Hybrid bond graph, Uncertainties, Thermo-fluid process.