Robust fault detection in bond graph framework using interval analysis and Fourier-Motzkin elimination technique

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Résumé en anglais	This paper addresses the fault diagnosis problem of uncertain systems in the context of Bond Graph modelling technique. The main objective is to enhance the fault detection step based on Interval valued Analytical Redundancy Relations (named I-ARR) in order to overcome the problems related to false alarms, missed alarms and robustness issues. These I-ARRs are a set of fault indicators that generate the interval bounds called thresholds. A fault is detected once the nominal residuals (point valued part of I-ARRs) exceed the thresholds. However, the existing fault detection method is limited to parametric faults and it presents various limitations with regards to estimation of measurement signal derivatives, to which I-ARRs are sensitive. The novelties and scientific interest of the proposed methodology are: (1) to improve the accuracy of the measurements derivatives estimation by using a dedicated sliding mode differentiator proposed in this work, (2) to suitably integrate the Fourier-Motzkin Elimination (FME) technique within the I-ARRs based diagnosis so that measurements faults can be detected successfully. The latter provides interval bounds over the derivatives which are included in the thresholds. The proposed methodology is studied under various scenarios (parametric and measurement faults) via simulations over a mechatronic torsion bar system.
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