Merging Bond Graph and Signed Directed Graph to improve FDI procedure

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Résumé en anglais	The Fuel Cell (FC) is an ideal electrical powersource. However, FC stacks and even more FC systems are vulnerable to faults (such as water flooding and membrane drying) that can cause the disruption or the permanent damage. To guarantee the safe operation of the FC systems, it is necessary to use systematic techniques to detect and isolate faults for the purpose of diagnosis. The problematic for the model-based Fault Detection and Isolation (FDI) of fuel cell is that the model is complex because of coupling multiple physical domains (electrochemical, electrical, thermofluidic...). This is why, we propose in this paper, the exploitation of the behavioral and structural properties of the Bond Graph (BG) as a multi-domain power exchange and unified graphical modeling language for qualitative analysis of monitoring ability (using Signed Directed Graph properties). This is obtained after generation of the fault indicators from one part, and by dealing with an automatically built Signed Directed Graph (SDG) of the system, from another part. By combining qualitative method (based on Signed Graph) and quantitative method (fault indicator generation) using only one representation, an innovative approach to perform (single and multiple faults) diagnosis is proposed. The proposed contribution is illustrated by an application to a Proton Exchange Membrane Fuel Cell (PEMFC).
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