From non-model based diagnostic to fault tolerant control dedicated to proton exchange membrane fuel cell system.

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Abstract:
Proton Exchange Membrane Fuel Cell (PEMFC) is widely studied as the hydrogen fuel used to generate electricity should be an alternative solution to fossil fuels [1]. Moreover, the technology is dedicated to transport as well as to stationary applications [2]. Unfortunately, a large-scale deployment stays limited due to the restricted lifetime and reliability of the PEMFC system [3].
Therefore, ensuring nominal operating conditions for PEMFC system during operation is necessary to guarantee a better efficiency, reliability and a longer lifetime. Diagnostic approaches are developed to reach nominal operating conditions by detecting and isolating failures [4]. Different kind of faults could appear when a fuel cell system operates [5]. The aim is to perform long-term tests in laboratory and to design diagnostic algorithms able to detect a failure as soon as possible to avoid irreversible degradation. Non-model based diagnosis methods are well adapted when large amount of data collected during multiple experimental tests are available. This paper presents a non-model based approach for diagnosis of PEMFC system based wavelet analysis [6]. The results are validated on in-lab tests and prove that the method is able to diagnose different faults in a fuel cell system. The philosophy of this paper is to extend the study to a fault tolerant control approach; i. e. after fault occurrence, act on relevant parameters of the system, in order to recover performance and bring the system as close as possible near the nominal operation condition, or to shut down the system and schedule a maintenance operation [7-8].

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