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## Determination of the health state of fuel cell vehicle for a clean transportation

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**Abstract**—The penetration of Fuel Cell vehicle in a large scale market requires efficiency, long life cycle use and health state monitoring of the key powertrain element: the fuel cell stack. This paper presents three novel methods for an efficient and rapid estimation of the Electrochemical Impedance Spectrum (EIS) of the Fuel Cell. The EIS is a very useful technique for fault detection of electrochemical systems as FC. To perform EIS, measurements at high frequencies are quite easy and rapid to perform but the measurements at low (and very low) frequencies can take a long time to proceed. This long delay to obtain those low-frequency measurements can limit the applicability of the methodology, especially when considering that stationary operating conditions of FC are quite difficult to maintain, nevertheless required for guarantying the quality of the measurements. A method allowing an accurate estimation of the FC EIS at low and very low frequencies could be of a great interest to solve this issue. Authors present different FC EIS estimation methods in order to overcome the drawback of the EIS method used in the fault detection. The three different methods are validated experimentally and the performances are compared.

**Keyword:** Fuel Cell, electrochemical impedance spectroscopy, fault detection.

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