SEM 14 : Degradation prediction of PEMFC based on particle filter

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The Proton Exchange Membrane Fuel Cell (PEMFC) is a good solution to decrease environmental pollution, while the degradation of PEMFC, affects their lifetime and performance, and restricts the commercialization of PEMFC [1], [2]. Prognostic is able to estimate the degradation and predict the Remaining Useful life (RUL) of PEMFC to improve their lifetime and performance [3], [4]. In this paper, the degradation predications of PEMFC are made based on a novel model-driven method (Fig.1), which combines a particle filter with an empirical voltage degradation model. The steps of particle filter algorithm are shown as follows: initialization, weights updating, re-sampling, and state estimation output. The empirical voltage degradation model which contains linear and exponential sections is built based on the degradation data of PEMFC in fuel cell electric vehicle (FCEV). The degradation data of PEMFC are measured in Mobyposte FCEV vehicles which achieve the normal postal delivery mission in real road. The operating load and temperature of PEMFC are variable, and then the degradation phenomenon will be more serious.

The results show that the proposed model-driven method can give accurate voltage degradation predictions compared to the aging data of PEMFC (Fig.2). In addition, it appears that the voltage degradation phenomenon of PEMFC is obvious in FCEV, and more attentions should be paid on the research on the degradation and improvement measures for PEMFC.

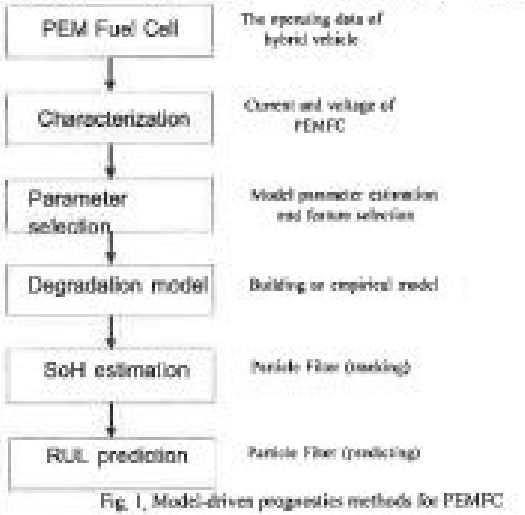

Fig. 1. Model-driven prognostics methods for PEMFC

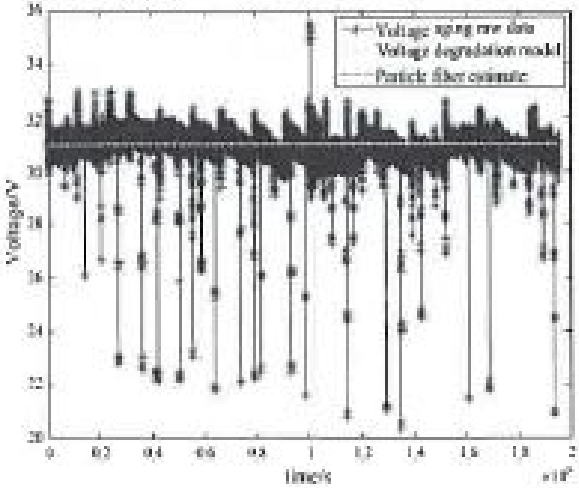

Fig. 2. The degradation prediction with empirical degradation model

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[3] M. Bressel, M. Hilairet, D. Hissel, and B. Bouamama, Remaining Useful Life Prediction and Uncertainty Quantification of Proton Exchange Membrane Fuel Cell Under Variable Load. IEEE T Ind Electron 63(2016) 2569-2577.
[4] E. Wan, and A. Nelson, "The Unscented Kalman Filter," in: S.Haykin (Ed.), Kalman Filtering and Neural Networks, New York: Wiley, 2001221-280.