SEM 18 : Developing a Prognostics-based Energy Management Strategy for Battery/Fuel cell Hybrid Electric Vehicles

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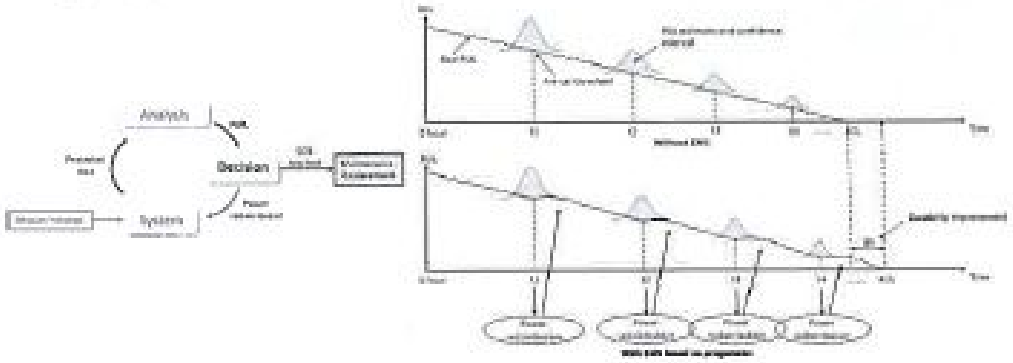
GDR -HySPàC (axe SEM)

Regarding the energy management of hybrid electric vehicles (HEVs), improving the durability of the hybrid system is of great significance [1]. This work has first proposed to develop an energy management strategy (EMS) based on prognostics, which implements the energy management with the help of the predictive nature of prognostics and takes automatic corrective actions to perform power distribution with the objective to extend the lifetime of the energy sources. To help launch more discussions on this brand-new subject, this work has started to address some encountered scientific issues and proposed a solution to mitigate the energy source degradation.

Figure 1(a) shows a closed system-analysis-decision loop to describe the idea of the prognostics-based EMS. When the mission is initiated, the system collects the data and performs data processing, and then, prognostics process is launched to estimate the current health state of the system and calculate the remaining useful life (RUL). According to the prognostics results, a decision is made by EMS, which distributes the demanded power to multiple energy sources. By setting the time instant of the prognostics, this process will be repeated for several times and the power will be redistributed again and again until the mission is completed, or the system reaches its end of life (EOL), which should be put into maintenance or replaced. The implementation is also shown in Figure 1(b).



(a) (b)

Figure 1: (a) The system-analysis-decision loop; (b) The process of implementing the prognostics-based EMS.

After showing the links between prognostics and EMS, this paper has also proposed the guideline on different time scales of data acquisition as well as the data uncertainty due to the unpredictable road driving conditions. The health indicators are proposed for both the battery and the fuel cell, which are distinguished from the performance evaluation criteria of the entire EMS. Finally, the effectiveness of the EMS is validated by comparing with the EMS without prognostics results and the simulation results showed that this EMS can mitigate the battery's degradation.

[1] Song, Ziyou, Heath Hofmann, Jianqiu Li, Jun Hou, Xuebing Han, and Minggao Ouyang. "Energy management strategies comparison for electric vehicles with hybrid energy storage system." *Applied Energy* 2014, 134, 321-331.