A Digital Twin for Battery Aging and Temperature Prediction in a Cooled Powertrain System

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Battery performance is crucial to the performance of electrified systems, and in turn, the operating conditions affect the life and aging of the battery. A digital twin of a battery enables aging and temperature predictions based on actual operating and environmental conditions. Accurate aging predictions enable better Battery Management System (BMS) design and tuning. In this application, we demonstrate a simulation-based digital twin of a battery in a cooled powertrain system. As very detailed battery models are often too slow for system simulation, we use an equivalent circuit model (ECM) to enable real-time simulation (created in ANSYS Twin Builder using Modelica based models). The ECM alone is not sufficient as battery aging and performance depend on temperature too. We couple the ECM to a simplified 3D thermal Reduced Ordered Model (ROM) from ANSYS Fluent to create an accurate and fast digital twin. We show how the simulation-based digital twin can be used to monitor system performance in real-time and predict future performance.