Model-Based Health Management for Magnetic Levitation systems

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ABSTRACT: Model based reasoning systems offer unique capabilities relative to determining real-time operational availability of mission critical systems and equipment. We are developing a generic reusable methodology for Integrated Systems Health Management (ISHM) applications. Our ISHM methodology lends itself to condition-based maintenance, reliability and availability of system and components for magnetic levitation (MagLev) systems . The ability to represent structures and behaviors of physical systems in the form of components, connections, relations, and containment allows modeling of a wide variety of electrical, electronic, and mechanical systems, such as the ones found in MagLev systems.

Our ISHM methodology leverages the combination of component centric domain models, qualitative fault models and models of operational policies to evaluate system and component health, make recommendations for prognostics, and perform condition-based maintenance. Qualitative fault models capture generic expert diagnostic reasoning as causal directed graphs which is used to isolate root causes and predict future impacts. Simulation algorithms applied to domain models determine expected state of systems and its components. Incipient problems are detected by comparing expected system variables against sensor observations in real time. Discrepancies between predicted and observed behaviors trigger qualitative events, which are diagnosed by the qualitative fault models. Further analysis of Root Causes determine their impacts and maintenance procedures are invoked to ensure and enhance the health, availability, and life expectancy of system's components.

This paper will describe our ISHM methodology and its applications to MagLev systems.

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