Proposal for a Special Session on
Hybrid Intelligent Systems for Prognostics and Health Management

Topic:

Prognostics and Health Management (PHM) is a discipline that links studies of failure mechanisms to system lifecycle management in a Condition Based Maintenance (CBM) context. The science of prognostics is based on the analysis of failure modes, detection of early signs of wear and aging, and fault conditions. These signs are then correlated with a damage propagation model to predict an estimate of remaining useful life of an engineering/engineered system. With the predicted information it is possible to make more informed decisions in order to extract maximum usable life out of a component while keeping the systems safe and reducing catastrophic failures. PHM methodologies heavily rely upon hybrid intelligent systems and their applications are relevant to health management for aerospace systems (engines, structures, actuation systems, avionics, power trains, etc.), defense systems, wind turbines, nuclear power plants, automotives, electronics, structures (composites, metallics, civil structures like buildings and bridges, etc.), and manufacturing to name a few.

PHM research is currently focused on various fronts that are expected to be a part of this session. Some of these that directly relate to the theme of the conference are:

1. Diagnostics and Prognostics algorithms – Data-driven, Model-based, and hybrid algorithms for diagnostics and prognostics. Signal processing algorithms for feature extraction, state estimation, fault detection, identification, and isolation, and computation of remaining useful life.
2. Methods for representing and managing uncertainty in predictions – probabilistic, statistical, and fuzzy approaches for representing propagating uncertainty in diagnostics and prognostics algorithms.
3. Smart sensing and sensor fusion for diagnostics and prognostics
4. PHM for autonomous and unmanned aerial vehicles
5. Intelligent methods for automated contingency planning and management using prognostic estimates. Multi-objective optimization algorithms using classical or intelligent methods to carry out strategic planning and execution in future under uncertain conditions.

Why is it Significant

Prognostics has received a significant attention in the CBM industry with the promise of cutting down on lifecycle costs and avoidance of catastrophic failures. Prognostics allows to plan for impending contingencies in advance and hence results in reduced downtimes and better optimized logistics operations. The paradigm shift from scheduled maintenance to a preemptive predictive maintenance brings economic and safety promise to situations where the engineered/engineering systems are critical and expensive, and that undergo ageing or show failure modes that may lead to catastrophic events. While it is practically impossible to model these complex systems in entirety, intelligent hybrid

approaches have shown enormous promise. Technologies to sense and interpret the signals have been of key importance.

Organizer's Biography

Abhinav Saxena is a Research Scientist with Stinger Ghaffarian Technologies at the Prognostics Center of Excellence of NASA Ames Research Center, Moffet Field CA. His research focus lies in developing and evaluating prognostic algorithms for engineering systems using soft computing techniques. He has published more than two dozen papers on these topics. He is a PhD in Electrical and Computer Engineering from Georgia Institute of Technology, Atlanta. He earned his B.Tech in 2001 from Indian Institute of Technology (IIT) Delhi, and Masters Degree in 2003 from Georgia Tech. Abhinav has been a GM manufacturing scholar and is also a member of IEEE, AAAI and ASME.