Center for Intelligent Maintenance Systems

ims

National Science Foundation (NSF)
Industry/University Collaborative Research Center for
Intelligent Maintenance Systems

NSF

Development of Smart Prognostic Agents (WATCHDOG AGENT™)

Rationale of the Project:

The performance of machines and equipment degrades as a result of aging and wear, which decreases their performance reliability and increases the potential for faults and failures. On the other hand, highest quality of products and services becomes indispensable for attaining and retaining one's market position. Therefore, in order to achieve near-zero down-time and the best possible quality of products and services in contemporary markets, it becomes increasingly important to predict and prevent process or services failures and thus follow the proactive Predict and Prevent (PAP) maintenance paradigm, in stead of the currently prevalent Fail and Fix (FAF) maintenance paradigm mirrored in reactively addressing and fixing the failure once it occurs.

Proposed Approach and Solution:

In order to fulfill this requirement, we propose a paradigm shift in service and production maintenance from the traditional approaches centered on detecting and quantifying failure, towards an approach centered on quantifying and predicting performance degradation of a process, machine, or service. Performance degradation is a harbinger of system failure and as such it can be used to predict unacceptable system performance before it occurs.
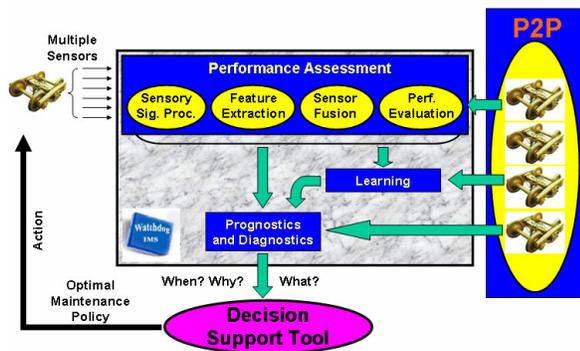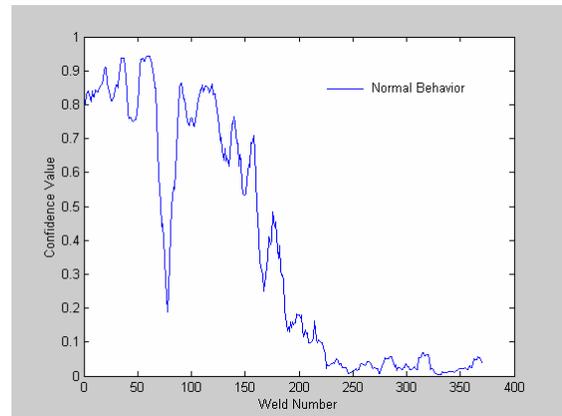

Fig. 1: Functionality of the Watchdog.

Fig. 2: Welding electrode wearout is depicted in the decreasing trend of performance confidence values.

Watchdog^{TM} Agents assess and predict the process or equipment performance based on the inputs from the sensors mounted on it. Performance-related information is extracted from multiple sensor inputs through signal processing, feature extraction and sensor fusion techniques. Historical behavior of process signatures is utilized to predict their behavior and thus forecast the process or machine performance. Based on the forecasted performance, proactive maintenance can be facilitated through the prediction of potential failure before it occurs. Furthermore, this proactive maintenance infrastructure can be supported by the information learnt at Watchdog^{TM} and this Peer to Peer (P2P) paradigm will be utilized to improve diagnostic and forecasting functionalities of the Watchdog^{TM}.

Accomplishments & Benefits to Sponsors
- Developed generic performance assessment and forecasting methods;
- Conducted experimental case studies in turning, drilling, welding, elevator door performance monitoring, remote spindle performance assessment and prediction, automotive e-Manufacturing testbed in GM, remote assessment and prediction of a material handling device and in embedded prognostics for industrial automation systems.
- Verification through testbeds in several automotive, machine tool and postal service companies.