System-level Maintenance Decision Support Tool Design

Objective

The overall goal of "System-Level Maintenance Decision Support Tool" is to provide a solution supporting maintenance operation to achieve near-zero downtime and optimal profit-cost strategy for various maintenance domains. Currently the focus is in the maintenance strategy of production/maintenance systems and field service systems.

Approach

A general frame for various maintenance systems is created. Different modules can be developed individually for specific maintenance platform and plugged into the frame under different applications environment, including production line systems and field service systems. The current design includes two major modules: a Genetic Algorithm optimizer and candidate evaluator. The optimizer is searching for optimal decision candidates using a Genetic Algorithm, while the evaluator is calculating a quantitative score for each of the decision candidates upon the current system configuration and predicted behavior.

The GA optimizer generates multiple decision candidates and search for better ones during each iteration. The selection criterion is the score each candidate will obtain through the evaluator. Using the evolution ability in GA, the GA optimizer filters out the less-scored decision candidates and builds new generation upon the better-scored candidates. A set of near-optimal candidates can be found after the optimization run ends. The task of the evaluator is to assign scores for each decision candidates provided through the GA optimizer. No matter it is a possibly good candidate or a bad one, all candidates are analyzed from the current time to a predefined horizon. Using Progressive State Model, the events that will happen within the time horizon will be clearly identified as well as the productivity and other system parameters between the events. The final score is given according to the productivity and maintenance utilization. Higher score stands for a better scheduling decision.

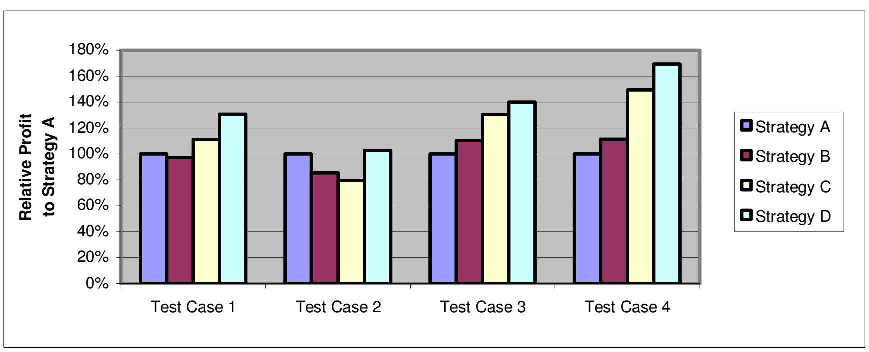

Figure 1: Cost effects of maintenance various maintenance policies. Results indicate significant potential advantages of using predictive information and GA-based optimization (Strategy D).

Accomplishments

1. A dynamic maintenance scheduling procedure based on the Genetic Algorithm paradigm has been developed to maximize the system level benefits of predictive machine level information.
2. Maintenance scheduling procedure based on the Genetic Algorithm paradigm has been tested and verified in a simulated environment.
3. Tools for evaluation and optimization of priorities of short-term maintenance operations has also been developed and tested in a real factory environment.

Future work

1. Extend the design to include the decision support functionality for field service systems,
2. Validate the long-term dynamic scheduling methodology through real-world applications.