ABSTRACT

Design for Existing Lines (DFEL): New Part and Process Plan Design Determination and Optimization to Best Fit and Utilize Available Existing Production Lines

Arlene G. Smithson's
Doctor of Engineering in Manufacturing Oral Defense
will be held on
February 3, 2005
from 9:30 a.m. to 11:00 a.m.
1515 HH Dow Building

If you plan to attend Arlene's Oral Defense, please let Kathy Bishar at kbishar@umich.edu know by Tuesday, February 1.

Chair: Kazuhiro Saitou

Modern market scenarios are setting manufacturers in an ongoing quest to cut their manufacturing costs in order to maintain profitability. The purpose of this research is to help manufacturers reduce the cost of introducing a new product into the market via a systematic method for modifying the design of the new product for an optimal utilization of existing production lines that are dedicated to other products.

The method takes as inputs a nominal part design and the process information of the (potentially multiple) existing line(s), and produces a modified part design and a process sequence that maximizes the utilization of available manufacturing processes in the existing lines or equivalently minimizes the addition of new processes dedicated to the new product. The proposed method formulates the part design decisions and the process plan as a mixed discrete-continuous multi-objective problem.

Two search methods are explored in the optimization of the DFEL analysis and evaluation: exhaustive enumeration and Genetic Algorithm (GA). The first search method generates all possible manufacturing sequences for the desired part for evaluation. Therefore this method provides the absolute best solution to the DFEL problem presented but it is computationally intensive for real world applications. The second method, GA, is a multi-objective genetic algorithm used to generate quasi-Pareto optimal design sets to speed-up the solution(s) search.

To illustrate the methodology and application of the search methods described, a series of simple examples where used which use a desired part scenario against two available lines. A simplified 3-Dimensional example used to introduce the methodology and its preliminary computer automation through problem specific programs using exhaustive enumeration and GA. Another 2-Dimensional example introduced to include more variables into the DFEL analysis for more realism and further definition of the GA evaluation for the problem. And a third more realistic 3-Dimensional example presented to expand the DFEL methodology evaluation and computer automation through GA with reference for the inclusion of costing, capacity, and fixturing features and constraints inclusion in the analysis. The study demonstrates the evolution and effectiveness of the proposed approach.