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Surprisingly Simple Metamodels to Forecast Cycle Time Quantiles

Abstract

Real-time control has become increasingly difficult as manufacturing systems and their models become more complex in terms of job variety, machine flexibility and machine reliability. We consider a control policy to be a set of rules governing when jobs are released to the manufacturing floor (and perhaps to which machine in a flexible system). The objective of a control policy is to maximize efficiency (machine utilization) while meeting job demand times. A critical quantity in this planning is the quantile (say the 90% quantile) of forecast completion time for a job released to the system in its current state. We propose an analysis method based on offline simulation of a fraction of all possible states that fits a metamodel to predict the state-based cycle time quantile. The rapid calculation enabled by the metamodel allows real-time support of a dynamic strategy for job release. In several examples, a small experiment design (0.02% of all possible conditions) allows fitting a metamodel with a prediction error typically 1% or less. This work is joint with Giulia Pedrielli at Arizona State University.

Biography

Russell Barton is a Distinguished Professor of Supply Chain and Information Systems in the Smeal College of Business at Penn State and holds a courtesy appointment in the Department of Industrial and Manufacturing Engineering. From 2013-2018 he served as Senior Associate Dean for Research and Faculty. In 2017-18 he was Vice President, INFORMS Sections and Societies. From 2010-2012 he was Program Director for Service Enterprise Systems and Manufacturing Enterprise Systems at the U.S. National Science Foundation. He has a B.S. in electrical engineering from Princeton University and M.S. and Ph.D. degrees in operations research from Cornell University. He is a Fellow of IISE, a Certified Analytics Professional®, and a Senior Member of IEEE. His research has focused on the interface between applied statistics, simulation of manufacturing and service processes, and product design and manufacturing.