

Measuring Variability on Electrical Power Demands in Manufacturing Operations

Speaker:

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Abstract:

Manufacturing energy studies have generally focused on estimating the mean electrical power demanded by machines. Variability is, however, also an important factor to consider in manufacturing power studies, since an understanding of electrical demand uncertainty can support the estimation of peak power demand, which impacts energy costs and electricity distribution systems. For example, U.S. federal law requires power suppliers to provide credits to large electricity consumers, such as manufacturers, when they enter into pre-established peak demand reduction agreements. The peak demand in a manufacturing plant can also be used to plan and design a factory electrical system, and to determine the amount of capital to be invested in facilities and equipment providing electricity services to new, large customers.

Thus, this study proposes a systematic method for estimating the peak demand based on readily available information such as manufacturing parameters. More specifically, the proposed method extracts the power demand mean and variance from manufacturing parameters at the machine state level by considering various manufacturing processes. The machine state level mean and variance are then used to approximate the mean and variance at the machine level by implementing the probability mixture model. Applying the Lindeberg central limit theorem to the machine level information, we estimate the mean and variance of power demands at the manufacturing system level. Then, a method for estimating the peak power demand using the mean and variance at the system level is proposed.

In an illustrative example, we demonstrate our proposed method for real manufacturing power profiles, including milling, turning, and welding. We show how to connect manufacturing process parameters with the mean and variance of power demands and how to estimate the peak power demand based on the mean and variance. To validate the proposed method, we simulate a hypothetical manufacturing system; the results suggest that the proposed method can estimate the mean power demand with 2% error and standard deviation with 12% error, and that the peak power demand can be estimated with 20% error even in the worst case.

Biography:

Dr. Jeon has been Assistant Professor of Mechanical and Industrial Engineering at Louisiana State University (LSU) since 2015. Dr. Jeon received his Ph.D. and M.S. in industrial engineering from Pennsylvania State

University. Before joining LSU, Dr. Jeon held several positions such as a visiting researcher at Politecnico di Milano in Italy and a computer network specialist at SamsungSDS in Korea. His current research includes modeling and estimating energy consumption of manufacturing processes and systems based on probabilistic approaches.

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