Fuzzy Logic Modeling for Process Optimization and Control

Brian Schaible and Y. C. Lee

Department of Mechanical Engineering
University of Colorado
Boulder, CO 80309-0427

Abstract

A non-linear process is usually governed by a mix of different physical phenomena. The interactions of these phenomena are complicated, and cannot be modeled properly by a single function as used in regression models. As a result, we need a technique that is able to integrate different functions to describe the interactions of the phenomena. The fuzzy logic modeling technique is ideal for such integration.

Fuzzy logic modeling uses several overlapped functions to represent a process, and such fuzzy representation can accurately model a non-linear process without a sophisticated data analysis. To illustrate this new modeling technique, we will present the following two cases.

1. Fuzzy logic modeling of a non-linear process by using idealized solutions. For many cases, we may know the exact solutions at idealized operating conditions, e.g. temperature = 0 or ∞. The fuzzy logic modeling is an effective method to integrate these idealized solutions to describe the process at non-idealized conditions.

2. Fuzzy logic modeling for ranking process parameters. The statistical analysis of variance (ANOVA) is used widely for the parameter ranking. However, its accuracy is limited due to the poor modeling capability of regression models. A new fuzzy logic ANOVA can enhance such ranking accuracy substantially.

In addition, we will discuss a potential application to use fuzzy logic modeling for process control. The modeling can identify the cause of a process shift and to recommend the parameter adjustments to accommodate the shift.