EDITORIAL

Arguably, there is no need to distinguish *process control* as a separate branch of control theory. Historically, highly complex multivariable and nonlinear plants often with difficult dynamics, large transport and measurement delays, and with control elements prone to saturation — plants commonly found in chemical, petroleum, food, pharmaceutical and other process industries — are considered to be the subject of process control. Plants with difficult characteristics are certainly not limited to process industries. However, plants in process industries are often unique and subject to continuous changes due to equipment upgrades and modifications in operating conditions. Consequently, it is economically infeasible to develop and maintain state-of-the-art control systems for all but the most critical plants. Furthermore, complexity and uniqueness lead to the lack of reliable models for controller design.

The central research topic of process control is the development of controller synthesis methods that can be applied by engineers with limited training in control theory and produce robust designs that are easy to obtain, apply, maintain and re-tune, and are applicable to uncertain plants with difficult dynamics, time delays and nonlinearities. For a long time, the requirement of the simple designs for difficult plants limited the practically used methods to the well-established and proven methods of PID control, interaction decoupling, dead-time compensation and other classical methods all known since the late 1950's.

The research effort of the last 20 years has resulted in significant theoretical developments in the areas of robust linear control and model predictive control (MPC). After many years, MPC has become the first "new" control method widely accepted by the industry. Significant research effort was directed towards the development of nonlinear process control, adaptive control and model identification. The need to reduce process measurements into the process model led to a wider use and acceptance of statistical methods of process modeling. The combination of process control and statistical data processing emerges as a new direction – a data-driven control.

This special issue gives a sample of current research in process control and data processing relevant to process control. Several papers address theoretical issues ranging from inherent degree of fault tolerance of the MPC (paper by Maciejowski) to the controller design and identification in distributed parameter systems (papers by Christofides and Daoutidis, and by Skliar and Ramirez).

Problems of data processing are well represented in the special issue. Höskuldsson presents a new statistical modeling approach inspired by the Heisenberg uncertainty principle and demonstrates its application to statistical process control. Miller *et al.* introduce the idea of using contribution plots to identify the cause of the variability of product quality; the proposed approach is applied to the monitoring of a photographic emulsion manufacturing process. Ling and Rivera study the application of three different nonlinear black-box identification methods to the problem of modeling binary distillation. Duever and Penlidis discuss model discrimination and nonlinear parameter estimation with application to the modeling of polymerization reactions. The application of statistical methods to the problem of lake bed classification is considered by Yin *et al.* Two papers (by Klien and Rivera, and Tholudur and Ramirez) describe the application of neural networks in modeling and signal interpretation.

By putting together this special issue, we hope to stimulate the cooperation between control and statistics communities. Our further hope is to increase the interest of the readers of *Applied Mathematics & Computer Science* in the problems of process control and data processing.

Mikhail Skliar
W. Fred Ramirez