Guest Editorial
Integrated Optimization of Industrial Automation

Complex industrial production of steel, paper, automobiles, and mining processes requires multiple layered and networked computer control systems, usually referred to as distributed control systems (DCS), to perform operational management, monitoring, and automation for the entire system, which one can view as a matrix. Horizontally there are similar production subsystems linked in series. Vertically there are parallel flows that have to be coordinated to meet production goals. System operators usually specify control and operational layers such as planning and scheduling, operational control, and lower level control loops. Once these layers are determined, the only decision variables that can achieve the required optimization and automation of the whole production line are the controlled variables for each production unit.

In contrast, integrated optimization approaches aim to optimize the operation of all the decision variables at different layers such that product quality and production efficiency can be maximized while energy and other consumptions can be minimized while maintaining safe operations. This means that condition monitoring is also an important issue that has been addressed in both research and industrial sectors with respect to the automation of whole production lines, and is indeed an integrated part for industrial automation. As a result, integrated optimization of industrial processes raises new challenges in modeling, optimization, and condition monitoring.

In response to the above challenging issues on integrated optimization of industrial automation, we organized this Special Issue. We received 36 submissions that cover a broad range of topics relevant to automation science and engineering for industrial processes. After a rigorous peer-review process, 17 papers were selected for publication. Thirteen address recent advances in integrated optimization and condition monitoring for soft sensing, product quality prediction, and ball mill grinding. Four papers address optimal tracking control of nonlinear systems in coal gasification, adaptive observer-based data-driven control for nonlinear discrete-time processes, model predictive control for wind power generation and flotation processes.

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Dr. Shah was the recipient of the D. G. Fisher Award of the CSChE for significant contributions in the systems and control area, as well as the NSERC University-Industry Synergy Award.