Editorial

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Biographical notes: Prof. N.P. Mahalik, with more than 16 years of teaching, research and development experiences, is currently working as a Guest Professor in the Department of Mechatronics, Gwangju Institute of Science and Technology (GIST), South Korea. He received his BSc Engg. (Electronics), MEngg. (Communication), PhD (Machine Control) and Postdoctoral research in the years 1989, 1993, 1998 and 2002, respectively. He has received the prestigious NOS (1994) and Brain-Korea-21 fellowship (2001) awards from the Indian and Korean government, respectively, for pursuing research especially in the field of interdisciplinary areas. His research areas include distributed machine control, micromechatronics, FDI, system integration and simulation software. He has experience in authoring and editing research books (six) for higher technical education, and has published more than 70 research papers and reports.

1 Introduction

Evolutionary changes in the digital technology and application portfolio are the main driving forces behind the design, development and implementation of advanced control architecture in the industry. Typical industrial automation platforms are production lines, assembly lines, machine systems, process control systems, Supervisory Control and Data Acquisition (SCADA) and so on. In these platforms, the implementation of Smart Control Architecture (SCA) is befitting and already emerged. There is a significant difference between the conventional one and SCA. Smart control attempts to build upon and enhance the conventional control design strategy and concept to solve new challenging interfacing problems. SCA is thought of as a *vector* accommodating the *elements* such as digital technology, field-level processing ability, real-time capability, field programming facility, interchangeability and interoperability, adaptability, immunity to environmental impacts (e.g. noise, vibration, dust, moisture, temperature, etc.), self-diagnostic capability, life cycle information storage, Intrinsic Safety (IS) and most importantly, the distributed control philosophy. The design step concerned with the decentralisation of control tasks through multiple processing units where implementation has multiple points of interactions.

Control architectures can be classified under three categories: centralised, distributed and hybrid. In a centralised system, all the sensors and actuators, switches, valves, etc. are directly wired back to a central controller. For a large system, the total number of I/O signals could be thousands, and this number is beyond the capacity of a central computer. Even a powerful computer has difficulty in polling round all the inputs within the time limit of the system. Other vital disadvantages in the centralised systems are: central failure, inflexibility, inability to make the best use of online technique, slow to take advantage of improved technology and most importantly the installation cost is high. In addition, most industrial systems are distributed with multiple control points, which interact to a limited extent. Hence, there has been a move towards distribution of control task in the system. A Distributed Control System (DCS) is one in which there are several autonomous but cooperative processors that perform sensing, monitoring, control and other applications at different points of interaction. This system employs local decision making at the point of interaction.

The main objective of this special issue is to provide fundamental information, concepts, principles, characteristics, applications and latest technological developments along with comparisons and performance with regard to DCS. It incorporates a collection of research, development, tutorials, and case study papers based upon selected contributions. The explicit motivation comes from the fact that the academic and industrial research and developments on industrial automation and control engineering are being carried out at many important academic institutions and industrial sectors around the world, respectively. The technological trend in this domain has to be disseminated so that the DCS revolution can further turn up quickly.

In this special issue there are nine papers. The first paper reviews the evolution of industrial automation. The second paper provides an executive overview with respect to industrial ethernet value proposition. The Fault Detection and Isolation (FDI) in multistage manufacturing systems is very important. The third paper considers these aspects. Wireless sensor network is an advanced way of monitoring and controlling the industrial systems. The fourth paper deals with the channel assessment for plant-floor wireless sensors operating in unlicensed band. The fifth paper presents a case study that examines DCS implementation and optimal operation of industrial systems. In that paper, the detailed process modelling of a crystallisation process is presented. Virtual design is considered as an additional layer of any design process. The sixth paper explores a novel method of building a virtual vehicle system using a distributed network. The concept of Hardware In Loop (HIL) is also introduced. Performance evaluation of communication network is presented in the seventh paper. The educational institutions should now consider DCS as an important subject in their control engineering curriculum. The eighth paper suggests that DCS and hence fieldbus technology should be considered as one of the competencies in modern control engineering graduation. The last paper concludes by highlighting the important attributes of industrial machine and process control systems.