Editorial

Large-scale complex systems (LSS) have been traditionally represented in control literature by models which are characterized by a large number of state and control variables, strong nonlinearities and uncertainties. Their decomposition into smaller, more manageable subsystems, possibly organized in a hierarchy, has been associated with intense and time-critical information exchange and with the need for efficient decentralization and co-ordination mechanisms.

The last decade of the past Millennium and the early years of the 21st century have revealed new characteristic features of industrial and non-industrial large-scale and complex systems. The enterprise of the present time is to operate in a highly networked environment. Also there is an ever more increased concern for new aspects such as: a) integration of various technologies, b) economic, environmental, and social aspects, and c) security issues. Consequently, the design of control systems must take into account more aspects and needs additional skills and tools. At the same time, the recent advances in computer and communication technologies have shown that they can provide effective tools and adequate technical infrastructures to support the design and enable the implementation of advanced control systems for the large-scale and complex applications of the present time.

The TC (Technical Committee) 5.4 on "Large-Scale Complex Systems" of IFAC (International Federation of Automatic Control) has already a more than 30-year tradition. The main events of this TC are the symposia entitled "Large- Scale Systems: Theory and Applications". The inaugural edition was held in Udine, Italy in 1976. Since then, at a three-year succession, the Symposium took place in Toulouse, France (1980), Warsaw, Poland (1983), Zurich, Switzerland (1986), Berlin, GDR (1989), Beijing, China (1992), London, UK (1995), Patras, Greece (1998), Bucharest, Romania (2001), Osaka, Japan (2004), and Gdansk, Poland (2007). The next edition of Symposium will be held in Lille, France, in 2010.

In 2002, at the IFAC World Congress and General Assembly held in Barcelona , the IFAC Technical Committee 5.4 was placed under the Coordinating Committee "Manufacturing and Logistic Systems", chaired by Professor Shimon Nof. Since then, the scope and objectives of the TC have been adapted accordingly to reflect the current trends in control systems and the new place of this TC within the IFAC organization. The TC focuses on manufacturing and related systems which are characterized by complexity and/or a networked structure of interconnected subsystems. It aims at developing new decentralized and hierarchical control methods, decision-making, and risk analysis techniques together with practical solutions based on new advances in computer and communication tools. A practical consequence of the new place of the TC is organizing the MCPL (Management and Control of Production and Logistics) conference starting with 2004. MCPL conferences were held in Santiago de Chile (2004) and Sibiu, Romania (2007). The next MCPL conference is to be organized in Coimbra, Portugal in 2010.

It can be appreciated now that several subfields that are traditional for LSS domain remain of increasing interest to the scientific community, such as decentralized and hierarchical control, model reduction, optimization, and complex system analysis. Traditional applications of LSS methods, such as power, gas, transportation, manufacturing, environmental systems are more than ever of great interest. The new issues such as collaborative control, intelligent network systems, risk management and decision support in LSS are well received by the LSS community. Among main ideas and trends one can include: a) large systems become ever "larger" (more complicated and networked) and b) there is still a need for practical solutions, possibly including new technologies with a view to attaining a correct balance between control techniques and computer and communication tools.

At the LSS symposium in Gdansk a formal meeting of the TC5.4 was held and Prof. Brdys of Birmingham University, UK, was elected for nomination as a chair of the Committee. According to Prof. Brdys, complexity is anticipated to be a central problem in modern system theory and practice. Complexity issues in control of large scale and complex systems such as manufacturing systems and related systems require a deeper and systematic continuation in the development of a relevant theory of complex systems including its extension to recent communication issues. Variety of theoretic results motivated by practice and successfully developed within various long term activities of this TC could offer a deep background for such continuation. Multidisciplinary approaches appear to be adequate in modelling and controlling large-scale and complex systems

At the end of my second term as a chair of the TC 5.4, I intended to publish a special issue of this journal addressing several relevant aspects and results in LSS domain. Consequently, the present issue of the

journal contains several papers of the members of the TC and other invited authors.

Wan, Ruan, and Liu of China review their investigating efforts and results over the past fifteen years in the on-line steady-state hierarchical intelligent control and optimization of large-scale industrial processes, a research direction initially proposed by Roberts three decades ago. Borowa and colleagues from UK and Poland describe an approach for detecting and localisation of pipe leakage in Drinking Water Distribution Systems (DWDS) which are large-scale and complex distributed dynamic systems. A practical DWDS is decomposed into suitable subnetworks which make the monitoring process easier while fewer sensors are required. The subnetworks and corresponding PCA (Principal Component Analysis) monitoring models are selected based on the network operational knowledge and information regarding its topology. Duviella, Chiron and Charbonnaud of France propose a weighted digraph representation of dam-river systems to solve the water asset-management by resource allocation and setpoint assignment problem. Tangour and Borne of EC Lille (France) give a review of several various metaheuristics optimisation methods which have been implemented in various applications such as the optimization manufacturing problems and recommend hybrid approaches. Chamroo and colleagues from France and Bulgaria propose a new control scheme for a highly non-linear anaerobic digestion process. Ivanescu and Florescu of Romania present a solution for the control problem of a hyperredundant robot with continuum elements that performs the coli function for grasping. Ayadi and his colleagues from Tunisia propose a practical approach to design and implement a real-time system based on a RISC microcontroller dedicated to a DC motor speed control.

Leon, Zaharia, and Galea of Romania propose a system of autonomous agents for dynamic routing in high performance distributed systems.

Pascale Zarate of France presents several methodological issues in an effort to develop Cooperative Decision Support Systems (CDSS) for collective decision making processes. In order to make the information systems more usable, Svetlana Cojocaru from the Moldavian Academy of Sciences propose intelligent interfaces, which are able to adapt themselves to user's learning needs, take over the initiative in their interaction with user, are able to guide him so that the objectives may be achieved in a fast and comfortable way.

F. G. Filip

Chair, IFAC TC 5.4 (2002-2008)