BOOK REVIEWS

Cybernetics and Applied Systems

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Initially, the field of cybernetics encompassed different areas of sciences as statistics, information, computing machines, nervous systems, as well as adjacent disciplines as economics, sociology, psychopathology and linguistics, not as a collection of individual disciplines, but rather as a way of reasoning in sciences.

In the last decades, cybernetics revolutionized large areas of engineering and technology. Also, its concepts of self- regulation, autonomy, interactive adaptation provided a rigorous theoretical basis for the achievement of a dynamic equilibrium among human individuals, groups and societies.

The state- of- the art in cybernetics has made the subject of many books, where the center of interest was sometimes shifting to other disciplines, for example toward artificial intelligence. The present book highlights the most outstanding topics of cybernetics and presents the most recent trends in this discipline. It proves to be an information source on the state- of- the-art in different branches of cybernetics and reports on the research efforts in theory, applications and methodology.

The book contains 17 chapters in which the authors ,by their contributions,have explored in different manners, how cybernetics involves in an improved understanding of intelligence.

Cybernetics, as Ernst von Glaserfeld presents it in his contribution, is a metadiscipline, in that it distills and clarifies notions and conceptual patterns, opening up new pathways of understanding in a great many areas of experience. Two major orientations in cybernetics can be pointed out in this paper. The first one is concerned with the conception and design of technological developments based on mechanisms of self-regulation by means of feedback and circular causality. Among its results there can be noted: industrial robots, automatic pilots, different automata and computers. Computers have in turn led to the development of functional models of more or less intelligent processes. Thus, the field of artificial intelligence emerged, a field now comprising not only systematic studies in problem-solving, theorem definition, number theory and other areas, but also sophisticated models of inferential processes, semantic networks, etc. Other results of this essentially practical orientation have been obtained in management theory and politics. For both these disciplines cybernetics has laid the principles of the relations between the controller and the controlled, the government and the governed. The second orientation focussed on the general human quest for knowledge and produced a comprehensive biology of cognition in living organisms and a theory of knowledge construction.

Major problems in homeostatic control and the results of homeostatic control structures simulation make the subject of the paper of V.I.Astayev,Y.M.Gorsky and D.A.Pospelov. The

application of homeostatic principles to the problems of technics, medicine, artificial intelligence and linguistics is also presented. This contribution is structured in five sections dedicated to: homeostatic principles in living matter, structures of homeostats and their models, homeostatic models of collectivities, interconnection between homeostatics and artificial intelligence, construction of simple homeostats by "sticking" two antagonists. A demonstration of the significance of homeostatic control, which is characteristic of biological processes, has been intended. In the authors' opinion self-organization processes observed also in technical and social systems are homeostatic in their nature.

In Marion Bunge's contribution the principle according to which everything is a system or a component of a system is analysed. This holds for atoms, people, societies, ideas and their components, and the things composing them. The idea underlying the paper is quite distinctive of a systemic approach, which is adopted only occasionally, and tacitly rather than explicitly. The main problems dealt with in the paper are: conceptual and concrete systems, CES models, state space representations, individual-system or micro-macro relations, philosophical dividends.

A similar subject is discussed by Marc E. Carvallo in his contribution to system science. Since 1940 many scientists have attempted to define the nature and the scope of system theory, system research, system analysis and system science. Such terms and definitions being often polyinterpretable, broadly used, and occasionally misused, the author is first preoccupied with some major premises of these notions, and then develops a system science as a subjective system that includes the observer.

A paper on sociocybernetics,of which definition is the application of concepts, methods and ideas of the new cybernetics to the study of social and sociocultural systems ,is contributed by R. Felix Geyer and Johannes van der Zouwen. The paper lets readers get a rough impression of the large variety of innovative theoretical and empirical researches in sociocybernetics.An overview of the main trends and developments in sociocybernetics since the late 1970s is provided.

Rod Swenson 's chapter is dedicated to the aspects of order, evolution and natural law in connection with complex system theory. Natural symmetry and the laws of evolution, maximum entropy production and the physics of order, biology and culture are among his topics of interest. Far from being static or purposeless, the evolutionary dynamics of the natural world is viewed as creative and purposive; the world is in the order-production business, and this can be understood as a spontaneous search for symmetry in terms of natural laws.

In the next chapter of the book, Fenton F. Rabb attempts to lay the ground of the theory of social institutions emergence from human conversational interactions based on the theory of entification and evolution of order in physical sciences. The author discusses different aspects such as: the need for theories of organization, a new view of entropy, the emergence of institutions, application to formal organizations, practical implications. The last part of the paper discusses the pessimistic/optimistic positions and a Faustian trade-off concerning the effects of organizations on the environment, on health, future generations, freedom of the individual.

Intelligent models of economic and social systems are proposed by Robert W. Blanning, James R. Marsden, David E. Pingry and Ann C. Seror in their contributions. They explore what, if anything, can be learnt about the intelligent behaviour of economic and social systems from the growing body of research in cognitive science and artificial intelligence. Three topics are discussed. First, the source of human system intelligence is explained by invoking the physical symbol hypothesis in artificial intelligence and by extending it to including a description of economic and social systems. Secondly, three important facets of the intelligence are described, and finally, the organizational intelligence is viewed in terms of both formal and common sense reasoning, the latter being largely circulated by the developmental psychology.

Pierre Auger's contribution offers a theoretical framework for studying complex systems

composed of a large number of elements and presenting a hierarchical structure. Studying such systems could have been risked otherwise. Indeed, if the system has many possible states, computer simulation of such systems will need a great deal of computer time, and the results will be very difficult to use because of too many data to handle. With the proposed approach, if hierarchical partition has few groups, each of them with many states, a set of a few differential equations is obtained and an important reduction of the number of variables is noticed. The paper also studies the jump from a microscopic level to a macroscopic level, the relation between individual and population, and represents a contribution to the general complex system theory.

The contribution of Yan M. Yufik, Thomas B. Sheridan and Valery F. Veda focusses on the cybernetics of mutual non-machine adaptation. At the beginning the authors review some experimental results concerning operator training for complex interactive tasks, and present some general ideas of knowledge measurement, setting up a framework in which the results can be discussed. In this knowledge measurement framework, they propose the computational model of a cognitive process manifest in operator's behaviour, and try to model the formation of chunks, that is, components of operator cognitive models that represent clusters of strongly interactive variables, to be processed as wholes when solving control tasks. Finally, they briefly hint at the research directions in knowledge measurement concerning skills diagnosis, operator training, and interface design.

Constantin Virgil Negoita's chapter is dedicated to a key concept in approaching learning mechanisms: the pullback in a categorial structure. The pullback can be seen as a cybernetical approach to knowledge manipulation, an approach where the importance of parallel processing is recognized. The pullback concept suggests an understanding of the process of management as a cultivation of an open system according to its natural structure.

Parallel distributed processing makes Alex. M. Andrew's contribution. His paper raises many more open problems with no keys for the time being, but a tutorial survey thinks this good . Parallel operation entered standard computing technology, under such headings as digital array processor, pipeline machine, data-driven architecture, and concurrent versions of Prolog, Pascal, etc. Since brain operates in a highly parallel fashion, discussions of parallel operation invariably evoke comparison with the nervous system. It is realized that the human brain embodies even more "clever tricks" than those known by workers in mainstream AI, so there is a lot of interest in parallel distributed processing, with the explicit intention of investigating and modelling the nervous system operation. The potentialities of parallel distributed processing are discussed under two headings: the enhacement of computing power and the imitation of the "clever tricks" of brain.

Advances in the technology of very large scale integrated systems have greatly resurrected the interest in neural networks. Two chapters of the book discuss such a subject. After a short introduction in artificial neural networks, Roman Swiniarski presents two types of popular neural networks: static, feedforward neural networks and Hopfield dynamic neural networks. The first group of networks have large and promising applications, particularly, in pattern recognition and signal processing, while the second type has been applied as a new massively parallel technique of solving combinatorial optimization problems.

A similar problem- neural network vector quantization in image coding - is discussed in C. N. Manikopoulos's chapter. This contribution tackles the following aspects: vector quantization, a neural network approach to vector quantization, properties evaluation of the algorithm (distorsion measures, convergence, optimality), implementation aspects by two methods (cascade and direct mapping), adaptive image coding, image coding using multistage vector quantization. Simulation experiments have been carried out with the adaptive neural network vector quantization as well as cascade neural network vector quantization in coding a videoconference sequence. The results, numerical and pictorial, have been quite favourably considered.

James J. Buckley's contribution is a tutorial on the modern fuzzy controller. First, the internal workings of a basic fuzzy controller are discussed in detail. The Sugeno fuzzy controller is presented separately, because of its structure not fitting into the general description of basic fuzzy controller. The next section presents well- known theoretical results on the fuzzy controller, namely: the functional relationship between the defuzzified output and all the inputs of the fuzzy controller, limit theorems, and stability. This section also contains suggestions for further research. The last part of the contribution contains an "extras" (something to be added to the basic fuzzy controller to enhance its performance). Self-organizing, adaptive, predictive, self-regulating, fuzzy model based, and neural fuzzy controllers are presented.

The chapter authored by Markus F. Peschl is an introduction to cognitive science and cognitive modelling. Arguments from computer science, philosophy, epistemology, philosophy of science, as well as from semiotics are put forward to make it explicit the inadequacy,the insufficiencies, and problems of a traditional approach to cognitive science. To make it clear the implicit assumptions and basic problems of cognitive science, the traditional approach of this discipline is discussed in the first part of the contribution.

The Takuji Kobori chapter gives a general view of the current research and development of active and hybrid control systems relevant to seismic response controlled structure. In particular, to achieve the final purpose of safety and functional integrity of building structures in severe earthquakes, innovative ideas are required to combine a high capacity energy absorber with a highly efficient active seismic response control system. The author brings in the concept of a seismic response control, defines the active seismic response control system, the hybrid control system and ends with the control algorithms: feedback control, feedback and feedforward control. Essentially, the selection of the most appropriate devices and systems depends on the type of external disturbance, the type of subject structure , and the aim of control. A final conclusion would be that, as the advanced technologies develop, an active response control system could offer the ultimate and perfect design of an earthquake- resistant structure for the near future.

As an overall evaluation, it may be concluded that the contributions included in the book are carefully made and specifically address the trends in the field of artificial intelligence and cybernetics and their applications to the study of complex, natural phenomena. How these techniques can be used is thoroughly described. The reviewer's feeling is that the book makes a valuable contribution to teaching cybernetics with artificial intelligence based on symbol manipulation to cybernetics students and, not less , to cybernetics scientists and engineers. The book will certainly be referred whenever various comments on cybernetics are made.

Theodor-Dan Popescu