

Dilip Kumar Pratihar and Lakhmi C. Jain (Eds.)

Intelligent Autonomous Systems

Studies in Computational Intelligence, Volume 275

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Intelligent Autonomous Systems

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Foreword

Intelligent Autonomous Systems (IAS) are the physical embodiment of machine intelligence providing a core concept for integrating various advanced technologies with pattern recognition and learning. The basic philosophy of IAS research is to explore and understand the nature of intelligence in problems of perception, reasoning, learning and control in order to develop and implement the theory to engineered realization. In other words, the objective is to formulate various methodologies for the development of robots which can operate autonomously and exhibit intelligent behavior by making appropriate decisions to perform the right task at the right time. Since IAS basically deals with the integration of machines, computing, sensing, and software to create intelligent systems capable of interacting with the complexities of the real world, advanced topics like soft computing, artificial life, evolutionary biology, and cognitive psychology have great promise in improving its intelligence and performance.

Because of the inter-disciplinary character, the subject has several challenging issues for research, design and development covering a number of disciplines. These issues are further concerned with the development of both technology and methodology apart from various operations.

The present research monograph titled "Intelligent Autonomous Systems: Foundations and Applications", edited by two renowned researchers, Professor Dilip K. Pratihar of IIT, Kharagpur, India and Professor Lakhmi C. Jain, University of South Australia, Australia, provides a fairly representative cross-section of the activities that is going on all over the world in this area. The volume comprising ten chapters begins with explaining the basic definition and elements of IAS, and then covers different problems in topics like adaptive motion planning, stair-climbing and obstacle avoidance, ensemble learning, and attack graph in designing a robot with various functions. The most salient feature is the use of soft computing tools for optimization, learning, reasoning and uncertainty analysis in such a design for real life applications. It is shown, as an example, how synergistic integration of the merits of genetic algorithms, neural networks and fuzzy logic can be leveraged for dynamically balanced biped robots moving on uneven terrains.

Besides, some general issues like security management with scalable representation of the attack Graphs and the development of intelligent tools with Hidden Markov Model are studied.

I believe the chapters would help in understanding not only the basic issues and characteristic features of Intelligent Autonomous Systems, but also the application of different technologies (classical and modern) being used in this area so that it can be extended to other domains. Professors Pratihari and Jain deserve congratulations for bringing out the nice piece of comprehensive collection.

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Preface

If history is a useful guide, we can state that humans have always used machines to reduce the hard labour otherwise required to provide society's needs. Since the middle of last century, researchers have been trying to utilise intelligence in the machines. The recent advances in artificial intelligence and the availability of cheap computing power are at the heart of the present day success of intelligent autonomous systems.

To fulfil the increasing demands of systems in a highly dynamic world, today's systems need to be intelligent and autonomous. An intelligent autonomous system can take its decisions independently and as the situation requires in an ever changing environment. In order to develop such a system, the principle of artificial, computational intelligence needs to be merged with the original system. It is a difficult task and to achieve it, training must be provided to the system. This may be either off-line or on-line in order to build a suitable knowledge-base. A proper combination of off-line and on-line training can also yield an efficient and intelligent autonomous system.

It is of interest to observe today's machines and engineering systems coming to the market with built in knowledge bases. Although these systems are already in operation, there is probability of further improvement in performance through more advanced training. A large number of training tools have been developed by researchers. Besides the traditional tools, biologically-inspired and knowledge-based tools have proved their effectiveness in the training and learning processes. In the near future, a large number of intelligent autonomous systems will evolve using the principle of soft computing. This book has ten chapters and the Appendix. It deals with the principles and the applications of intelligent autonomous systems.

We thank the authors and reviewers for their contributions. Thanks are also due to the editorial team of the Springer-Verlag Company for their helpful assistance during the book's preparation.

D.K. Pratihari, India
L.C. Jain, Australia

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