Autonomy Oriented Computing
From Problem Solving to Complex System Modeling

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Autonomy oriented computing (AOC)

unifies the methodologies for effective analysis, modeling, and simulation of the characteristics of complex systems. In so doing, AOC offers a new computing paradigm that makes use of autonomous entities in solving computational problems and in modeling complex systems. As compared to other paradigms, such as centralized computation and top-down systems modeling, AOC has been found to be extremely appealing in the following aspects:

(1) To capture the essence of autonomy in natural and artificial systems;
(2) To solve computationally hard problems, e.g., large-scale computation, distributed constraint satisfaction, and decentralized optimization, that are dynamically evolving and highly complex in terms of interaction and dimensionality;
(3) To characterize complex phenomena or emergent behavior in natural and artificial systems that involve a large number of self-organizing, interacting entities; and
(4) To discover laws and mechanisms underlying complex phenomena or emergent behaviors.
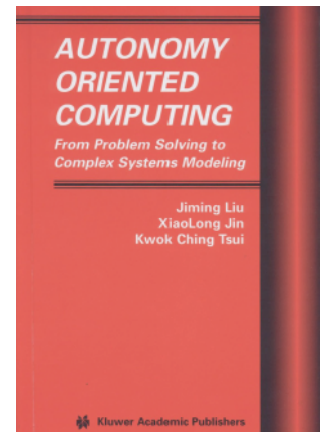
This book can serve as a comprehensive reference book for researchers, scientists, engineers, and professionals in the fields of computer science, autonomous systems, robotics, artificial life, biology, psychology, ecology, physics, business, economics, and complex adaptive systems, among others. It can also be used as a text or supplementary book for graduate or undergraduate students in a broad range of disciplines.

The book contains two parts. In Part I, Fundamentals, we describe the basic concepts, characteristics, and approaches of AOC. We further discuss the important design and engineering issues in developing an AOC system, and present a formal framework for AOC modeling. In Part II, AOC in Depth, we provide detailed methodologies and case studies on how to implement and evaluate AOC in problem solving.