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Metaheuristic Optimization: Nature-Inspired Algorithms Swarm and Computational Intelligence, Theory and Applications

Springer

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Preface

Metaheuristics are global optimization techniques for solving real-life complex problems. The classical techniques for solving such realistic day-to-day problems is time-consuming and will not proffer an exact or feasible solution. Consequently, there is a need to shift from classical techniques to standard metaheuristic techniques inspired by nature. Metaheuristic techniques are capable of using search experience intelligently to explore and exploit the search space in a randomized manner, and the solution methods are inexact and near optimal. Nature-inspired algorithms swarm and computational intelligence with theory and applications are open text and resource designed for undergraduates, postgraduates and researchers in diverse field of studies like Professional and Applied Sciences (engineering and technology, military sciences, transportation, environmental studies, business, agriculture, consumer science and others); Natural Sciences (biology, chemistry, earth sciences, physics, space sciences and others); Formal Sciences (computer sciences, pure and applied mathematics, statistics and others); Economics; Humanities and Social Sciences. This book will guide students and research fellows who are developing problem-solving skills related to transportation and trans-shipment; planning and scheduling in product- and service-based systems like retail outlets, banking, airline industry and more; inbound and outbound supply chain management in industries; inventory management; maintenance management; warehousing; cost and quality control and others. It provides a guide to a better understanding of the development of nature-inspired algorithms and resolution of real-life complex stochastic problems as well as numerical problems. The organization of the book is as follows: Chapter 1—General Introduction to optimization—gives classical search techniques and limitations, metaheuristic techniques, nature-inspired algorithms and swarm intelligence. Chapter 2 discusses detailed information on particle swarm optimization and the swarming habit or behaviour of creatures, animals, or insects and the application in the field of evolutionary computation and application of PSO in numerical optimization. Chapter 3 provides an introduction to artificial bee colony algorithm, foraging behaviour and waggle

dance of honeybees while passing information about a given food source to the rest of the bee colony, such as the food source consistency, direction and distance from the nest, mathematical modelling of the bee algorithm and real-life application of the bee algorithm in fast moving grocery retailer system or big box facility. Chapter 4 gives detailed information related to the ant colony algorithm, with broad information on path navigation and behaviour of ants to solve the optimization problem, ants foraging pattern by depositing pheromones along the path taken until they get to the desired destination, especially during exploration for food source and model development with solved examples. Chapter 5 provides detailed information on grey wolf optimization (GWO) algorithm. GWO algorithm takes into consideration the motivation from the hunting pattern of the grey wolves, with solved numerical example. Chapter 6 gives an introduction to whale optimization algorithm (WOA). Feeding pattern of the whale which consist of strategically encircling prey. The humpback whale is considered in this context. Algorithm formation process is illustrated and solved with a numerical example. Chapter 7 gives an introduction to firefly algorithm. It describes converging nature of the firefly, especially where they find brighter light. How the less bright fireflies converge or swarm towards fireflies with brighter light. Rules for developing the firefly algorithm, advantages and disadvantages of firefly algorithm, area of application of fire fly algorithm and solved numerical problem are provided. Chapter 8 gives an introduction to bat algorithm. The communication and navigational pattern of bats and micro-bats echolocation (EL) are described. The great strength of a bat linked to the appealing wave of sound often exhibited while searching for prey. Algorithm development and solved numerical and real-life example are used to illustrate the approach. Chapter 9—Ant lion optimization algorithm—describes dangerous hunting technique of ant lion by digging holes in a cone-like shape while the insect goes down to the bottom of the hole and places its jaw at that end to ensure proper eating of prey falling into the trap. Model equation of the ant lion algorithm and solved examples are used to illustrate the approach. Chapter 10—Grasshopper optimization algorithm—describes important feature of grasshoppers, the search process of grasshopper during quest for food using exploration and exploitation procedure. Grasshopper algorithm for solving a real-life problem and numerical examples are used to illustrate the approach. Chapter 11 provides an introduction to butterfly optimization algorithm and power of fragrance and route-finding pattern of butterflies, and step-by-step mathematical model and application with numerical example are provided. Chapter 12 gives an introduction to moth flame optimization algorithm, in which steps for generating moths randomly within the neighbourhood or solution space and solved numerical example are provided. Chapter 13 presents detailed information on genetic algorithm and its application to real-life problem. Chapter 14 gives an introduction to artificial neural network (ANN). ANN is inspired by the pattern in which the biological nervous system (brain) process information and by mimicking how information flow through a set of interconnected neurons that work together to solve a problem. General mathematical model

and application of ANN model to open-pit mine vibration prediction are provided. Chapter 15 is the final chapter which is focused on the future of nature-inspired algorithm, swarm and computational intelligence, other area of application of nature-inspired algorithms, other algorithms inspired by nature and conclusion.

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