Preface

Swarm Intelligence (SI) is one of the areas of artificial intelligence which is being developed dynamically. As a precursor of SI we can mention three algorithms such as Stochastic Diffusion Search (SDS), Ant Colony Optimization (ACO), and Particle Swarm Optimization (PSO). The SDS algorithm was published in 1989 by Bishop. The SDS is the first SI metaheuristic where an agent-based probabilistic global search optimization technique is introduced. The ACO was published in 1992 by Dorigo in his Ph.D. thesis. The main inspiration for ACO was the actions of a real ant colony. The original ACO algorithm is a probabilistic optimization technique useful in discrete optimization for finding the best paths in the graphs. The PSO was published in 1995 by Kennedy et al. The main inspiration for the PSO algorithm was the social behavior of such organisms as birds (a bird flock) or fish (a fish school). The original PSO is a global optimization technique for a continuous domain.

SI is a relatively new branch of artificial intelligence that is used to model the collective intelligent behavior of social swarms in nature. A simple behavior of particular agents and self-organizing interaction among them are observed in nature, e.g., fish shoals, bird flocking, ant colonies. These behaviors were the inspiration for developing "artificial colonies of agents" which are able to solve difficult optimization problems. The concept of Swarm Intelligence can be described as follows:

"The simple behavior of individuals which are relatively simple in structure + interactions between individuals of the swarm over time = very complex collective behavior"

Based on the general concept of Swarm Intelligence many SI algorithms have been developed up until now. The SI algorithms represent the subfamily of nature inspired global optimization techniques. Other subfamilies are physical algorithms (such as simulated annealing, harmony search, and so on), evolutionary algorithms (such as genetic algorithms, genetic programming, and others), and immune algorithms (such as clonal selection algorithms, negative selection algorithms, and so on). The main advantages of the SI algorithms over traditional optimization techniques are as follows: SI algorithms start with a population of potential solutions not from a single point, SI algorithms do not require the derivative objective function, the solutions can cooperate with each other to share knowledge.

The family of SI algorithms is still growing. In the table below you can see the list of 45 algorithms (sorted by the date of their development) selected from the whole family of swarm algorithms. 24 of them (which are marked by gray color) are presented in this book in detail - in tutorial form.

SI Algorithm (Year)	**Biological inspiration**
Stochastic Diffusion Search (1989)	Tandem calling mechanism employed by one species of ants
Ant Colony Optimization (1992)	Real ant colonies using pheromone as a means of chemical messenger
Particle Swarm Optimization (1995)	Social behavior of bird flocking or fish schooling
Bee System (2001)	Foraging behavior of bee colonies
Bacterial Foraging (2002)	Social foraging behavior of Escherichia coli
Fish-swarm Algorithm (2002)	Fish behaviors such as preying and swarming
Beehive (2004)	Communicative and evaluative methods and procedures of honey bees
Bacterial Colony Chemotaxis (2005)	Bacterium's reaction to chemoattractants
Bee Colony Optimization (2005)	Bee colonies in nature
Bee Swarm Optimization (2005)	Behavior of real bees in nature
Virtual Bees (2005)	Swarm of bees and interactions between them when they find nectar
Cat Swarm (2006)	Behaviors of cats and their skills such as tracing and seeking
Artificial Bee Colony (2007)	Natural foraging behavior of real honey bees
Fast Bacterial Swarming (2008)	Foraging mechanism of Escherichia coli and the swarming pattern of birds
Bumblebees (2009)	Collective behavior of social insects
Cuckoo Search (2009)	Brood parasitic behavior of some cuckoo species
FireFly Algorithm (2009)	Behavior of fireflies and their flashing light (process of bioluminescence)
Glowworm Swarm Optimization (2009)	Luciferin induced glow of a glowworm which is used to attract mates/prey
Artificial Fish School Algorithm (2010)	Fish behaviors such as preying, swarming, following
Bat Algorithm (2010)	Echolocation characteristics of microbats
Cockroach Swarm Optimization (2010)	Social behavior of cockroaches
Hunting Search (2010)	Group hunting of animals such as lions, wolves, and dolphins
Bacterial Colony Optimization (2012)	Five basic behaviors of Escherichia coli bacteria in their whole lifecycle
Blind-Naked Mole-Rats (2012)	Social behavior of the blind naked mole-rats colony
Krill Herd (2012)	Herding behavior of krill individuals
Lion's Algorithm (2012)	Lion's social behavior that aids to keep the mammal strong in the world
Wolf Search (2012)	Wolves search for food and survive by avoiding their enemies
Fruit Fly Optimization (2013)	Behavior of fruit flies
Social Spider Optimization (2013)	Cooperative behavior of social-spiders which interact with each other
Chicken Swarm Optimization (2014)	Behavior of chickens when they search for food
Dispersive Flies Optimisation (2014)	Swarming behavior of flies over food sources
Grey Wolf Optimizer (2014)	Mimics the social dominant structure of the grey wolves pack
Elephant Herding (2015)	Herding behavior of the elephant groups
Monarch Butterfly Optimization (2015)	Migration of monarch butterflies
Crow Search Algorithm (2016)	Intelligent behavior of crows
Dolphin Swarm Algorithm (2016)	Dolphin's echolocation, information exchanges, cooperation
Dynamic Virtual Bats Algorithm (2016)	Bat's ability to manipulate frequency/wavelength of the emitted sound waves
Whale Optimization Algorithm (2016)	Social behavior of humpback whales - the bubble-net hunting strategy
Swarm Dolphin Algorithm (2016)	Social behaviors of dolphins
Artificial Wolf Pack Algorithm (2016)	Social behaviors of the wolf pack in scouting, calling and besieging
Grasshopper Optimisation (2017)	Behavior of grasshopper swarms in nature
Spotted Hyena Optimizer (2017)	Social relationship between spotted hyenas and their collaborative behavior
Salp Swarm Algorithm (2017)	Swarming behaviour of salps when navigating and foraging in oceans
Emperor Penguin Optimizer (2018)	Mimics the huddling behavior of emperor penguins
Seagull Optimization Algorithm (2019)	Migration and attacking behaviors of a seagull in nature

In each chapter, the given algorithm is presented by the pseudo-code, by the source-code in Matlab, and by the source-code in C++ programming language. Also, at the end of each chapter, the step-by-step numerical example is shown. This example presents the particular steps of the described algorithm in very detailed numerical manner. As an editor, I believe that such a way of presenting algorithms will be very helpful in the rapid understanding of their operation, and will give the reader a comprehensive answer to the question: How does the given algorithm work? Also, I would like to note that in the second volume of this book – entitled: *Swarm Intelligence Algorithms:*

Modifications and Applications – the modifications and the real-world engineering applications of each algorithm are presented.

At the end of this short preface, I would very much like to thank all the contributors for their hard work in preparation of the chapters for this book. I also would like to wish all readers enjoyment in reading this book.

Adam Slowik
Department of Electronics and Computer Science
Koszalin University of Technology, Koszalin, Poland