Foreword

Swarm intelligence is an exciting new research field still in its infancy compared to other paradigms in artificial intelligence. With many successful applications in a wide variety of complex problems, swarm-based algorithms have shown to have much promise, being efficient and robust, yet very simple to implement. A number of computational swarm-based systems have been developed in the past decade, where the approach is to model the very simple local interactions among individuals, from which complex problem-solving behaviors emerge. One of the research areas within computational swarm intelligence is particle swarm optimization (PSO), which has its origins in bird flocking models. Each individual, referred to as a particle, follow two very simple behaviors, i.e., to follow the best performing individual, and to move towards the best conditions found by the individual itself. In terms of optimization, each particle moves towards two attractors, with the result that all particles converge on one solution.

Since its inception in 1995, research and application interest in PSO have increased, resulting in an exponential increase in the number of publications and applications. Research in PSO has resulted in a large number of new PSO algorithms that improves the performance of the original PSO and enables application of PSO to different optimization problem types (e.g., unconstrained optimization, constrained optimization, multiobjective optimization, optimization in dynamic environments, and finding multiple solutions). Elaborate theoretical studies of PSO dynamics have been done, and PSO parameter sensitivity analyses have resulted in a better understanding of the influence of PSO control parameters. PSO applications vary in complexity and cover a wide range of application areas. To date, the total number of PSO publications counts to approximately 1500 since 1995.

It should be evident to the reader that the published knowledge available on PSO is vast. This then provides motivation for a dedicated, up-to-date book on particle swarm optimization. However, such a task is not an easy one. These authors have succeeded in the daunting task of sifting through the large volumes of PSO literature to produce a text that focuses on the most recent and significant developments in PSO. The authors have also succeeded in conveying their significant experience in PSO development and application to the benefit of the reader. It should be noted that the intention of this book was not to produce an encyclopedia of PSO research and applications, but to provide both the novice and the experienced PSO user and researcher with an introductory as well as expert level overview of PSO. As such the authors provide the reader with a compact source of information on PSO, and a foundation for the development of new PSO algorithms and applications.

The book is very well organized, starting with an overview of optimization, evolutionary computation, and swarm intelligence in general. This is followed by a detailed development of the original PSO and first improvements. A concise summary of theoretical analyses is given followed by detailed discussions of state-of-the-art PSO models. An excellent contribution made by the book is the coverage
of a wide range of real-world applications, and of different optimization problem types. Throughout, the authors have provided a book which is hands-on, making the book accessible to first-time PSO users. Another positive of the book is the collection of benchmark problems given in the appendix, and the list of resources provided.

The authors have succeeded in their objective to produce a book which covers the main trends in PSO research and applications, while still producing text that is accessible to a wide range of authors. I have no second thoughts of recommending the book and making the statement that this book will be a valuable resource to the PSO practitioner and researcher.

Andries P. Engelbrecht,
University of Pretoria, South Africa

Andries Engelbrecht is a professor in Computer Science at the University of Pretoria, South Africa. He also holds the position as South African Research Chair in Artificial Intelligence, and leads the Computational Intelligence Research Group at the University of Pretoria, consisting of 50 Masters and PhD students. He obtained his Masters and PhD degrees in Computer Science from the University of Pretoria in 1994 and 1999 respectively. His research interests include swarm intelligence, evolutionary computation, artificial neural networks, artificial immune systems, and the application of these CI paradigms to data mining, games, bioinformatics, and finance. He has published over 130 papers in these fields in journals and international conference proceedings, and is the author of the two books, “Computational Intelligence: An Introduction” and “Fundamentals of Computational Swarm Intelligence”. In addition to these, he is a co-editor of the upcoming books, “Applied Swarm Intelligence” and “Foundations on Computational Intelligence”. He is very active in the international community, annually serving as a reviewer for over 20 journals and 10 conferences. He is an associate-editor of the IEEE Transactions on Evolutionary Computation, Journal of Swarm Intelligence, and the recent IEEE Transactions on Computational Intelligence and AI in Games. Additionally, he serves on the editorial board of 3 other international journals, and is co-guest-editor of special issues of the IEEE Transactions on Evolutionary Computation and the Journal of Swarm Intelligence. He served on the international program committee and organizing committee of a number of conferences, organized special sessions, presented tutorials, and took part in panel discussions. As member of the IEEE CIS, he is a member of the Games technical committee and chair of its Swarm Intelligence for Games task force. He also serves as a member of the Computational Intelligence and Machine Learning Virtual Infrastructure Network.