شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of 15-25- c and relative humidity 20-40%

بعض الوثائـــــــق الاصليـــــة تالفـــة

بالرسالة صفحات لم ترد بالاصل

Cairo University
Institute of Statistical Studies and Research
Department of Operations Research

A Particle Swarm Technique for Treating Optimization Problems

By

Ahmed Mohamed Emam Zaky

A thesis submitted to the Institute of Statistical Studies and Research
Cairo University

In partial fulfillment for the Degree of

Master of Science
in
Operations Research

Under the Supervision of

Professor Mohamed Hassan Gadallah
Professor of Operations Research
Head, Department of Operations Research, Institute of Statistical Studies and Research
Cairo University, Egypt

Dr. Mohamed Bayoumi Ali
Associate Professor
Department of Operations Research and Decision Support,
Faculty of Computers & Information
Cairo University, Egypt

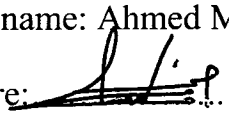
2010

Certification

I certify that this work has not been accepted in substance for any academic degree and is not being submitted in candidature of any other degree.

Paper referencing is given to any sources mentioned in this thesis.

Student name: Ahmed Mohamed Emam Zaky

Signature: 

Cairo University
Institute of Statistical Studies and Research
Department of Operations Research

Approval Sheet

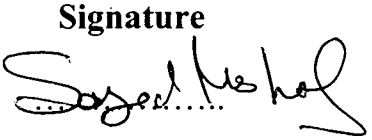
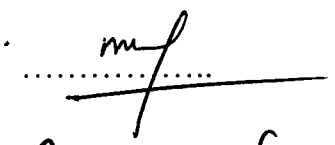
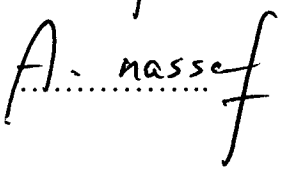
A Particle Swarm Technique for Treating Optimization Problems

By

Ahmed Mohamed Emam Zaky

A thesis submitted to the Department of Operations Research, Institute of Statistical Studies and Research, Cairo University, in partial fulfillment for the Degree of Master of Science in Operations Research.

This thesis has been approved by the Examining Committee

Name of the Examiner	Signature
Prof. Dr. Sayed Meshal Tag El Deen Institute of Statistical Studies and Research Cairo University	
Prof. Dr. Mohamed Hassan Gadallah Institute of Statistical Studies and Research Cairo University	
Prof. Dr. Ashraf Osama Nassef Faculty of Engineering American University	

2010

Dedication

My mother & father
They made bridges where there were none to make dreams come true

My wife
A magic river began long ago and followed through time to turn my dream into an enchanting oasis

Acknowledgment

All praise for Allah (Subhanahu Wa Ta'aala) with whose mercy and blessings. I have achieved what I have achieved today. Peace and blessings of Allah be upon the final prophet.

I take this opportunity to thank my advisor Prof. Dr. Mohammed Hassan Gadallah, for his guidance and motivation which he has extended to me throughout my thesis. I am grateful to him for his unlimited favors and help which extended to me during my rough time in my life and for his help in my work.

Also, I extend my gratitude to my Co-Advisor, Dr. Mohamed Bayoumi Ali, for his help and guidance in making my dream come true. No words can express my feelings for his faith and trust which he had in me during my work.

Abstract

Swarm intelligence (SI) is considered one of the most popular computational intelligence paradigms. It originated from the study of colonies, or swarms of social organisms. Studies of the social behavior of organisms (individuals) in swarms prompted the design of very efficient optimization and clustering algorithms used to solve difficult optimization problems by simulating natural evolution over populations of candidate solutions. One of these algorithms is the particle swarm optimization algorithm that we will focus in this thesis.

Particle swarm optimization (PSO) is a stochastic optimization approach, modeled on the social behavior of bird flocks. In PSO, individuals, referred to as particles, are "flown" through hyper dimensional search space. Changes to the position of particles within the search space are based on the social-psychological tendency of individuals to emulate the success of other individuals. The changes to a particle within the swarm are therefore influenced by the experience, or knowledge, of its neighbors. The search behavior of a particle is affected by that of other particles within the swarm, where each particle represents a candidate solution to the problem at hand.

The PSO particle positions oscillate in damped sinusoidal waves until they converge to points in between their previous best positions and the global best positions discovered by all particles so far. If some point visited by a particle during this oscillation has better fitness than its previous best position, then the particle movement generally converges to the global best position discovered so far. Also the

PSO algorithm does not guarantee convergence to a global best solution, or even a local solution, only to a best position found thus far.

This thesis introduces a new variation of the PSO algorithm called Triggered Particle Swarm Optimization (T- PSO). The new algorithm intended to combat two difficulties observed in many applications of PSO; the premature convergence of the solution, and the absence of confidence level in this solution.

The modified algorithm consists of three phases. First, the T- PSO technique executes the three main operations available in the original PSO algorithm (initialization, evaluation, and modification). In the second phase, each particle reinitializes its record of its best position. This is achieved with periodic resetting, based on the iteration count. The main objective of the second phase is to avoid making direction and velocity decisions on the basis of outdated information. In second phase, the algorithm uses the new positions as a seed for searching the solution instead of the traditional initialization based on randomness process, and then executes the modification and evaluation operations. The stopping criterion here depends on two conditions: (a) the maximum number of iterations (b) a certain defined tolerance value. Finally, the solution based on confidence interval is supplemented. This modification allows PSO to search in both static and dynamic environments.

The proposed algorithm is validated by several test benchmark problems. An experiment is performed to present the introduced algorithm solution based on confidence interval at 90%, 95%, and 99% confidence levels. The T- PSO finds better solutions than the traditional PSO algorithm. An application for Nonlinear Constrained Optimization is performed using the modified algorithm (T- PSO).

Table of Contents