



University of Minho
School of Engineering
Department of Production and Systems

DOCTORAL PROGRAMME IN COMPUTER SCIENCE MAP-i

TITLE

**PERFORMANCE ANALYSIS OF SWARM INTELLIGENT ALGORITHMS ON THE
TRAVELING SALESMAN PROBLEM**

SUPERVISORS

Ana Maria Alves Coutinho da Rocha
Webpage: www.norg.uminho.pt/arochoa
Email : arochoa@dps.uminho.pt

Edite Manuela Graça Pinto Fernandes
Webpage: www.norg.uminho.pt/emgpf
Email: emgpf@dps.uminho.pt

CONTEXT AND MOTIVATION

Swarm intelligence is an artificial intelligence algorithm based on the study of collective behaviour in decentralised and self-organised systems. Swarm intelligence systems are usually made up of a population of simple agents interacting locally with one another and with their environment. Although there is normally no centralised control structure dictating how individual agents should behave, local interactions between such agents often lead to the emergence of global behaviour. In other words, the individual actions are controlled by individual computations based on surroundings and location between objects. Examples of systems like this can be found in nature, including ant colonies, bird flocking, animal herding, bacteria growth and fish schooling.

Swarm intelligence techniques are population-based stochastic methods that can be used to solve combinatorial and continuous problems. They represent a promising tool for solving complex NP complete problems. These problems lead to various practical real world applications such as, traffic routing, networking, games, industry and robotics.

The Traveling Salesman problem (TSP) is the problem of finding a route of a salesman who starts from a home location, visits a prescribed set of cities and returns to the original location in such a way that the total distance traveled is minimum and each city is visited exactly once. Although a business tour of a modern day traveling salesman may not seem to be too complex in terms of route planning, the TSP in its generality represents a typical “hard” combinatorial optimization problem [1-3].

References

- [1] Rocha, Ana Maria A.C., Fernandes, Edite M.G.P., Soares, João Luís C., “*Solving the Traveling Repairman problem with differentiated waiting times through Lagrangian relaxation*”, Actas do I Congresso de Estatística e Investigação Operacional da Galiza e Norte de Portugal / VII Congreso Galego de Estatística e Investigación de Operacións, Universidade do Minho (publicado em CDRom), ISBN: 972-99841-0-7, 6pp, 2005.
- [2] Rocha, Ana Maria A.C., Fernandes, Edite M.G.P., Soares, João Luís C., “*Aplicação do algoritmo volumétrico à resolução aproximada e exacta do problema do caixeiro viajante assimétrico*”, *Investigação Operacional*, V. 25 (2) 277-294, 2005.
- [3] Rocha, Ana Maria A.C., Fernandes, Edite M.G.P., Soares, João Luís C., “*A first-order ϵ -approximation algorithm for large linear programs and a second-order implementation*”, em O. Gervasi et al. (Eds.), *Lecture Notes in Computer Science*, 3483 (488-498), Springer-Verlag, 2005.

OBJECTIVES

The main objectives of this project are to analyze and implement several swarm intelligent systems, select the most appropriate and develop a specific algorithm to solve the TSP problem, as well as to compare its performance with approximate and exact methods known in the literature.

RESEARCH UNIT

ALGORITMI R&D CENTRE

Nonlinear Systems Optimization and Statistics Group

Webpage: www.norg.uminho.pt/NSOS

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