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Technical Program & Abstracts

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14 June 2011

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11:15-12:30	M. Clerc	**Plenary 2** FAQ about PSO
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15 June 2011

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Detailed program of June 14, 2011 (Presentation 15 minutes + questions 5 minutes)

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Chair :
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Prediction of Stock Market Indices using Hybrid Genetic Algorithm/ Particle Swarm Optimization with Perturbation Term
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Date/Time June 14th, 2011(Tuesday) 16:30-19:00

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On the stability of nonholonomic multi-vehicle formation
Lotfi Beji, Mohamed Anouar El Kamel and Azgal Abichou

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Power as an Organizational Design Question: Endogenous Power Assignment and Power
Murat Tarakci and Patrick J.F. Groenen

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Jérémy Patrix, Abdel-Illah Mouaddib and Sylvain Gatepaille

Ecosystem Dynamics for Creative Image Generation
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Linda Slimani and Tarek Bouktir

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Detailed program of June 15, 2011

Session 3 : Applications of PSO Algorithms
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Co-Chair :
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Hybrid PSO-tabu search for solving non-linear constrained problem
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Classification of Soil and Vegetation by Fuzzy K-means Classification and Particle Swarm Optimization
Michel Chapron

A Swarm Intelligence Method Applied to Resources Allocation Problem
Cedric Leboucher, Rachid Chelouah, Patrick Siarry and Stephane Le Mennec

A PSO algorithm to solve a Real Course+Exam Timetabling Problem
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A New Hybrid Distributed Double Guided Genetic Swarm Algorithm for Optimization and Constraint Reasoning: cas of Max-CSPs
Asma Khadhraoui and Sadok Bouamama

Intrusion Detection Based on Swarm Intelligence using mobile agent
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Session 4 : Other Optimization Algorithms
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Florence Kussener

Optimal Wireless Sensor Network Coverage with Ant Colony Optimization
Stefka Fidanova

Predicting Multicomponent Protein Assemblies Using an Ant Colony Approach
Vishwesh Venkatraman and David Ritchie

A clustering ant colony algorithm for the long-term car pooling problem
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Jan Chircop and Christopher Buckingham

Non-dominated Sorting Gravitational Search Algorithm
Hadi Nobahari, Mahdi Nikusokhan and Patrick Siarry

Abstracts

Session 1: Abstracts

Memetic Particle Swarm for Continuous Unconstrained and Constrained Optimization Problems

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Abstract
Particle Swarm Optimization (PSO) is known for its effective and efficient global search and is one of the most effective Swarm Intelligence (SI) methods. PSO however fails to guarantee convergence to even locally optimal solution and so the method of switching to an effective local search at a safe point in the search is investigated with in-house General-Purpose PSO (GP-PSO). Combining the two algorithms results in guaranteed locally optimal convergence. Relations between various convergence criteria are investigated and methods derived to successfully switch, to the local search. Furthermore, user control is given with the derived method of switching, utilising the choice between accuracy and computational expense. With the added local search, this offers to extend the capabilities of the GP-PSO to competitive results with those in
comparison in the literature.

Keywords
Particle swarm optimization, Memetic algorithm

The No Free Lunch Theorem Does Not Apply to Continuous Optimization

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Abstract
After deriving the particle swarm equations from basic physics, this paper shows by contradiction that the NFL Theorems do not apply to continuous optimization. The discrete nature of an optimization problem at its most fundamental level is generally irrelevant from the broader continuous perspective as the discrete nature of matter at its most fundamental level is generally irrelevant from the broader classical perspective.

Key words
No free lunch, NFL, disproof

Particle swarm optimization for designing ideotypes for sustainable production systems

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Abstract

Agricultural systems have to adapt, in a changing climatic context, to face the growing social demand in terms of organoleptic, nutritional and environmental quality of food products. Thus, a crucial question for the future is how to manage fruit quality by finding the best combinations of genetic resources and cultural practices adapted to, and respectful of specific environments. This question was addressed using a particle swarm optimization and a process-based model. The obtained results show the interest of such as approach.

Key words

Optimization, Crop models, Ideotypes, Peach.

Particle Swarm Optimization with Inertia Weight and Constriction Factor

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Abstract

In the original Particle Swarm Optimization (PSO) formulation, convergence of a particle towards its attractors is not guaranteed. A velocity constraint is successful in controlling the explosion, but not in improving the fine-grain search. Clerc and Kennedy studied this system, and proposed constriction methodologies to ensure convergence and to fine-tune the search. Thus, they developed different constriction methods according to the correlations among some coefficients incorporated to the system. *Type 1"* constriction became very popular because the basic update equations remained virtually unmodified, and the original and intuitive metaphor valid. The main drawbacks of this constriction type are that constriction becomes too strong very quickly as the acceleration is increased; that the *speed of convergence* cannot be easily controlled; and that there is no flexibility to set a desired *form of convergence*. Another problem is that the method can be found in the literature formulated so as to constrict a PSO system which already includes the inertia weight, for which the calculation of a constriction factor using the formulae provided by Clerc and Kennedy does not guarantee convergence. This paper analyzes *Type 1"* constriction in detail, for which *Type 1* constriction is also relevant. The formulae for *Type 1* and *Type 1"* constriction factors suitable for a PSO algorithm including the inertia weight are provided.

Keywords

Constriction factor, guaranteed convergence, inertia weight, particle swarm.

A Generic Set-Based Particle Swarm Optimization Algorithm

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Abstract

Several set-based particle swarm optimization algorithms have been proposed in the literature for solving discrete and combinatorial optimization problems. However, a simple but generic algorithm defined in terms of mathematical sets is still missing. In this paper a new algorithm called Set-Based PSO is proposed that fills this gap. The Multidimensional Knapsack Problem is used as a test problem to investigate the performance of the algorithm. Computational experiments are presented on a set of problems known from the literature both for parameter tuning and to compare the algorithm's performance to that of two alternative algorithms.

Key words

Discrete Optimization, Set-based Particle Swarm Optimization, Multidimensional Knapsack Problem

Prediction of Stock Market Indices using Hybrid Genetic Algorithm/ Particle Swarm Optimization with Perturbation Term

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Abstract
Stock market indices prediction is one of the most important issues in the financial field. Although many prediction models have been developed during the last decade, they suffer a poor performance because indices movement is highly non stationary and volatile dynamic process. As improving the prediction accuracy becomes an important issue, we propose a new hybrid genetic Algorithm / Particle Swarm Optimization (GA/ PSO) model with perturbation term inspired by the passive congregation biological mechanism to overcome the problem of local search restriction in standard hybrid (GA/ PSO) models. This perturbation term is based on the cooperation between different particles in determining new positions rather than depending on the particles selfish thinking which enables all particles to perform the global search in the whole search space to find new regions with better performance. Experiment study carried out on the most famous stock market indices in both long term and short term prediction shows significantly the influence of the perturbation term in improving the performance accuracy compared to standard hybrid (GA/ PSO) models.

Key words
Stock markets, Particle Swarm Optimization, Genetic Algorithm, Perturbation term, Global search.

Session 2: abstracts

A Robust Aggregation Method for Quasi-blind Robots in an Active Environment

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Abstract
The aggregation of a swarm of autonomous agents into compact clusters is often a required behavior of multi-agent systems. In the case where no central control or coordination exists, this problem is known as the *Decentralized Gathering.* This work presents a first step in the application of a bio-inspired aggregation scheme to mobile robots whose abilities are very restricted: the only way they can communicate is through an active environment (stigmergy) and the only information they can receive is the local detection of the waves produced by other robots. The active environment obeys a cellular automaton rule and is simulated with a projection of light on the robots.

Key words
Decentralized Gathering, Agent Aggregation, Swarm Robotics, Reaction-diffusion-chemotaxis.

On the stability of nonholonomic multi-vehicle formation

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Abstract

The focus of the paper is to solve the stability problem of a multi-agent system composed of nonholonomic vehicles. The multi-vehicle formation is achieved following a first step where targets are identified and attractive sets circumscribing this are constructed. In a second step, the initial position and orientation of each agent is specified. In a last stage, a decentralized controller integrating a regulation control law, ensures obstacles avoidance, is elaborated. The formation's stability is achieved if a group of agents reaches their common target with the right direction and without any motion planning. The LaSalle's invariance principle is the mathematical tool used to prove the invariance of the elaborated set with respect to the nonholonomic multi-vehicle transient behaviors. The simulations illustrate the effectiveness of our strategy and it can be exploited in swarm navigation case.

Key words
Multi-vehicle; nonholonomic constraints, stabilization; formation; LaSalle's principle

Spatial Self-Reorganization of Repulsive Mobile Agents

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Abstract
We study the self- reorganization of large sets of agents moving in finite 2-dimentional spaces, under the effect of local repulsion laws. Agents are partitioned in two subsets (populations) and tend to move away from their neighbors lying in a local sense disk, following a force-inspired law. The contribution of a neighbor to the movement of an agent depends on whether they belong to the same population or not. First, we show that the ratio of the intensity between intra-population and inter-population repulsions is a critical parameter leading either to macroscopic separation , where agents are separated in different homogeneous regions depending on their state, or simply to local reorganization. We then show that the reorganizations are effective only above a sharp threshold of the collision rate between agents. We also present an application to swarm robotics, where a fleet of carrying robots self-organizes in collision-free streams of robots moving in the same direction, under the effect of the repulsion algorithm.

Key words
Self-reorganization, separation, repulsion, transportation

Endogenous Power Assignment and Power Disparity

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Abstract
The importance of power in social and organizational relationships has long been recognized.
Yet, the research on power does not provide a univocal definition or presents consistent findings with regard to the level of power disparity and merit based assignment of power. Using Newtonian laws, this paper conceptualizes power simultaneously as a relational capacity, behaviors attached to this capacity, and realization of power in the form of influence. We extend the formal design perspective, and allow for informal power structures and evolutionary dynamics. we employ the agent-based simulation method of an evolutionary computation technique called particle swarm optimizer algorithm (PSO). PSO offers a formal representation of the group dynamics which maps directly to our conceptualization of power, and the interaction between individuals due to power differences is embedded into the search process. The results suggest that organizational design of power structures should consider both the level of power disparity and evolutionary dynamics of power assignment. Finally, this study highlights environmental complexity and magnitude of high power as moderators in comparing different power models.

Key words:
Power, organizational design, agent based simulations, particle swarm optimization

Detection of primitive collective behaviors in a crowd panic simulation based on a multi-agent approach

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Abstract
We propose an approach towards multi-agent system for simulation and detection of primitive collective behaviors emerging from a crowd in panic. This paper presents various works on which our method is based, by methods of planning and decisions allowing emergence of primitive collective behaviors. We present then an implementation in a virtual environment and detection experiments of emergent collective behaviors by recognition and identification methods of the situations awareness in the domain of Data Fusion. Measurements and human evaluation of results show the utility of simulation and detection tools implemented. That would be applied to some current monitoring system, such as envisaging behavior anomalies according to specific scenarios.

Key words
Multi-agent system, collective behavior, crowd panic, simulation, detection.

Ecosystem Dynamics for Creative Image Generation

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Abstract
Digital artists are constantly searching for new methods which innovate or enhance the esthetic value of their works. Over the last years, there has been a growing interest in using the swarm paradigm, i.e. in designing decentralized systems with mobile agents that collaborate on the creation of an emerging piece of art. In particular, "creative ecosystems" are conceived based on basic characteristic features of natural ecosystems. In these models artificial organisms not only interact with one another and with their environment, but also complete a life cycle, reproduce and potentially evolve. The approach raises a number of interesting questions about which ecosystemic mechanisms are most useful for creative design, and what their contribution on the work of art can be. Recent studies investigated the phenomenon of niche construction and showed that it can considerably increase the diversity and the heterogeneity of artistic output. The present paper extends this approach by exploring further ecosystem dynamics such as competition, resource consumption and predator-prey relationships, and by evaluating their impact on creative image generation.

Keywords
Creative ecosystems, multi agent system, digital art, artificial life

Economic Power Dispatch of Power System with Pollution Control using Multiobjective Artificial Bee Colony Optimization with FACTS devices

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Abstract
This paper presents solution of optimal power flow (OPF) problem of medium-sized power systems via an Artificial Bee Colony (ABC) algorithm. The objective is to minimise the total fuel cost of generation and environmental pollution caused by fossil based thermal generating units and also maintain an acceptable system performance in terms of limits on generator real and reactive power outputs, bus voltages, shunt capacitors/reactors and power flow of transmission lines. In order to maximise the relief of congestion in power system and to reduce the total system real power loss we propose also the placement of FACTS devices in the power system. In this work the standard IEEE 30-bus test system with six generating units has been used to test the effectiveness of the proposed method. The results of

the proposed technique are compared with that of the Particle Swarm Optimization (PSO) technique. The simulation results show that by the ABC method with FACTS devices is superior in convergence compared to PSO. The ABC is used to obtain Economic dispatch of generators such that these generations give minimum cost as well as does not result in line flow violation. It reveals also that incorporation of FACTS devices with optimal location significantly enhance load margin as well as system stability.

Keywords
Optimal Power Flow, Power Systems, Pollution Control, NOx emission, Artificial Bee Colony, FACTS Device.

Stochastic Diffusion Search for Continuous Global Optimization

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Abstract
Stochastic Diffusion Search (SDS) is a multi-agent, naturally inspired search and optimization algorithm that is based on direct (one-to-one) communication between agents. SDS has been successfully applied to a wide range of optimization problems. In this paper, SDS is used to tackle the continuous nonlinear function optimization problem. The proposed method is tested on a mini-benchmark of four problems with promising results. The results show that SDS can also be used as an intelligent way to choose a starting point for a local search method.

Keyword
Stochastic diffusion search, swarm intelligence, continuous nonlinear function optimization, metaheuristics, local search

Session 3: abstracts

Hybrid PSO-tabu search for constrained non-linear optimization problems

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Abstract
In this paper we present a new method to solve a constrained non-linear problem. The method is based on hybridizing the Particle Swarm Optimization and tabu-search meta-heuristics (PSOTS). Tow tabu-lists are used within the PSO algorithm: the first one aims to diversify the best solutions obtained by particles when the second bans temporarily solutions non-respecting the constraints. The obtained meta-heuristic is validated on real thermal problem called T-junction problem. It consists on optimizing the thermal management of the system and minimizing its overheating by improving its design and the flow distribution. Our results are compared with Genetic algorithm.

Key words
Constrained non-linear optimization, Particle Swarm Optimization (PSO), Tabu-search (TS), hybrid method, flow and heat transfer optimization

Classification of Soil and Vegetation by Fuzzy K-means Classification and Particle Swarm Optimization

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Abstract.
Precision Agriculture is concerned with all sorts of within-field variability, spatially and temporally, that reduces the efficacy of agronomic practices applied in a uniform way all over the field. Because of these sources of heterogeneity, uniform management actions strongly reduce the efficiency of the resource input to the crop (i.e. fertilization, water) or for the agrochemicals used for pest control (i.e. herbicide). In particular, weed plants are one of these sources of variability for the crop, as they occur in patches in the field. Detecting the location, size and internal density of these patches, along with identification of main weed species involved, open the way to a site-specific weed control strategy, where only patches of weeds would receive the appropriate herbicide (type and dose). Herein, the first stage of recognition method of vegetal species, the classification of soil and vegetation, is described and is based upon the fuzzy k-mean classification (FKC) and on particle swarm optimization (PSO).

Key words:
Fuzzy k-mean classification, particle swarm optimization, precision agriculture

A Swarm Intelligence Method Applied to Resources Allocation Problem

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Abstract
This paper presents a suggested method to solve an allocation problem with a swarm intelligence method. The application of swarm intelligence has to be discrete. This allocation problem can be modelled like a multiobjective optimization problem where we want to minimize the time and the distance of the total travel in a logistic context. To treat such a problem we are presenting a Discrete Particle Swarm Optimization (DPSO) method in which we adapt the movement of the particles according to the constraints of our application. To test this algorithm, we create a problem whose solution is already known. The aim of this study is to check whether this adapted DPSO method succeeds in providing an optimal solution for general allocation problems and to evaluate the efficiency of convergence towards the solution.
By the way, for comparison purpose, we also applied evolutionary game techniques on the same example. Tentative allocation plans are strategies. Evolutionary game theory studies the behavior of large populations of agents who repeatedly engage in strategic interactions. Changes in behavior in these populations are driven by natural selection via differences in birth and death rates. We focused on replicator dynamic which is a fundamental deterministic evolutionary dynamic for games.

Keywords
Resources Allocation, Discrete Particle Swarm Intelligence, Hard-constrained environment, Evolutionary Game Theory, Replicator dynamic

A PSO algorithm to solve a Real Course+Exam

Timetabling Problem

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Abstract
University course and exams timetabling is a very well-known constrained problem. The problem becomes more difficult when we have to face a dynamic timetabling problem where new courses and exams can appear during the semester. In this paper, we propose a particle swarm approach to simultaneously solve both problems as well as a local search procedure to handle the dynamism. We show that our approach can find high quality solutions within minutes, where a traditional forward checking requires hours to obtain comparable
ones.

Keywords
University course timetabling, dynamic exam timetabling, particle swarm optimization

A New Hybrid Distributed Double Guided Genetic Swarm Algorithm for Optimization and Constraint Reasoning: case of Max-CSPs

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Abstract
In this paper we propose a new distributed double guided hybrid algorithm combining the particle swarm optimization (PSO) with genetic algorithms (GA) to resolve maximal constraint satisfaction problems (Max-CSPs). It consists on a multi-agent approach inspired by a centralized version of hybrid algorithm called Genetical Swarm Optimization (GSO). Our approach consists of a set of evolutionary agents dynamically created and cooperating in order to find an optimal solution. Each agent executes its own hybrid algorithm and it is able to compute its own parameters. Our approach is compared to the GSO. It demonstrates its superiority. We reached these results thanks to the distribution using multi-agent systems, diversification and intensification mechanisms.

Key words
Genetic Algorithm, Particle Swarm Optimization, Max-CSPs, multi-agent system, guidance probability.

Intrusion Detection Based on Swarm Intelligence using mobile agent

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Abstract
Due to the increase in access of malicious data over the internet resources, intrusions Detection Systems (IDSs) have become the necessary component of the computer and information security framework. Although the field of IDSs is still developing, they are not able to detect all types of intrusions.

New intelligent Intrusion Detection Systems (IDSs) which are based on sophisticated algorithms rather than current signature-base detections are in demand. This work discuss about the ways of implementing a swarm intelligence approach to data clustering to detect intrusions. Mobile agent technology is used to initially collecting data properties. These data are evaluated by the combining of the artificial Immune recognition system and the artificial fuzzy ants clustering systems.
Our approach allows us to recognize not only known attacks but also to detect suspicious activity that may be the result on knowledge Discovery and Data Mining (KDDCup 1999) dataset compared to a standard learning schema that use the full dataset.

Key words
Intrusions Detection, Swarm Optimization, mobile agent , fuzzy c-means

Session 4: abstracts

Active contour: a parallel genetic algorithm approach

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Abstract
This paper presents an algorithm for automatically detecting contours using snake algorithm. Prior knowledge is first used to locate initial contours for the snakes. Next we optimize the energy by using genetic algorithm approach. We introduce parallel computing to reduce computation time
for the genetic algorithm calculations.

Key words
Active contour, parallel computing, genetic algorithm, segmentation, snake

Optimal Wireless Sensor Network Coverage with Ant Colony Optimization

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Abstract
Wireless Sensor Network is a fast growing and exciting research area that has attracted considerable research attention in the recent past. The creation of large-scale sensor networks interconnecting several hundred to a few thousand sensors nodes opens up several technical challenges and immense application possibilities. We discuss in this paper wireless sensor network coverage problem. This problem consists in placing sensors so as to get the best possible coverage while saving as many sensors as possible. To solve it we prepare an Ant Colony Optimization (ACO) algorithm. We compare our results with existing metaheuristic algorithms.

Key words
Wireless sensor network, metaheuristics, ant colony optimization

Predicting Multicomponent Protein Assemblies Using an Ant Colony Approach

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Abstract
Biological processes are often governed by functional modules of large protein assemblies such as the proteasomes and the nuclear pore complex, for example. However, atomic structures can be determined experimentally only for a small fraction of these multicomponent assemblies. In this article, we present an ant

colony optimization based approach to predict the structure of large multicomponent complexes. Starting with pair-wise docking predictions, a multigraph consisting of vertices representing the component proteins and edges representing scored transformations is constructed. Thus, the assembly problem corresponds to identifying minimum weighted spanning trees that yield arrangements of components with few atomic clashes. The utility of the approach is demonstrated using protein complexes taken from the Protein Data Bank. Our algorithm was able to identify near-native solutions for 5 of the 6 cases tested, including one 6-component complex. This demonstrates that the ant colony model provides a useful way to deal with highly combinatorial problems such as assembling multicomponent protein **complexes.**

Key words
Macromolecular assembly, multiple protein docking, *Hex*, ant colony optimization

A clustering ant colony algorithm for the long-term car pooling problem

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Abstract
The increased use of private vehicles has caused significant traffic congestion, noise and air pollution. Public transport is often incapable of effectively servicing non-urban areas. Car pooling, where sets of car owners having the same travel destination share their vehicles, has emerged to be a viable possibility for reducing private vehicle usage around the world. This paper describes a clustering ant colony algorithm for solving the long-term car pooling problem. Computational results are given to show the superiority of our approach compared with other meta-heuristics.

Key words
Swarm intelligence, Ant colony optimization, Transportation problem, Car pooling problem.

A Multiple Pheromone Algorithm for Cluster Analysis

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Abstract

Ant colony optimisation algorithms (ACO) work via a process called stigmergy in which ants deposit pheromone traces in order to influence foraging patterns. Pheromone traces are picked up and followed by other ants but they evaporate over time. Paths with more pheromone will survive longer and have a higher chance of getting followed and reinforced whilst weaker traces simply fade away. The premise behind the proposed Multiple Pheromone Algorithm for Cluster Analysis (MPACA) is that ants detect individual features of objects in space and deposit pheromone traces that guide towards these features. Each ant starts off by looking for a particular feature but they can combine with ants looking for other features if the match of their paths is above a given threshold. This enables ants to detect and deposit pheromone corresponding to feature combinations and provides the colony with more powerful cluster analysis and classification tools. The basic elements of MPACA are that: (i) at the start of the learning process, every object has at least one ant assigned to it for each feature; (ii) each ant searches for other objects with a matching feature value; (iii) a pheromone is laid down whenever an ant has found an object with a matching feature; (iv) if ants detecting different features find their paths are matching above a certain level, they will combine and start looking for the conjunction of features; and (v) ants become members of the same colony when the population density of ants in the area is above a threshold value. This paper explains the algorithm and explores its potential effectiveness for cluster analysis.

Key words
Ant Colony Algorithms, Artificial Life, Emergent Behaviour, Cluster Analysis, and Self-organisation.

Non-dominated Sorting Gravitational Search Algorithm

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Abstract
This paper proposes an extension of the Gravitational Search Algorithm (GSA) to multiobjective optimization problems. The new algorithm, called Non-dominated Sorting GSA (NSGSA), utilizes the non-dominated sorting concept to update the gravitational acceleration of the particles. An external archive is also used to store the Pareto optimal solutions and to provide some elitism. It also guides the search toward the non-crowding and the extreme regions of the Pareto front. A new criterion is proposed to update the external archive and two new mutation (turbulence) operators, called sign and reordering mutations, are also proposed to promote the diversity within the swarm. Numerical results show that NSGSA can obtain comparable and even better performances as compared to the previous multi-objective variant of GSA and some other multi-objective optimization algorithms.

Key words
Gravitational Search Algorithm, Multi-objective Optimization, Non-dominated Sorting, Sign Mutation, Reordering Mutation.

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