

Department of Computer Science
University of Cyprus

Lectures Program by Prof. Andries P. Engelbrecht
University of Pretoria, South Africa

Colloquium: Particle Swarm Optimization in Dynamic Environments



Speaker: Prof. Andries P. Engelbrecht

Affiliation: University of Pretoria, South Africa

Category: Colloquium

Location: Room 148, Building 12 Faculty of Pure and Applied Sciences, New Campus ([map](#))

Date: Tuesday, March 17th, 2009

Time: 15:00 - 16:00

Host: Andreas Pitsillides (Andreas.Pitsillides AT ucy.ac.cy)

Abstract:

The original particle swarm optimization (PSO) algorithms have been developed to solve unconstrained, static continuous-valued optimization problems. Due to the characteristics of PSO, it cannot be applied to find solutions in dynamically changing environments. The PSO approach has to be adapted in order to inject diversity into swarms such that the exploration abilities of the swarm are increased. This then allows PSO to find and track optima in dynamic environments. This talk will start by formally defining dynamic environments and discussing different classes of dynamic environments, as well as classes of dynamic optimization problems. Then an introduction to PSO will be provided, with an explanation of why the original PSO cannot be used in dynamic environments. Adaptations of PSO to find and track single solutions in dynamic, single objective, and unconstrained environments will then be discussed. The talk will then continue to discuss more complex dynamic optimization problems. It will be shown how PSO can be adapted to track multiple solutions in a dynamic environment, and results will be given to illustrate the performance of PSO in this task. Dynamic multi-objective optimization problems will be considered, discussing how a vector-evaluated PSO can be used to solve dynamic multi-objective optimization problems. Finally, the ability of PSO to cluster temporal data will be illustrated.

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Lecture 1: Angle Modulation as An Approach to Optimize Binary-Valued Problems

Location: Room 148, Building 12 Faculty of Pure and Applied Sciences, New Campus ([map](#))

Date: Monday, March 16th, 2009

Time: 13:30 - 14:45

Abstract:

There exists a number of good algorithms that can be applied to solve binary-valued optimization problems. This includes, amongst others, genetic algorithms, ant colony optimization meta-heuristics, and local search methods such as hill-climbing. There also exists a number of very efficient and simple optimization algorithms developed to solve continuous-valued optimization problems. These algorithms have been developed specifically for continuous-valued problems, and have to be adapted in order to be applied to binary-valued problems.

Angle-modulation (AM) is a technique borrowed from signal processing and used to allow such optimization algorithms developed for continuous-valued problems to be also applied to binary-valued problems without having to change the algorithm. AM is used to implement a homomorphous mapping, where a bit-generating trigonometric function is evolved, by evolving the amplitude, frequency, scale and offset of the trigonometric function. An algorithm specifically developed for continuous-valued problems, e.g. particle swarm optimization, differential evolution, bee colony optimization, is then used to find the values for these four floating-point variables that will result in an optimal bitstring for the binary-valued problem being optimized. Using AM to solve binary-valued problems, the search space is always a four-dimensional continuous-valued space, which is usually significantly less than the dimension of the original binary-valued problem. An advantage of the AM method is therefore that a larger-dimensional problem is mapped to a smaller dimensional problem.

This lecture will discuss the AM method, and will show how this method can be applied to allow continuous-valued algorithms to be used to solve binary-valued problems.

For inquiries regarding Lecture 1 please contact: M. Chris Christodoulou, CS Dept (cchrist@cs.ucy.ac.cy) or check the Colloquium web site: <http://www.cs.ucy.ac.cy/colloquium/>