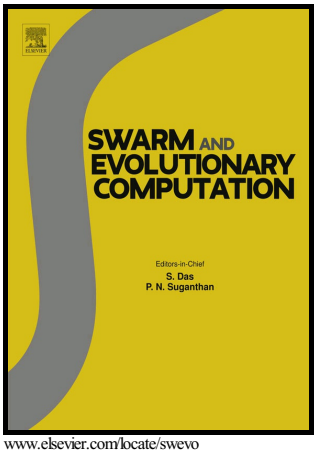
# Fuzzy Self-Tuning PSO: A Settings-Free Algorithm for Global Optimization

Marco S. Nobile, Paolo Cazzaniga, Daniela Besozzi, Riccardo Colombo, Giancarlo Mauri, Gabriella Pasi




www.elsevier.com/locate/swevo

PII: S2210-6502(16)30353-4
DOI: http://dx.doi.org/10.1016/j.swevo.2017.09.001
Reference: SWEVO304

To appear in: *Swarm and Evolutionary Computation*

Received date: 19 October 2016
Revised date: 31 August 2017
Accepted date: 3 September 2017

Cite this article as: Marco S. Nobile, Paolo Cazzaniga, Daniela Besozzi, Riccardo Colombo, Giancarlo Mauri and Gabriella Pasi, Fuzzy Self-Tuning PSO: A Settings-Free Algorithm for Global Optimization, *Swarm and Evolutionary Computation,* http://dx.doi.org/10.1016/j.swevo.2017.09.001

# Fuzzy Self-Tuning PSO: A Settings-Free Algorithm for Global Optimization

Marco S. Nobile[a,c,*], Paolo Cazzaniga[b,c], Daniela Besozzi[a,c], Riccardo Colombo[a,c], Giancarlo Mauri[a,c], Gabriella Pasi[a]

[a] *Department of Informatics, Systems and Communication, University of Milano-Bicocca, Milano, Italy*
[b] *Department of Human and Social Sciences, University of Bergamo, Bergamo, Italy*
[c] *SYSBIO.IT Centre of Systems Biology, Milano, Italy*



**Abstract**

Among the existing global optimization algorithms, Particle Swarm Optimization (PSO) is one of the most effective methods for non-linear and complex high-dimensional problems. Since PSO performance strongly depends on the choice of its settings (i.e., inertia, cognitive and social factors, minimum and maximum velocity), Fuzzy Logic (FL) was previously exploited to select these values. So far, FL-based implementations of PSO aimed at the calculation of a unique settings for the whole swarm. In this work we propose a novel self-tuning algorithm—called Fuzzy Self-Tuning PSO (FST-PSO)—which exploits FL to calculate the inertia, cognitive and social factor, minimum and maximum velocity independently for each particle, thus realizing a complete settings-free version of PSO. The novelty and strength of FST-PSO lie in the fact that it does not require any expertise in PSO functioning, since the behavior of every particle is automatically and dynamically adjusted during the optimization. We compare the performance of FST-PSO with standard PSO, Proactive Particles in Swarm Optimization, Artificial Bee Colony, Covariance Matrix Adaptation Evolution Strategy, Differential Evolution and Genetic Algorithms. We empirically show that FST-PSO can basically outperform all tested algorithms with respect to the convergence speed and is competitive concerning the best solutions found, noticeably with a reduced computational effort.

*Keywords:* Particle Swarm Optimization, adaptive algorithms, Fuzzy

*Corresponding author. email: nobile@disco.unimib.it