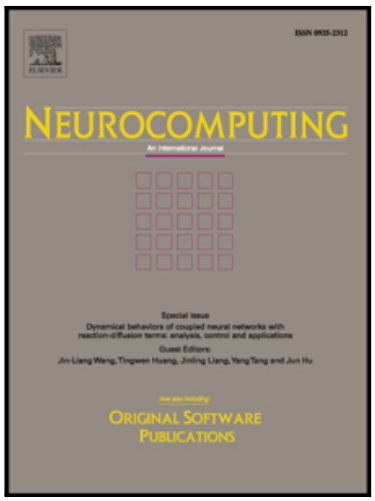

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PII: S0925-2312(17)31076-7
DOI: 10.1016/j.neucom.2017.03.086
Reference: NEUCOM 18577

To appear in: *Neurocomputing*

Received date: 20 May 2016
Revised date: 21 November 2016
Accepted date: 23 March 2017

Please cite this article as: Karl Mason, Jim Duggan, Enda Howley, Multi-Objective Dynamic Economic Emission Dispatch using Particle Swarm Optimisation Variants, *Neurocomputing* (2017), doi: 10.1016/j.neucom.2017.03.086

Multi-Objective Dynamic Economic Emission Dispatch using Particle Swarm Optimisation Variants

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Abstract

Particle swarm optimisation (PSO) is a bio-inspired swarm based approach to solving optimisation problems. The algorithm functions as a result of particles traversing and evaluating the problem space, eventually converging on the optimum solution. This paper applies a number of PSO variants to the Dynamic Economic Emission Dispatch (DEED) problem. The DEED problem is a multi-objective optimisation problem in which the goal is to optimise two conflicting objectives: cost and emissions. The PSO variants tested include: the standard PSO (SPSO), the PSO with Avoidance of Worst Locations (PSO AWL), and also a selection of different topologies including the PSO with a Gradually Increasing Directed Neighbourhood (PSO GIDN). The aim of the paper is to test the performance of different variants of the PSO AWL against variants of the SPSO on the DEED problem. The results show that the PSO AWL outperforms the SPSO for every topology implemented. The results are also compared to state of the art Genetic Algorithm (NSGA-II) and Multi-Agent Reinforcement Learning (MARL). This paper then examines the performance of each PSO algorithm when the power demand is modified to form a triangle wave. The purpose of this experiment was to analyse the performance of different PSO variants on an increasingly constrained problem.

Keywords: Constrained Optimisation, Multi-objective, Swarm Intelligence, Particle Swarm Optimisation, Dynamic Economic Emission Dispatch, Power Generation

1. Introduction

Particle swarm optimisation (PSO) was first proposed by Kennedy et al. in 1995 [14], when modelling the behaviour of flocking birds. PSO has become a popular field of study in recent years due to its applicability to a broad range of research areas. These include swarm intelligence, multi-agent systems, optimisation and evolutionary computation.

At its core, the algorithm consists of a number of particles traversing a problem space and moving towards the best known locations. There have been many proposed variations to the

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