

Ant Colony Optimization for Power Plant Maintenance Scheduling Optimization: A Simplified Hydro Tasmania System

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Abstract

In order to maintain a reliable and economic electric power supply, the maintenance of power plants is becoming increasingly important. In this paper, a formulation that enables ant colony optimization (ACO) algorithms to be applied to the power plant maintenance scheduling optimization (PPMSO) problem is developed and tested on a simplified hydro system of Hydro Tasmania, Australia. In the PPMSO problem, there are a number of constraints to be satisfied when scheduling for maintenance, and whether these constraints can be met depends on some external conditions, such as the inflow into reservoirs and system demand. In order to obtain optimal or near-optimal schedules under these stochastic external conditions, the ACO formulation developed is capable of incorporating options of deferring outages, as well as shortening of outage durations. Heuristic formulations for favoring normal outage duration over deferral and shortening options are also developed. In this paper, the above formulation was applied to a simplified version of the Hydro Tasmania system under three different storage inflow conditions, namely dry, intermediate and wet years. The simplified system consists of the largest power station in Tasmania and a cascade system that encompasses four power stations. There are 14 maintenance tasks to be scheduled over a 12-month horizon, which includes a 42-day major upgrade of the largest power station. The PPMSO problem is therefore defined as the determination of an optimal maintenance schedule such that the maintenance tasks accomplished and the Energy In Storage (EIS) of the system are maximized, subject to a number of constraints, which include load constraints, as well as precedence and timeframe constraints, for investigative and actual maintenance tasks. The outcome of the ACO runs suggests that the major upgrade maintenance can proceed as normal in a wet year, but in an intermediate year and dry year, the outage duration needs to be shortened from 42 days to 14 days and 8 days, respectively. Furthermore, the EIS of the system is observed to be increasing throughout the optimization process under all three inflow conditions. In conclusion, the results obtained by using the ACO formulation developed are promising and the formulation will be further investigated and applied to the real Hydro Tasmania system.