A particle swarm optimization and min–max--based workflow scheduling algorithm with QoS satisfaction for service--oriented grids

ABSTRACT

In service-orientated grids (SOG) environments, grid workflow schedulers play a critical role in providing quality-of-service (QoS) satisfaction for various end users (EUs) with diverse QoS objectives and optimization requirements. The EU requirements are not only many and conflicting, but also involve constraints of various degrees—loose, moderate or tight. However, most of the existing scheduling approaches violate EU constraints in tight situations and suffer inferior QoS optimization results. In this paper, a constraints-aware multi-QoS workflow scheduling strategy is proposed based on particle swarm optimization (PSO) and a proposed look-ahead heuristic (LAPSO) to improve performance in such situations. The algorithm selects the best scheduling solutions based on the proposed constraint-handling strategy. It hybridises PSO with a novel look-ahead mechanism based on a min–max heuristic, which deterministically improves the quality of the best solutions. Extensive simulation experiments have been carried out to evaluate the performance of the proposed approach. The simulation results show that the LAPSO algorithm guarantees satisfaction (0% violation) of the EU constraints even in tight situations. It also outperforms the comparison algorithm, with about 30% increase, in terms of cumulative QoS satisfaction of optimization requirements. In addition, the new scheme significantly reduces the CPU time by about 75% compared to the benchmark algorithm.