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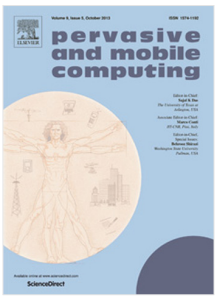

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A novel multi-objective particle swarm optimization based energy efficient path design for mobile sink in wireless sensor networks

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Abstract

Data collection through mobile sink (MS) in wireless sensor networks (WSNs) is an effective solution to the hot-spot or sink-hole problem caused by multi-hop routing using the static sink. Rendezvous point (RP) based MS path design is a common and popular technique used in this regard. However, design of the optimal path is a well-known NP-hard problem. Therefore, an evolutionary approach like multi-objective particle swarm optimization (MOPSO) can prove to be a very promising and reasonable approach to solve the same. In this paper, we first present a Linear Programming formulation for the stated problem and then, propose an MOPSO-based algorithm to design an energy efficient trajectory for the MS. The algorithm is presented with an efficient particle encoding scheme and derivation of a proficient multi-objective fitness function. We use Pareto dominance in MOPSO for obtaining both local and global best solutions of each particle. We carry out rigorous simulation experiments on the proposed algorithm and compare the results with two existing algorithms namely, tree cluster based data gathering algorithm (TCBDGA) and energy aware sink relocation (EASR). The results demonstrate that the proposed algorithm performs better than both of them in terms of various performance metrics. The results are also validated through the statistical test, analysis of variance (ANOVA) and its least significant difference (LSD) post hoc analysis.

Keywords: Wireless sensor network, Multi-objective particle swarm optimization, Pareto optimality, Mobile sink, Rendezvous points.

1. Introduction

Sink mobility in wireless sensor networks (WSNs) has garnered much attention in the past few years [1–9], due to its innumerable and manifold advantages. A WSN with mobile sink (MS) comprises of a large number of static sensor nodes (SNs) and one or more mobile sinks. The MS traverses the target area for the collection of data from the SNs. It is already well established that data collection using MS can solve the hot-spot [5–7] problem

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