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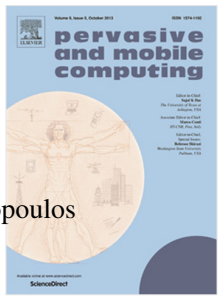

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An Algorithmic Study in the Vector Model for Wireless Power Transfer Maximization[☆]

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Abstract

Rapid technological advances in the domain of Wireless Power Transfer (WPT) pave the way for novel methods for power management in systems of wireless devices and recent research works have already started considering algorithmic solutions for tackling emerging problems. However, many of those works are limited by the system modelling, and more specifically *the one-dimensional abstraction* suggested by Friis formula for the power received by one antenna under idealized conditions given another antenna some distance away.

Different to those works, we *use a model* which arises naturally from fundamental properties of the *superposition of energy fields*. This model has been shown to be more realistic than other one-dimensional models that have been used in the past and can capture superadditive and cancellation effects. Under this model, we define *two new interesting problems* for configuring the wireless power transmitters so as to maximize the total power in the system and we prove that the first problem can be solved in polynomial time. We present a *distributed solution* that runs in pseudo-polynomial time and uses various knowledge levels and we provide theoretical performance guarantees. Finally, we design *three heuristics* for the second problem and evaluate them via simulations.

Keywords: Wireless Power Transfer, Distributed Algorithms, Wireless Systems

1. Introduction

Wireless Power Transfer (WPT) has recently become a commercially viable option in various wireless systems due to the reliability of continuous power supply and the convenience provided by the fact that no static (wired) network connections are needed between the devices. The efficiency of the various technological alternatives is increasing every year. Current fast-charging protocols achieve up to 84% efficiency for wireless power transfer up to distances of 15 meters [2], while at the same time keeping thermal dissipation significantly low [3]. A WPT enabled system consists of several wireless transmitter and receiver devices. A *wireless transmitter (charger)* is a device that has a dedicated power source with significant power supply and can transfer power wirelessly to receivers. A *receiver (node)* is a device that is powered by harvesting the radio frequency energy from the chargers. A receiver is usually an electronic device that is needed to perform a specific task in the wireless system, for example a sensor mote in a wireless sensor network. Systems of wireless devices have to operate under increasing demands of power in order to sustain various computational and communication tasks. For this reason, the efficient and distributed cooperation of the

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