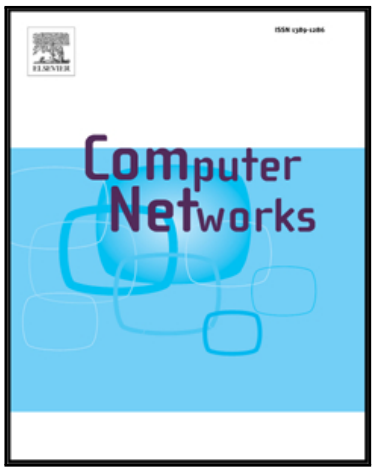

Coverage on Demand: A Simple Motion Control Algorithm for Autonomous Robotic Sensor Networks

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PII: S1389-1286(18)30072-0
DOI: 10.1016/j.comnet.2018.02.004
Reference: COMPNW 6402

To appear in: *Computer Networks*

Received date: 13 July 2017
Revised date: 18 November 2017
Accepted date: 6 February 2018

Please cite this article as: Haitao Zhao , Lingchu Mao , Jibo Wei , Coverage on Demand: A Simple Motion Control Algorithm for Autonomous Robotic Sensor Networks, *Computer Networks* (2018), doi: 10.1016/j.comnet.2018.02.004

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Abstract: Autonomous robotic sensor networks are composed by robotic sensors that can move, sense and communicate with each other in a cooperative way, and therefore are more powerful than static sensor networks. In robotic sensor networks, an important problem is motion control: how each sensor can autonomously move to the desirable location for better network coverage over targets. In this paper, we study a new motion control problem that has the following critical requirements: (i) All targets in the area of interest should be covered by sensors; (ii) The number of sensors that cover one target depends on the target's importance, i.e., more important targets should be covered by more sensors; (iii) The robotic sensors are kept connected, i.e., each sensor has at least one route to any other sensor in the network; (iv) Proper distance between every two neighboring sensors is maintained to avoid coverage overlap and possible collision. As a solution to this problem, we propose a simple motion control algorithm that operates in a pure autonomous manner. The proposed algorithm models the coverage demand into virtual force field, and hence each sensor can simply obey the effect of force field onto it to move. We demonstrate by extensive simulations that the proposed algorithm is very effective and is applicable to large-scale networks.

Key words: Robotic sensor networks, motion control, autonomous algorithm, coverage on demand

I. Introduction

The autonomous robotic sensor network (RSN) consists of a group of mobile sensors that can cooperate with each other to gather, process and exchange information. Each sensor is equipped with at least one wireless transmitter to exchange coordination and data with its neighbors, i.e., those within its communication range. With the capability of moving, sensing and communicating, the robotic sensor networks are more powerful than static sensor networks, and therefore have been used in many fields such as surveillance and monitoring [1, 2].

One challenging problem in RSN for surveillance is the motion control. This problem concerns the optimal movement of a set of robotic sensors to maintain the connectivity of the network [3-5], to achieve maximum coverage area [6, 7], or to improve the coverage over maneuverable targets [8, 9], and so on.