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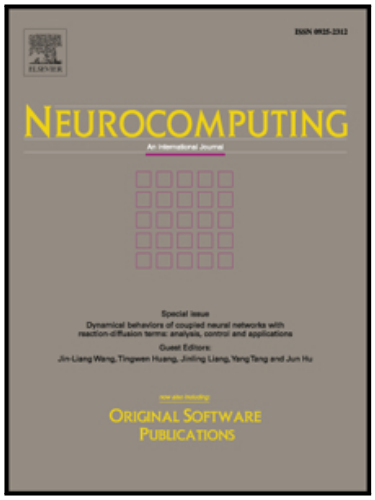

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Distributed Coordination of multiple mobile actuators for pollution neutralization *

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Abstract

This paper is concerned with distributed coordination of multiple mobile actuators for pollution neutralization in a polluted environment, where a static mesh sensor network is pre-deployed for measuring the concentration of contaminants, and mobile actuators with neutralizing chemicals implement spraying operation at a steady rate to reduce the contaminants continuously. A hazard intensity distribution is introduced to evaluate adverse impact of contaminants on the environment. Autonomous actuators are dynamically deployed to minimize the total hazard intensity. This coordination problem can be formulated as a distributed deployment problem based on centroidal Voronoi tessellation (CVT). Two control strategies with switching motion controllers are proposed to achieve optimal deployment of mobile actuators for unlimited and limited actuating range respectively. To escape local minimum and balance the actuator workload, a novel workload adjustment strategy is designed to change the normalized amount of neutralizer sprayed by mobile actuators, which makes each actuator approach a common workload. Compared with pure CVT and switching motion controller, the total hazard intensity can be further decreased if the workload adjustment strategy is implemented. Simulation examples are provided to validate the effectiveness of the proposed method.

Keywords Multi-agent systems, pollution neutralization, optimal deployment, centroidal Voronoi tessellation, workload balance.

1 Introduction

Multi-agent systems have been an active research field during the past decade [1]-[4]. Generally speaking, an agent can refer to physical entity as well as any living creature or even a program code if it has partial or full autonomy and some degree of artificial intelligence. However, in a narrow sense, especially in engineering technology, the agent refers to a dynamical system and the multi-agent system is viewed as a cooperative team of autonomous agents with motion, sensing, communication, computation and even actuation capability. Instead of acting individually or being operated by a centralized supervisor, the agents can interact and share the information with their neighbors in a distributed manner. This kind of interaction, which has learned from universal collective behavior in nature or society, facilitates the distributed cooperation of

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