A Macroscopic Model for High Intensity Radiofrequency Signal Detection in Swarm Robotics Systems

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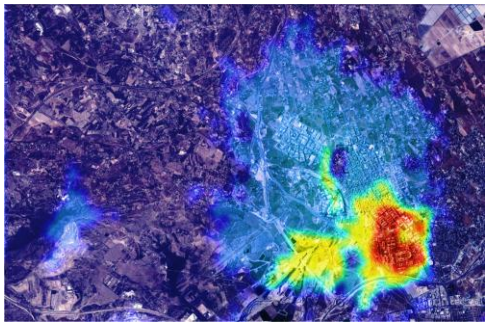
Abstract

In recent years, there has been a growing interest in resource location in unknown environments for robotic systems, which are composed of multiple simple robots rather than one highly capable robot [1], [2]. This tradeoff reduces the design and hardware complexity of the robots and removes single point failures, but adds complexity in algorithm design. The challenge is to program a swarm of simple robots, with minimal intercommunication and individual capability, to perform a useful task as a group [3], [4].

This paper is focused on finding the highest intensity area of a radiofrequency (RF) signal in urban environments. These signals are usually more intense near the city center and its proximity, since in these zones the risk of signal saturation is high. Radio frequency radiation (RFR) is boosted or blocked mainly depending on orography or building structures. RF providers need to supply enough coverage, setting up different antennas to be able to provide a minimum quality of service.

We will define a micro/macroscopic mathematical model to efficiently study a swarm robotic system, predict their long-term behavior and gain insight into the system design. The macroscopic model will be obtained from Rate Equations, describing the dynamics of the swarm collective behavior.

In our experimental section, the Campus of the University of Alicante will be used to simulate our model. Three RFR antennas will be taken into account, one inside our Campus and two other in their perimeter. Several tests, that show the convergence of the swarm towards the RFR, will be presented. In addition, the obtained RFR maps and the macroscopic behavior of the swarm will be discussed.



Key words: Macroscopic Mathematical Model, Swarm Robotic System, Resource Location.

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