# Cooperative Communication in Ad-Hoc Networks

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**Abstract**

Cooperative, communicating system theory has been an active area of research in the past few years. Military applications include rescue group coordination and unmanned aerial vehicle (UAV) flight planning. Different properties of the wireless units in the system determine if, how, and when they communicate with each other.

Typically, for ad-hoc network problems, a graph structure is employed. The units occupy nodes in the graph, and at each time-step can move to adjacent nodes, or stay at the same node. Each unit in the system typically has a task, e.g. travel to a destination node in the graph. There are many different types of constraints that can be levied on the units themselves, and on the system as a whole.

The cooperative communication problem in mobile ad-hoc networks (CCPM) deals with maximizing the total connectivity for a set of wireless agents as they traverse the graph from a set of source nodes to a set of destination nodes. This problem has been shown to be NP-hard, and many efficient heuristics have been developed to provide high quality solutions. In this paper, we remove the underlying graph structure of the ad-hoc network, and formulate a continuous time analog of the CCPM. Previously, two agents were said to communicate if they occupied adjacent nodes in the graph. Now, we consider the Euclidean distance as a measure of communication connectivity. This continuous approach provides a more realistic model of the problem.

In this work, we present mathematical programming formulations and discuss issues related to the computational complexity of the new problem. Numerical results are presented and directions of future research are addressed.

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