Geometric Spanners for Topology Control in Wireless Networks

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Abstract

In this thesis titled "Geometric Spanners for Topology Control in Wireless Networks" we develop and analyze algorithms for communication in wireless networks. Especially, we consider ad hoc networks which are known as spontaneous wireless networks without a fixed infrastructure and without centralized administration. We distinguish between static, dynamic, and mobile ad hoc networks. In a static ad hoc network, we do not allow the participants any dynamics and movements, i.e. all hosts are stationary. In a dynamic ad hoc network, we allow the hosts to enter and/or leave the network. Finally, in a mobile ad hoc network (MANET), every host can move around without any restriction.

A special feature of this work is that we consider *power-variable* ad hoc networks, i.e. networks in which every participant is allowed to adjust the transmission range(s) of its sender(s). In addition, we distinguish between omnidirectional (radio) and directional (beam radio, infrared) communication.

The goal of this work is the development and the analysis of resource-efficient wireless communication structures (topologies). We focus on the resources routing time and energy consumption. For this purpose we introduce models, develop algorithms, and identify suitable measures. We use mathematical analyses to develop topologies with provably good graph and communication properties. Furthermore, we demonstrate experimentally that the results of our work are also suitable for real-world applications. Therefore we have developed and implemented different testbeds and present the outcome of our extensive experimental evaluations. We show that it is possible to build up and maintain wireless topologies using distributed, local algorithms without the need for any geographical positioning system.

In this work we model wireless networks using geometric graphs and use and extend methods in computational geometry.