Similarity of Routing in Ad Hoc Networks and Robotics

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Motivation

- How does a micro-mouse find a path to the goal in a maze?
- The micro-mouse explores the maze and stores the wall information for later use.
- It recognizes a wall by using light or touch sensors.
- It uses depth first search algorithm or the right-hand rule to explore the maze.
- After exploring the maze, the micro-mouse computes the best path from the start to goal and runs as fast as it can.

Similarity of routing in mobile ad hoc networks and robotics.

- A mobile robot in an unknown environment and a message in the ad hoc network have the same problem in the similar situation.
- The goal is to find a good path between two points minimizing one or more parameters such as travel length or journey time.
- The problem is how to deal with unknown obstacles they meet on the way.
- They can use the similar level of local geographic information about their environments.

Project Objectives

1. Develop geographic routing technique for mobile ad hoc networks by adopting the robotic techniques such as navigation, path planning, shortest path algorithms, etc.
2. Improve geographic routing technique by taking advantage of the networks; cooperation of multiple nodes or messages, rapid propagation of information, etc.
3. Show that the geographic routing algorithm is scalable to large and dense networks and robust against mobility in the rapidly changing mobile ad hoc network.

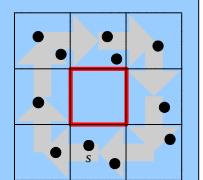
Robotic Routing

- Robotic routing is a grid based geographic routing technique for mobile ad hoc networks.
- The message is forwarded to a node in the neighbor cell closer to the destination.
- If the message cannot proceed any more, it gets around the obstacle by grid-based right-hand rules until greedy forwarding is possible.
- The message proceeds toward the destination switching the above two modes.
- Explored obstacles information can be stored at the nodes for successive messages to avoid the obstacle in advance.

Grid-based Right-hand Rule

- In grid-based right-hand rule, the message follows the border cells.

ex) 4-Quadratic RHR : the message can move in 4 directions; up, down, left and right

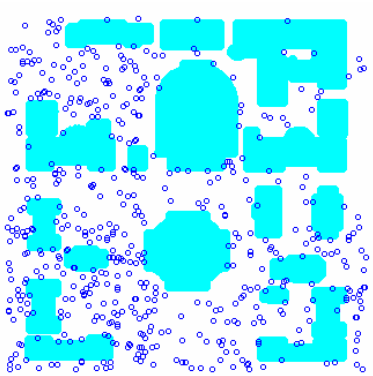


Model of Ad Hoc Networks

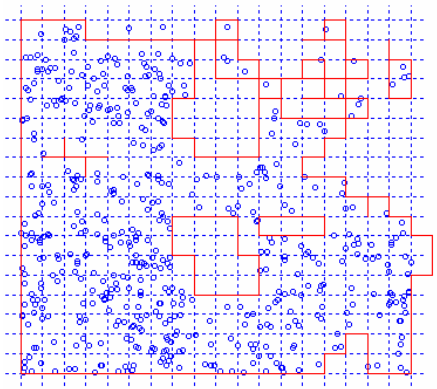
- The ad hoc network consists of transmission regions and obstacles.
- Permanent obstacles which radio cannot go through or nodes cannot be located because of geographical features. Eg. lakes, rivers, mountains, buildings.
- Transient obstacles where there was no nodes that can forward the message.

- The network is virtually partitioned into a grid
- Each node knows the grid number it belongs to.
- Each node periodically broadcasts to single-hop neighbors its own grid number and the grid numbers that its single-hop neighbors belong to.

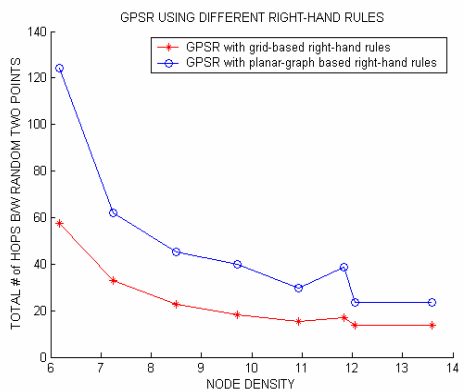
500 Nodes Are Randomly Distributed On Columbia Campus.



Buildings are considered as obstacles for messages.



The obstacles are represented by a set of grid line segments. Small buildings may not be an obstacle for messages.



Grid-based right-hand rule improves the performance of GPSR.

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