

Outline of Proposed Research

The proposed research will be in the area of computational geometry, studying the motion of mobile agents in the physical world. A tremendous amount of research has been done on static objects. By contrast, how to model and control objects in a moving and highly dynamic environment remains a challenging problem, in spite of the fact that this problem arises in major application areas such as robotics and ad-hoc wireless networks. With this motivation in mind, I propose to study geometric motion planning problems that arise in the following two contexts.

Watchman Route Problems Given a simple polygon P , and a moving “watchman” point r outside of P , find a shortest closed route for r such that each point on the boundary of P is clearly seen from at least one position of r . Since the path is closed, when r completes the route, it can repeat the tour. Thus, r “guards” the polygon. This problem is called the *External Watchman Route Problem* [NG94]. The recent thesis of Rafa Absar [Abs05] investigated this problem for a watchman whose visibility is limited, guarding a polygon that is convex. Questions that remain in the limited visibility model include the planning of a watchman route for a non-convex polygon, and for a collection of polygons. This project will first focus on these problems, and will then extend to the consideration of multiple watchmen.

Ad-hoc wireless networks A mobile ad-hoc network (MANET) is a self-configuring network of mobile nodes connected by wireless links. The nodes are free to move arbitrarily. Since each node has a fixed transmission range, the topology of the network is determined by the proximity of pairs of points, and can change rapidly and unpredictably. I plan to design geometric algorithms and dynamic data structures that deal with continuous motions. Early contributions to this area appeared in [Gao04], which introduced a number of research questions to be investigated.

These two projects differ in the sense that, we plan the motions of the agents in the *Watchman Route Problems*, whereas we do not have any control over the motions of the nodes in *Ad-hoc networks*. However, both problems involve handling dynamic moving objects with a constraint on visibility or transmission range. Reference [BGH99] provides a general method for designing algorithms for dynamic environments using “kinetic data structures”. I will extend and apply these notions to explore the above problems.

References

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