Statement of Research Interests

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My main research interests are in the areas of computational geometry and computational learning theory, and my work in these areas applies to the fields of robotics, computer vision, software engineering and visualization.

In one paper I examined the complexity of testing different control flow statements of standard programming languages by defining a complexity measure that is similar to a complexity measure used in computational learning theory and applying it to different control flow statements and combinations of statements. This measure gives bounds on the number of random test points needed to determine that a program is approximately correct, and thus it gives insight into the relative difficulty of testing different program constructions.

I considered the problem of localizing a robot in a known environment in another paper. I assumed that the robot can "see" walls using sonar probes, and that it has a map and a compass. By moving around and using its sonar sensing device, the robot can determine possibilities for its position in the map. The goal is to minimize the distance that the robot travels in order to exactly identify its position. The map of the known environment and the data returned by the robot's sensors are modeled as geometric objects. I showed that the localization problem is NP-hard, and I developed a polynomial time approximation scheme that travels close to the optimal distance. I have extended this research by considering other sensing models and showing that the results still hold for these models.

In my dissertation and several papers I developed a model for approximate testing of objects using point probes. In this model an unknown object is "probed" to see if it meets the specifications for the object to within some given error tolerance. The probes model the data given by point light detectors or a tactile robot sensor in an automated manufacturing application. They also model pixel data used for automatic target recognition. In my work I examined the "testability" of various geometric objects as well as general properties that make an object testable or untestable. I also related my model to the "helpful teacher" learning model and to results in geometric probing.

In other work related to automated manufacturing I have looked at the problem of determining whether an object can be manufactured using certain milling techniques by examining the geometry of the object. I have also worked on determining the position and orientation of an object using probes, which has applications in both automated manufacturing and automatic target recognition.

I have also done work in the area of graph drawing on visibility representations for graphs in two and three dimensions. My work involves determining which types of graphs have visibility representations, as well as developing algorithms for giving a visibility representation for a particular graph. Graph drawing has applications in software visualization, user interfaces and VLSI routing.

In the future I plan to continue working on theoretical problems and on applied research projects that use theoretical results.