STATEMENT OF PURPOSE

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During my M.S. study between 1996 – 1998 in Bogazici University, I have worked with Assoc. Prof. Levent Akin on the subject of partially observability in robot navigation. My study has been focused on examining techniques for controlling a class of dynamical systems in which the underlying state of the system is not fully observable. Throughout this study, I have used techniques coming from many disciplines, but mostly from the machine learning, planning and operations research communities. In the artificial intelligence community, researchers have mostly focused on problems, which require the assumption that the system state is completely observable at any given time. These techniques have some areas where they can be used efficiently, but for many problems the complete observability assumption does not hold. Unfortunately, the resulting solutions can be arbitrarily bad at controlling the system, even if the algorithms developed for fully observable problems are directly applied.

There is a class of problems that can be modelled as Partially Observable Markov decision problems (POMDPs). This is a formal model that captures many of the salient features of the problems in which I have been interested, including probabilistic state transitions and partial observability. In my study, I wanted to see how the POMDP model could be used to solve problems typically addressed in the area of artificial intelligence and how techniques from the artificial intelligence community could be adapted to solve partially observable problems. The computational complexity of this class of problems is known to be NP-complete. But the optimal techniques developed for this class, has given the idea that approximate solutions can be developed for these problems.

My decision is to continue my study on partially observability as a Ph.D. work. Moreover, in the Thesis part, Assoc. Prof. Levent Akin has accepted to work with me as my Thesis advisor. The next step in my study will be applying some of the mentioned algorithms to real problems. Robotics, especially the problem of navigation, is an area where I have not tried POMDP techniques practically. But I have developed a test-bed like simulation system to get an empirical comparison of heuristic, direct, indirect and brute force methods for robot navigation problems where the robot's environment was modelled as a POMDP.

I have planned to study on the following areas in my future steps: adaptation of other machine learning techniques to develop approximations, adaptation of the optimal algorithms to produce approximate solutions, applying aggregation-decomposition techniques to reduce the complexity of large problems, development of algorithms that reduce problem complexity by decomposing the problem hierarchically and consideration of problems where some of the POMDP model assumptions must be relaxed.