As a member of the Northern Bites, Bowdoin's RoboCup team, I worked this summer to improve the ability of our robots to self-localize. Self-localization is the process of determining one's position using sensory inputs. Self-localization is a key component of effective robot behaviors and multi-agent cooperation, but is a non-trivial task.

In RoboCup, self-localization mainly involves processing images streamed from the camera in the Nao robot's forehead and using the gathered landmark information to determine one's location and heading on the field. The landmark information is very noisy, however, and must be filtered in order to calculate an accurate location. The Northern Bites have been using an Extended Kalman Filter for years, with great success, for self-localization. My work this summer was to improve upon our implementation of the standard unimodal EKF and explore new information sources and techniques for determining our position on the field.

In the past, the Northern Bites EKF self-localization system used only goalposts, corner points, and field crosses for position information. I worked this summer to incorporate lines into the system, as well. Lines can provide extra heading orientation information to supplement the other landmarks. The major difficulty in adding lines to this system came in proper identification of lines. There are many lines on a soccer field, and taken alone, they look identical. I worked in the vision system to begin to use corner identifications to positively identify lines so that they could be of more use to the EKF.

RoboCup involves a lot of uncertainty, not only in landmark measurements, but also in the proper identification of the landmarks themselves. Especially as the league progresses to using a more realistic soccer field, the ability to deal with ambiguity in landmark identifications is becoming ever more necessary. To this end, I researched using a multiple model EKF to more effectively deal with ambiguity. Instead of using a single filter to process measurements, this version has multiple models, each of which is a possible model for the robot's position. The most likely model is computed based on how well the observed landmarks and their measurements fit with each model. This allows the system to be more flexible and compensate for common and confusing situations like being displaced due to a penalty or an uncertain starting position.

My research and work this summer is an interesting and useful starting point for more improvements to our localization system which will hopefully lead us to much improved behaviors and team play as our own self-localization certainty improves.
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