Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Institut für Automatik

NR.
YEAR, HS/FS

GROUP PROJECT

IfA-Nr. 30001

Authors

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ETZ

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Robocup: Cooperative estimation and prediction of player and ball movement

Description

The RoboCup team is one of IfA's most recent endeavors. We are developing an autonomous multi-agent control system for the game of soccer with the Nao Robot that is used in the Standard Platform League. Our research is divided into four main directions: motion control, vision, communication, and multi-agent behavior. The project is in its starting phase and the motion control group focuses on algorithms for walking/running—while ensuring the stability of the robot—kicking the ball, and goalkeeping. The vision group collaborates with the Computer Vision Lab and implements algorithms for goal, player and field line detection, as well as determining the ball's position, direction and speed. The communication group is currently setting up a global eye system for validation, and evaluating different protocols for communication among the robots. Finally, the behavior group will build on the other blocks to compute an optimal strategy to win the game. We are recruiting highly motivated and talented students with proficient knowledge of C for our campaign.

In this project, the students will develop an intelligent sensor fusion algorithm of for the robocup team that estimates in real time the position of each player, the position of each adversary, and the position of the ball. The algorithm will be implemented in Matlab under the realistic constraints of noisy and missing data (measurements). Adaptation of the Matlab software to the Robocup computing environment, and the subsequent application to the hardware system, is a plus.

Tasks

The following are the main tasks of this project:

- *Literature review on Kalman filtering*
- *Review of dynamic models for player and ball movement*
- *Matlab simulation of player and ball movement within a realistic area*
- *Kalman filter applied to a model of all players with full state feedback and noise*
- *Kalman filter applied to a model of the ball*
- *Kalman filter applied to a model of all players with multiple measurements and restricted state feedback*
- *Kalman filter applied to a model of the ball with multiple measurements*

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Procedures

1. *Work planning: In a preliminary meeting, the schedule and organization of the project will be established in agreement with the student.*
2. *Preliminary analysis of the project: In the initial phase, the students will achieve general understanding of the project requirements and of the tools that are available or need to be developed. This will be achieved through discussion with the supervisors and independent literature review.*
3. *Coding and simulation on a computer: Simulation of Robocup dynamic environment.*
4. *Coding and simulation on a computer: Implementation of Kalman filter and extended Kalman filter in matlab.*
5. *Exploration of sensor fusion techniques.*
6. *Implementation of extended Kalman filter for estimation of team players, opposing team players, and ball in a noisy and constrained environment.*
7. *Documentation: It is essential that the candidate produces accurate and extensive documentation of the methods being implemented. Final documentation must be a self-contained description of features and examples for later reference by other users.*
8. *Internal meetings: regular meetings between the student and supervisors will take place every one week. Additional meetings will be scheduled according to the project needs.*
9. *Preparation of dissertation: It is recommended that the student produces updated drafts of the dissertation as the project tasks are being accomplished.*
10. *Final presentation: At the end of the project, the students will be required to present his work at the automatic control institute in a 30-minutes seminar.*

Time schedule

- *Simulation of Robocup dynamic environment in Matlab (until Mar. 12)*
- *Familiarization with Kalman filtering for linear systems (until Mar. 19)*
- *Familiarization with extended Kalman filtering for nonlinear systems (until Mar. 26)*
- *Implementation of extended Kalman filtering for nonlinear systems in the Robocup environment (until Apr. 9)*
- *Implementation of extended Kalman filtering for nonlinear systems in the Robocup environment with measurement constraints (until Apr.23)*

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- *Familiarization with state-of-the-art sensor fusion, consideration of true Robocup environmental constraints, and potential hardware implementation (until May 31)*
- *Preparation of the written report (until May 31)*
- *Preparation of the presentation (until May 31)*

Oral presentation Signatures *Date 31/05/11*

SUPERVISING PROFESSOR *Prof. John Lygeros, Institut für Automatik*

SUPERVISOR *Sean Summers*

STUDENTS *Fabio Marti, David Lehnen, Roggo Matthias, Daniel Gilgen*