Kalmp’t Olympics Event A Report

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**Summary**:

The goal of the event A is to implement perception, planning and control components into the given goalie robot and block as much balls as possible. The three components are summarized in the following block diagrams, figure 1.

*Figure 1 High level Flow diagram for perception, planning and perception components*

Camera sensor reading

Kalman filter initialization

Estimate states with Extend Kalman Filter

Select optimal catch location with estimated states

PID control a robot link to each millstone

Set milestones in configuration space for planning

Solve for robot configuration with Inverse kinematics at given catch location

Estimate possible catch locations

Perception

Planning

Control

The raw camera sensor reading is used to estimate the states of the ball and the landing locations of the ball. The planning components then choose the best location to block the ball and create a planned path. The PID components calculate the required torque at each joint to achieve the target configuration to block the ball.

**Components:**

As shown in figure 1, there are 4, 3 and 1 subcomponents in perception, planning and control component respectively. The first subcomponents only output the raw sensor reading from the camera sensor.

**Input:**, list of to catch the ball

**Assumption**: Constant velocity on and. Velocity on is only affected by gravity

**For each** in the list:

The travel time to hit that is

With the assumption: and

List of catch locations

**If** , the ball does not bounce before it reaches the , output the result to the list

**If** , the ball hit the ground before it reaches the , recalculate the catch location with iterative method

**Initialize**

**While** : update with assumed trajectory equation

**If**  the ball hits the ground, deduce the velocity

**Assumption:** velocity deduced by a factor when ball hit ground

Time difference

End link position with pre-calculate configuration

Robot

Prepare

Waiting

Prediction

Most possible

**State:** “Wait”

At the center using pre-calculated initial configuration

**State:** “Prepare”

Move to the most possible location with pre-calculated configuration

Ball is far from the desired catch, and the predicted catch location is inaccurate

Ball is close to the desired catch, and the predicted catch location is accurate

**State:** “Catch”

Add interpolated mile stone to the closest possible catch locations calculated by IK

If there is reading

of other balls

No reading for other balls

Most possible prepare location

Accurate predicted catch location with lowest cost

3, but used to calculate a reliable initial prior to initialize the extend Kalman filter. A more detailed

**Input:**

**Given:**

**Given:**

Solve for from:

With , solve for :

Collect first 10 positons in world coordinates.

**Assumption:** Constant velocity on and. Velocity on is only affected by gravity

**Given:**

Least square curve fitting on:

Solve for

Solve for

*Figure 2.1 Initialization Algorithm*