

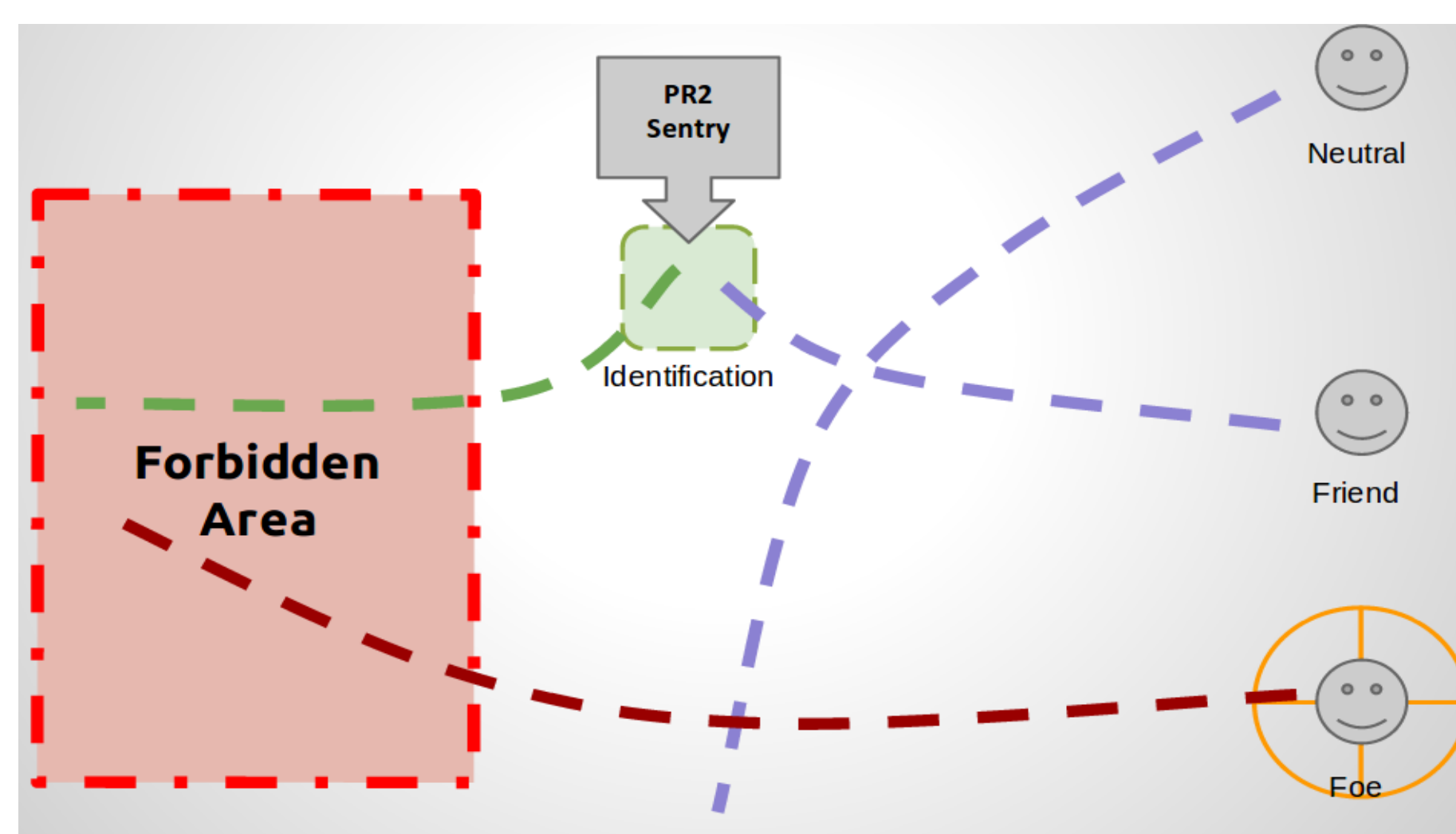
You Shall Not Pass: Robotic Sentry with Friend or Foe Identification System

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CS 4758: Robot Learning
Professor: Ashutosh Saxena

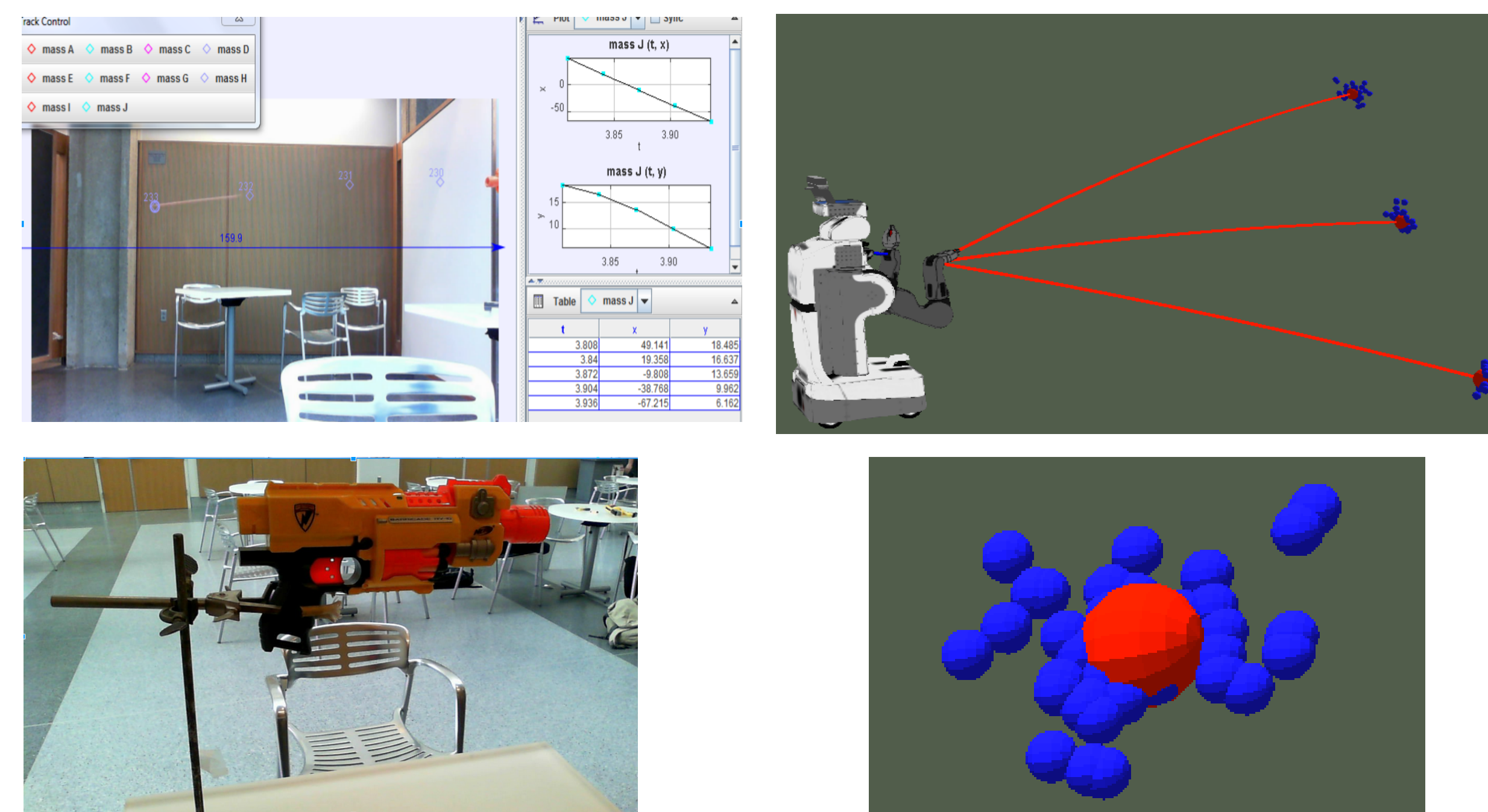
Goal

We propose an application of existing robot learning algorithms to create a robotic sentry. The robot can gauge the hostility of an intruder and make intelligent decisions to aim and shoot.

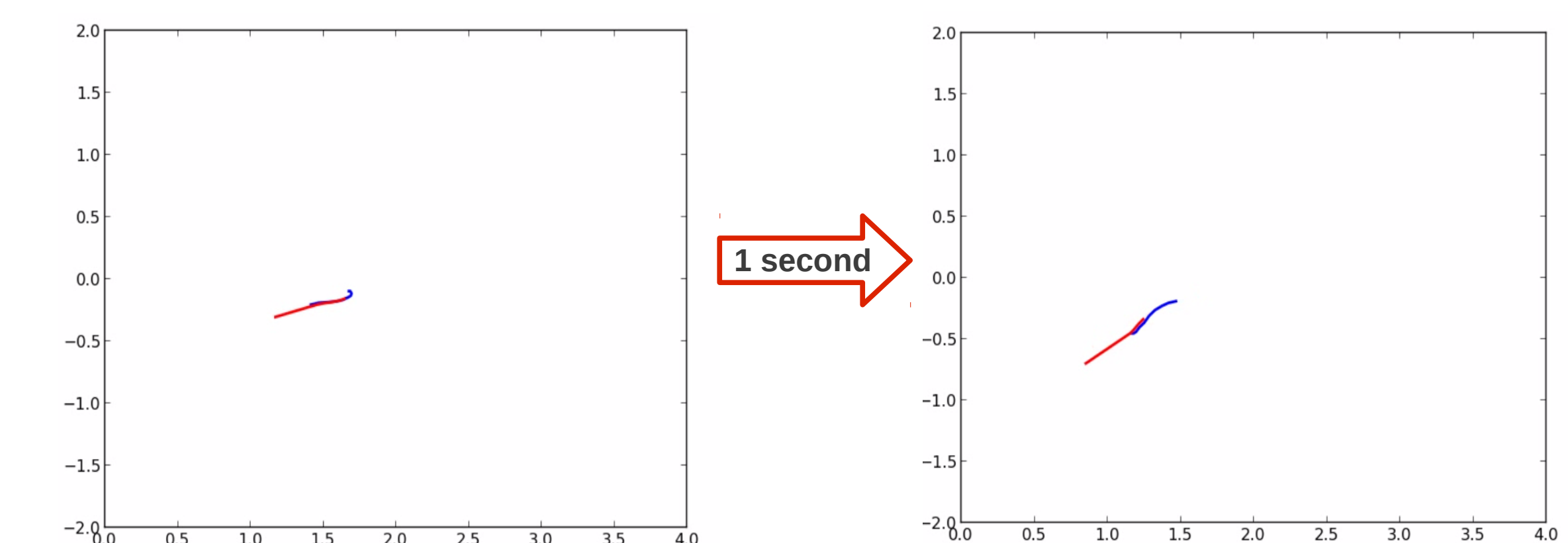


Approach

Stochastic modeling of Nerfgun bullet trajectory



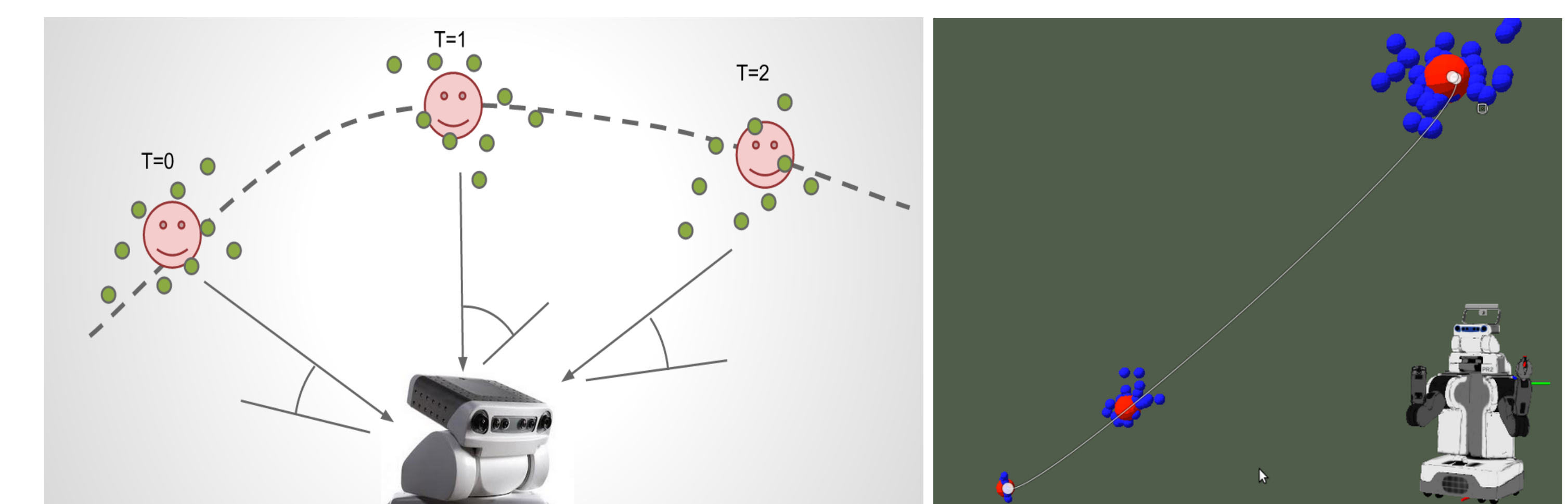
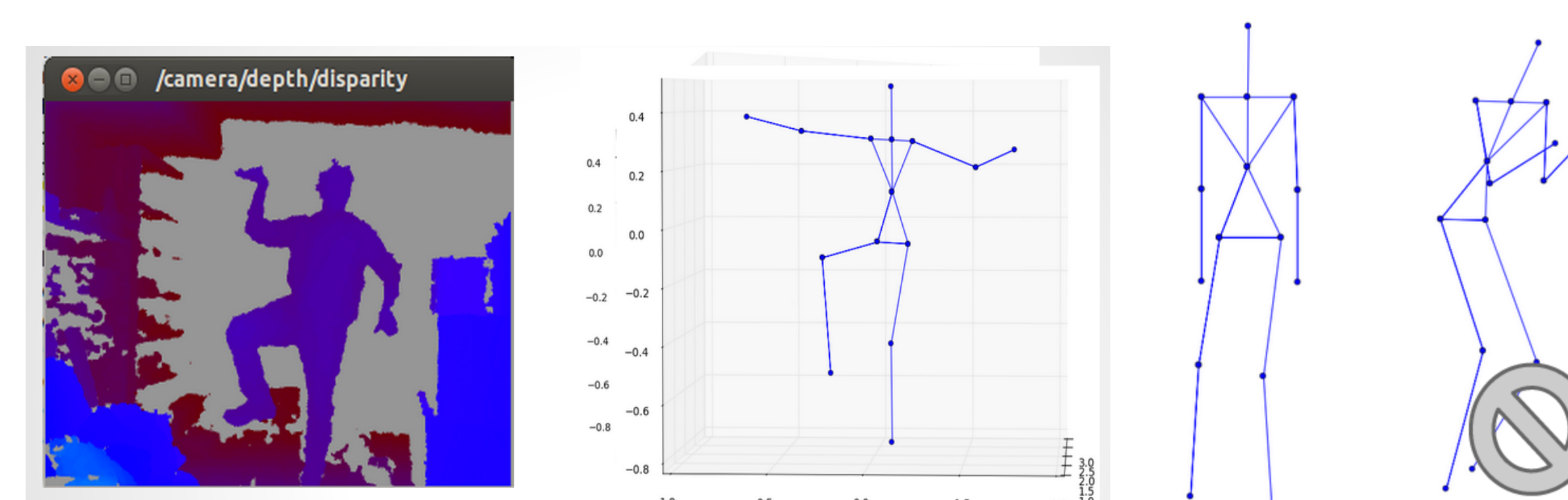
Real-time path prediction using Kalman filter



Aim calculation to determine best shot

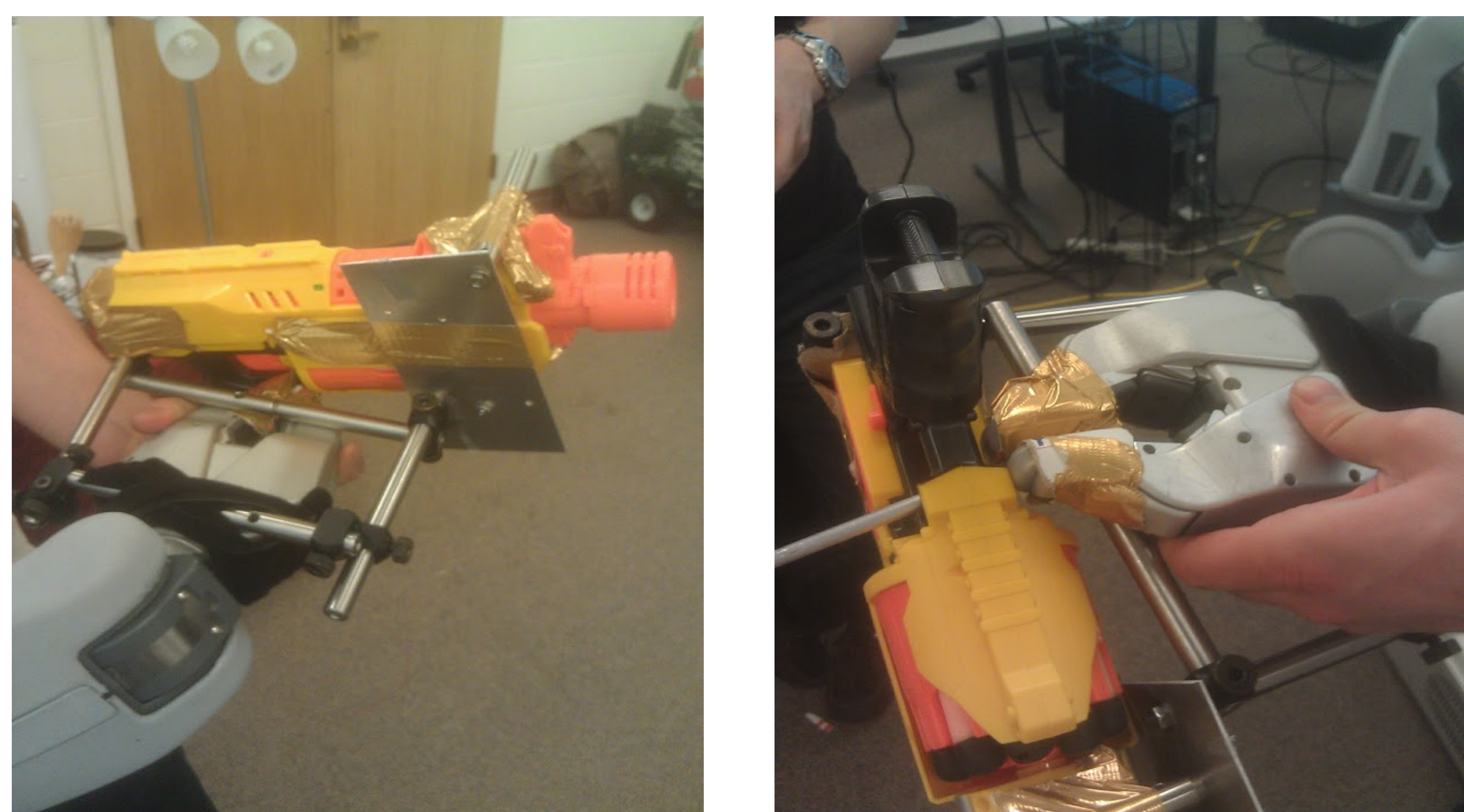
1. Sample target trajectory
2. Inverse kinematic to fine aim angle and time of flight
3. Sample bullet arrival using stochastic model
4. Pick angle with higher probability of hitting the target

Real-time hostility detection using SVM



Setup

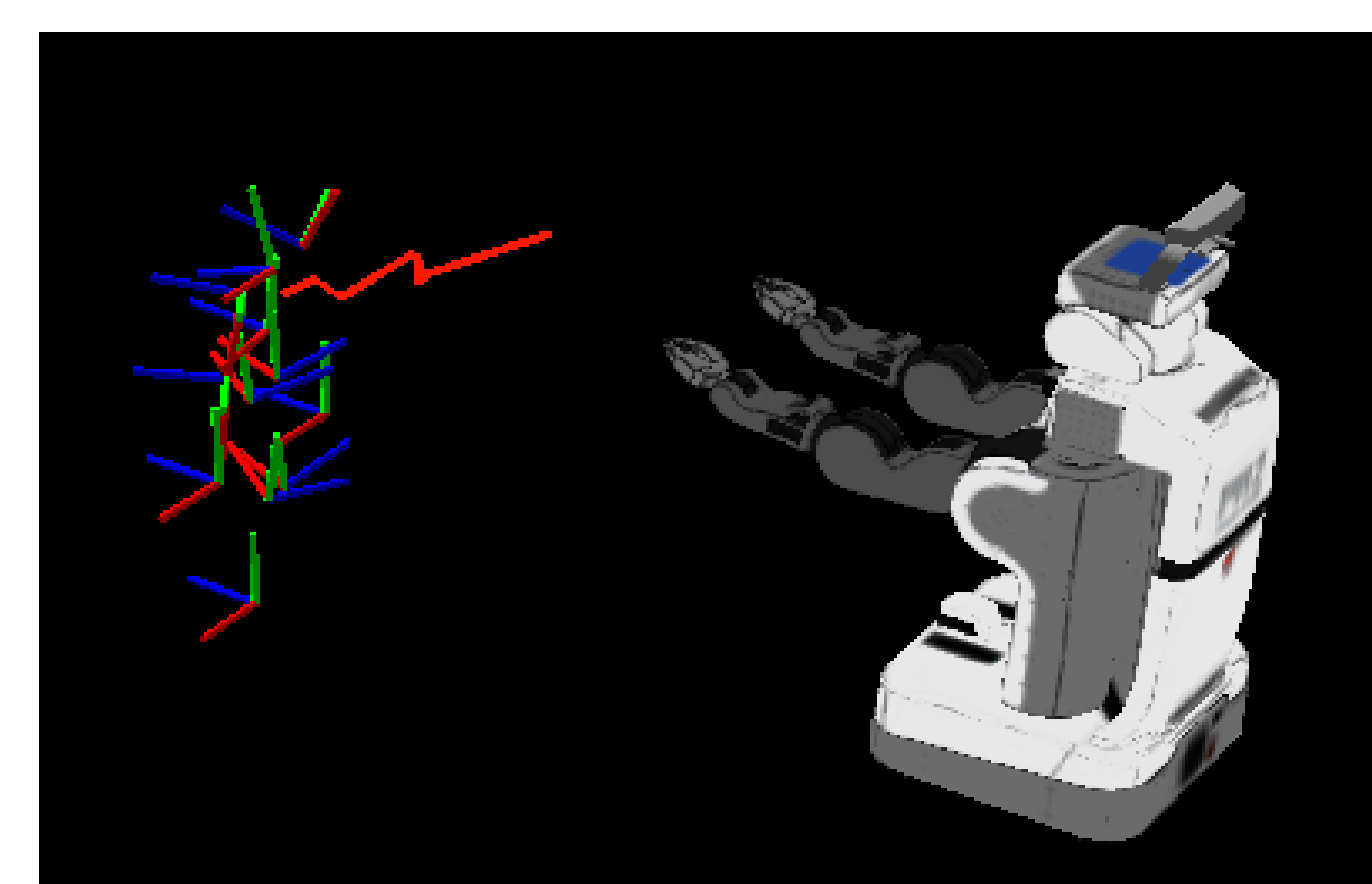
- Robot Operating System for core functions
- Kinect to track intruder pose and position
- Robot behavior and actual shooting visualized in RVIZ
- Nerfgun (semi-auto) interfaced with PR2 gripper: open grip to shoot.



Results

- Combined all components to run in real-time
- Hostility and path mapped in real time via RVIZ
 - PR2 aims gripper to match optimal shot in simulation

Performance



- Hostility detect with SVM: 68% accuracy on one frame. Greater with multiple frames.
- Kalman path prediction fits linear movement only
- Unable to gauge performance of shooting without PR2

Difficulties

- PR2 gripper could not easily work with nerfgun
- Slow simulation speeds, poor computer hardware.
- Not possible to demo shooting (PR2 broken)

Future Improvements

- Test of code on physical PR2
- EKF for nonlinear path prediction
- Greater training set for SVM
- Robot base movement to pursue intruder