Multi-person tracking for autonomous sports videography system

Background

NAPPLab, lead by Prof. Micah Corah, is developing a robotic videography system for filming team sports and social behaviors. This system will consist of a network of pan-tilt-zoom cameras controlled by a centralized computer. Ultimately, we would like this sytem to be able to autonomously film groups of moving people or athletes according to human inputs such as by selecting aesthetically pleasing views of players passing a ball or obtaining multiple views of a runner that could later be used to reconstruct their motion. For this field session the task will be to develop a system that is able to track locations of multiple people (the athletes) and estimate their velocity. This position and velocity data will then serve as an input to our planning and control systems. Because this field session project represents a component in a larger research task, we expect the team to complete this project by building simple and configurable modules based on existing tools for robotics research. Specifically, the team should use ROS2 (Robot Operating System) to build modules (nodes) that will interface with our broader system by sending and receiving standardized messages.

Project Description

The group will be divided into two teams that will cooperate to accomplish the project goals:

1. 3D multi-person tracking
   a. The system should estimate position and velocity of multiple athletes, potentially using a flat-ground assumption
2. Camera system operations
   a. The team should develop procedures to setup, calibrate, and deploy the system in an outdoor environment such as a sports field.
   b. This procedure may involve calibrating camera extrinsics and

intrinsics and
locating bounds of the field of play.

Notes:
Computing and camera equipment necesary to complete this project will be
provided.
The team will also have access to (and contribute to) tools maintained by
NAPPLab for detection, camera control, and calibration.
Likewise, the team may wish to interface with cameras via existing ROS2 driver
nodes.

Project Goals

1. Develop tracking system capable of estimating position and velocity of at
least 5 athletes in an outdoor space of at least 30mx30m
2. Produce tools and procedures to deploy and calibrate the camera system in no
more than 30 minutes
4. Demonstrate the functionality of the tracking system according to stated
guidelines
5. Provide thorough documentation of code and procedures for use in continued
development of this system

Skill Set

* Experience with Linux & Unix environments, especially Ubuntu
C/C++
Scripting language and scientific/mathematical programming
* Python with numpy
* Julia
Robotics skills (preferred or to be developed during field session)
* ROS/ROS2 experience
* Experience with computer vision algorithms and/or coordinate frames and rigid
  body transforms

Preferred Team Size

3-4 students

Outcomes and Opportunities with NAPPLab

Please reach out to Prof. Micah Corah if you are interested in continuing to

work on robotics research with NAPPLab.
Opportunities may include: independent study, hourly RA-ship, Summer Undergraduate Research Fellowship (SURF), or Mines Undergraduate Research
Fellowship (MURF).

This project may contribute to future research publications in robotics
conferences or journals.
If so, student contributors will be acknowledged for their contributions.
If you wish to contribute as an author to publications stemming from this
project, you must reach out to Prof. Corah directly to discuss how to do so and
what kinds of contributions would merit authorship.

Intellectual Property

This project is a component of ongoing research in NAPPLab.
We suggest adoption of the BSD 3-Clause license to facilitate continued use of
products of this field session in our research program.

Location of Work:

Mines Campus

Client Liason

Micah Corah
micah.corah@mines.edu

Carole Bouy (MS-Thesis)
cbouy@mines.edu