Simulation tools based on real data 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 incorporate real data that represents
motion of human athletes playing team sports into our simulation system.
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

As we work toward developing a multi-camera videography system, we would like to
evaluate our planning and control methods with realistic simulation tools.
Specifically, we are interested in using real data to drive motion of simulated athletes.
In turn, our simulator (based on ROS2 and Gazebo) will render camera views
by which our tools perform simulated tracking and filming.
This will enable us to evaluate our tools for tracking, control, and videography
planning in a realistic simulation environment.

Notes:

The team will also have access to (and contribute to) tools maintained by
NAPPLab (and contributed to by priod Field Session teams) for detection,
tracking, camera control, and other purposes.

Project Goals

The tasks to be completed are as follows
1. Identify suitable datasets containing tracking or motion capture data for
team sports
2. Design a common format for these datasets and tools to convert or load data
3. Develop a tool to publish the converted data; provide mechanisms to specify
publishing rate, speedup, start and times, transformation (offset, rotation,
scale) to locate motion appropriately on the simulated playing area.
4. Develop capabilities to realize simulated player motion in Gazebo based on
published data.

Optionally, the team may seek to complete the following additional tasks:
* Animating player motion, either based on canned walking/running animation or
  captured data
* Randomizing athlete models or aspects of their motion
* Developing multi-camera capabilities for our simulation
  (our simulation currently only includes a single camera for use in tracking
  player motion)

Skill Set

* Experience with Linux & Unix environments, especially Ubuntu
C/C++
Scripting language and scientific/mathematical programming
* Python with numpy
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