Data Science Seminar Series

Wednesday, January 18, 1:00-2:00 pm, OM1241

TITLE

Computer Vision-Based Motion Control and State Estimation for Mobile Robotics

SPEAKER

Dr. Geoff Fink

ABSTRACT

Mobile robots are increasingly being used for a wide range of both indoor and outdoor applications, such as search and rescue, surveillance, and infrastructure inspection. However, most are still being remotely piloted. In this talk, I will discuss three of our recent research efforts towards improving the autonomy of mobile robots. First, I will discuss state estimation. State estimators for individual robots are often general, and many are even designed as an afterthought, whereas preference is given to the mechanical design and control of the robot.

Furthermore, the difficulty of state estimation is often underestimated. However, stable state estimates are essential for most control algorithms. We developed a low-level state estimator for quadrupedal robots that includes attitude, odometry, ground reaction forces, and contact detection. The second topic is dynamic visual servoing (VS). A typical visual servo control consists of a two-loop architecture where the outer loop uses a vision sensor to provide a reference velocity to the inner loop, and the inner loop regulates the velocity of the robot by providing force and torque commands. Then the vehicle tracks the reference velocity using a kinematic model. With high-speed tasks and underactuated systems, it is important to include the dynamics of the vehicle. We refer to VS that directly accounts for vehicle dynamics as dynamic VS. The last topic is visual-inertial simultaneous localization and mapping (SLAM). Our work uses the output of an existing monocular visual SLAM system which provides a scaled position measurement. Using an observer design, inertial measurements are combined with the visual SLAM output to estimate the vehicle position and linear velocity. We consider the observability of this visual-inertial SLAM problem and propose an observer design based on a change of coordinates which transforms the system into a LTV form. Our approach does not require an approximate linearisation of the model equations.

BIOGRAPHY

Dr. Geoff Fink received the B.Sc. degree in computer engineering from the University of Alberta, Edmonton, AB, Canada, in 2007, the M.Sc. degree in computer and electrical engineering from the University of Guadalajara, Guadalajara, Mexico, in 2011, and the Ph.D. degree in control systems from the University of Alberta, Edmonton, Canada, in 2018 under the supervision of Dr Alan Lynch and Dr Martin Jagersand.

From 2018-2021 he was a postdoctoral researcher at the Dynamic Legged Systems lab, Istituto Italiano di Tecnologia with Dr. Claudio Semini. Since 2021 has been a faculty member at the Department of Engineering & Applied Science at Thompson Rivers University, and currently holds the rank of Assistant Professor.

His research interests include robotics, visual servoing, sensing, perception, state estimation, and simultaneous localization and mapping (SLAM).

https://www.tru.ca/science/masters-degrees/mscds/Data_Science_Seminar_Series.html