Research Reflection

Application of Robotics

IS 809/709

Initiatives at Clemson University

- **NSF Industry/University Cooperative Research Center (I/UCRC) RObots and SEnsors for HUman WellBeing (ROSEHUB) Clemson Site**
  - The Clemson site of the National Science Foundation funded Industry/University Cooperative research Center (I/UCRC) on Robots and Sensors for the Human Well- Being (RoSeHuB)
  - The focus of the center is on robotic, sensor and actuation technologies that enhance automation with an eye on application development that enhances quality of life, work and/or health
  - The center currently consists of 4 sites (University of Minnesota-lead, University of Pennsylvania, Worcester Polytechnic University, and Clemson University.)
  - Robots and Sensors for Human Well-Being (ROSE- HUB) is the only NSF Industry/University Cooperative Research Center in the Robotics and Intelligent Systems technology space

- **NSF I/UCRC ROSEHUB (google.com)**

- **ARMLAB CLEMSON (google.com)**

Initiatives at Clemson University

- [A partnership for the future: Clemson, U.S. Army to develop next generation of autonomous vehicle tools, prototyping](#)

- [The Deep Orange program](#)

Initiatives at Texas A&M University

- AMERICA'S NEWEST CENTER FOR TRANSFORMATIVE RESEARCH AND EDUCATION
  - https://rellis.tamus.edu/
- RELLIS-3D: A Multi-modal Dataset for Off-Road Robotics
  - https://github.com/unmannedlab/RELLIS-3D

Initiatives at UIUC

- IOBT: EMPOWERING READINESS TO MEET COMMANDER INTENT
  - In the future, military operations will rely less on human soldiers and more on interconnected technology, leveraging advancements in embedded systems and machine intelligence in order to achieve superior defense capabilities.
  - The Internet of Battlefield Things will connect soldiers with smart technology in armor, radios, weapons, and other objects, to give troops "extra sensory" perception, offer situational understanding, endow fighters with prediction powers, provide better risk assessment, and develop shared intuitions.
  - The initiative is a collaboration between the Army Research Lab, academia, and industry.
- https://iobt.illinois.edu/

Research at UPenn

- Distributed and Collaborative Intelligent Systems and Technology Collaborative Research Alliance (CRA)
  - create Autonomous, Resilient, Cognitive, Heterogeneous Swarms that can enable humans to participate in a wide range of missions in dynamically changing, harsh, and contested environments.
  - These include search and rescue of hostages, information gathering after terrorist attacks or natural disasters, and humanitarian missions
  - https://www.dcist.org/

R&D at Amazon

- AWS Deep Racer
  - https://aws.amazon.com/deepracer/
- AWS Deep Racer is now open source and ready to hit the road with ROS 2
  - https://aws.amazon.com/blogs/opensource/aws-deepracer-is-now-open-source-and-ready-to-hit-the-road-with-ros-2/

TED Talk by Prof. Vijay Kumar

- [Autonomous Agile Aerial Robots](#)
  - In his lab at Penn, Prof. Vijay Kumar and his team build flying quadrotors, small, agile robots that swarm, sense each other, and form ad hoc teams -- for construction, surveying disasters and far more.

Lex Fridman Podcast #97

- Sertac Karaman: [Robots That Fly and Robots That Drive](#)
  - 0:00 - Introduction
  - 1:44 - Autonomous flying vs autonomous driving
  - 6:37 - Flying cars
  - 10:27 - Role of simulation in robotics
  - 17:35 - Game theory and robotics
  - 24:30 - Autonomous vehicle company strategies
  - 29:46 - Optimus Ride
  - 47:08 - Waymo, Tesla, Optimus Ride timelines
  - 53:22 - Achieving the impossible
  - 53:50 - Iterative learning
  - 58:39 - Is Lidar is a crutch?
  - 1:03:21 - Fast autonomous flight
  - 1:18:06 - Most beautiful idea in robotics
  - Sertac Karaman is a professor at MIT, co-founder of the autonomous vehicle company Optimus Ride, including robots that drive and robots that fly

Recent Research in Robotics

- [ICRA21 Autonomous Racing Talk] - Sertac Karaman (MIT) - On Fast and Agile Autonomous Super-Vehicles

- OPPORTUNITIES AND CHALLENGES WITH AUTONOMOUS RACING
  - 2021 ICRA Full-Day Workshop 31 May 2021

Examples

- FlightGoggles
  - FlightGoggles is envisioned to be development environment that allows the design, implementation, testing and validation of autonomous super-vehicles
  - Provides exteroceptive sensor simulation based on the Unity3D engine as well as vehicle dynamics and inertial sensor simulation capabilities
  - https://flightgoggles.mit.edu/learn

Possible Research Projects

- **16.30 Feedback Control Systems**
  - An MIT Feedback Control Systems Class that Teaches with Palm-size Drones
  - http://fast.scripts.mit.edu/dronecontrol/

Possible Research Projects

- Matlab Toolbox for Parrot Rolling Spider
  - A Matlab/Simulink toolbox for the Parrot Rolling Spider. The toolbox allows designing, simulating, and implementing estimation and control algorithms on the palm-size Parrot Rolling Spider drone. The toolbox is open source, and can be found here:
  - https://github.com/Parrot-Developers/RollingSpiderEdu

Devices

- [Parrot Rolling Spider Drones](): Linux-based and MATLAB/Simulink codes

- [DJI Tello]()

- [Parrot Mambo Fly]()

- [Crazyflie]()

Ground Bots
- [Raspberry Pi Mouse V3]()
- [ROSbot 2.0]()
- [GoPiGo3]() (needs assembly, out of stock)
- [AWS Deep Racer]()

Simulation Toolkits

- Unity
  - https://unity.com/
- Gazebo
  - http://gazebosim.org/
- Robotic Operating Systems (ROS)
  - http://wiki.ros.org/ROS/Tutorials
- ARL Autonomy Stack
  - Scalable, Adaptive, and Resilient Autonomy (SARA)
  - https://www.arl.army.mil/business/collaborative-alliances/current-cras/sara-cra/sara-overview/

Research Talks

- [Invited Session 1] Markus Lienkamp (TUM) - Indy Autonomous Challenge Key Opportunities and Challenges
- [ICRA21 Autonomous Racing] - Markus Lienkamp (TUM) - Indy Autonomous Challenge - YouTube
- TUM – Institute of Automotive Technology
  - The main research at the Institute of Automotive Technology under the supervision of Prof. Markus Lienkamp is about the demands in mobility.
  - https://github.com/TUMFTM
- Trust, Ethical problems, Ethical decision, Ethical codes,
  - Which trajectory to follow, do we hit bicycle, car or other cars?
  - See at 14 minutes of the video

- [Invited Session 2] Davide Scaramuzza (U of Zurich): Autonomous Drone Racing
  - [ICRA21 Autonomous Racing] - Davide Scaramuzza (U of Zurich): Autonomous Drone Racing - YouTube

Research Talks

- [ICRA21 Autonomous Racing] - Invited Session 3 – QnA and Discussion - YouTube