

Foundations of Robotics projects 2023-24

The time-constrained assessment will ask you to report on one of these projects. You will work in a small group on one of the topics below. Groups will be provided with some standard hardware components and also given a budget for additional components which can be ordered from university suppliers (RS and Farnell). Groups should prepare a joint report as a TAROS style paper for their own reference, and which may be submitted as supplemental information. Individual students are assessed only on an individual report on their own contribution to the project. Individual reports may refer to the non-assessed joint paper for technical details in order to save space for writing about individual contributions.

Open Robot whiskers

We have previously worked with physical robot whiskers, modelled on those of the rat. These have been closed source systems but we would now like to create an OSH version. This can be done using CAD, 3D printing, and various types of sensor including Hall effect sensors placed in gell at the base of the whisker. The project will study the previous designs and improve upon them to create a well documented, low-cost, easy to build OSH system buildable by makers around the world. Advanced projects could also add someware for inferring whisker contact locations using beam theory; analyse the vibrations of the whiskers as in our previous work; or integrate the whiskers onto OpenScout platforms built by other teams.

Video:

https://www.youtube.com/watch?v=GTek0_RQCzE

https://www.youtube.com/watch?v=Dr78I9_U4os

Papers:

Evans, Mat and Fox, Charles W and Pearson, Martin J and Lepora, Nathan F and Prescott, Tony J. *Whisker-object contact speed affects radial distance estimation*. IEEE International Conference on Robotics and Biomimetics, 2010.

Evans, Mat and Fox, Charles W and Pearson, Martin J and Prescott, Tony J. *Spectral template based classification of robotic whisker sensor signals in a floor texture discrimination task*. TAROS2009.

Evans, Mathew H and Fox, Charles W and Lepora, Nathan F and Pearson, Martin J and Sullivan, J Charles and Prescott, Tony J. *The effect of whisker movement on radial distance estimation: a case study in comparative robotics*. Frontiers in neurorobotics 6(12), 2013.

Sample exam question: Describe your own individual work on creating an open source robot whisker system, including equations from the module theory and numerical results testing if theory and practice match. Reflect on your work with a team including how you lead work by helping others and what you would do differently next time having learned from the project. For technical

details of the work, you may refer to a jointly written but non-assessed technical report written as a team.

OpenScout build and extend

Previous MSc students have designed and documented the OSH, 4-wheel, differential drive, OpenScout robot. They have also worked on our OSH R4 interface board, which is a PCB able to interface ROS2 to a variety of standard OSH and other motor drivers and motors. This project will build an OpenScout from components by following the existing documentation, then work to update the design to use R4 to better and more portably control it. Advanced projects might also integrate robot whiskers developed by other teams and/or integrate a standard ROS2 navstack.

OpenScout blog post:

<https://hackaday.com/2022/09/26/robotic-platform-is-open-sourced-and-user-friendly/>

OpenScout Video: <https://www.youtube.com/watch?v=7qVmZeZN1bE>

R4 repo: <https://gitlab.com/charles.fox/r4pcb>

OpenScout repo: <https://github.com/cbedio/OpenScout>

Example assessment question: Describe your own individual work on interfacing an open source control system with an open source mechanical robot, and extending its design, including equations from the module theory and numerical results testing if theory and practice match. Reflect on your work with a team including how you lead work by helping others and what you would do differently next time having learned from the project. For technical details of the work, you may refer to a jointly written but non-assessed technical report written as a team.