Nume cadru didactic: conf. dr. ing. Lucian Busoniu

Nr crt	Titlu	Scurtă descriere	Cerințe	Nivel (licență/master)
1, 2, 3, 4	**Robot, bring me... my glasses: Mixed air and ground assistive teams**	Robots that assist elderly or disabled persons, or even anyone in their day-to-day tasks, can lead to a huge improvement in quality of life. At ROCON we are pursuing domestic mobile manipulators, as well as UAVs for monitoring the persons. Our next goal is to integrate these two platforms into an overall framework that will both monitor the persons and assist them on the ground. This presents a wide range of opportunities for a team of students, starting from low-level vision and control tasks, through sensing and state estimation, to high-level control using machine learning and AI planning tools. Each student will work on one well-defined subtopic in these areas.

Specific tasks include:
- Vision for detecting the position and state of interesting objects in the environment -- such as a light switch, an object to retrieve, or the person being assisted.
- Higher-level sensing and estimation concern tracking persons, objects, or the robot itself along their trajectory as it evolves in time, using filtering and estimation techniques.
- Low-level control includes position and velocity control for the robot arm, UAV, or wheelchair: for example, the robot arm might plan its motion so as to turn off a light switch.
- High-level control concerns the overall assistive task. For example, a UAV might fly so as to keep monitoring a group of persons, or the mobile manipulator may plan its trajectory so as to find and retrieve a lost object.

Initial results, where an asistive mobile manipulator | See to the left. | BSc or MSc (up to 4 students) |

		turns off light switches, are showcased in the demo movie at https://youtu.be/zxb6pLwydfg. Interested students should get in touch with any of the contact persons below to setup a meeting. Apply to this project by contacting advisors Levente Tamas (Levente.Tamas@aut.utcluj.ro) or Lucian Busoniu (lucian@busoniu.net). See also: http://rocon.utcluj.ro		
5, 6	**Vision and control for autonomous UAVs**	A wide variety of UAV tasks involve detecting and tracking an object, and then controlling a desired UAV trajectory relative to this object. Examples include following a person, video inspection of an object in the environment, etc. This project is for a team of at least two students, one working on detection, and the other on control. For example, detection can be enhanced by using the highly nonlinear model of the drone together with a homography mapping to translate the 3D dynamics of the drone into the 2D image frame. Moreover, an Extended Kalman filter or other nonlinear filter will be used for tracking and sensor fusion between the vision information and data from the inertial measurement unit. On the control side, the aim is to design a trajectory-following controller that takes as input the detection result. This can be done either directly with visual servoing on the image, or otherwise by estimating the state of the quadrotor in the real world and controlling it with nonlinear design techniques. This project is connected to an ongoing cooperation with Siemens Germany. Interested students should get in touch one of the contact persons to setup a meeting: Levente.Tamas@aut.utcluj.ro, lucian@busoniu.net, zoltan.nagy@aut.utcluj.ro. See also: http://rocon.utcluj.ro	See to the left.	BSc or MSc (up to 2 students)
7, 8	Optimistic planning	Optimistic planning is a recent approach to the	This project is suitable for students who are	BSc or MSc (up to 2

	for nonlinear control applications	predictive control of nonlinear systems, which optimistically explores the space of action sequences from the current state. Due to generality in the dynamics and objective functions that it can address, it has a wide range of potential applications to problems in nonlinear control. In this project the student will work either on algorithmic developments in optimistic planning, on their real-time application to nonlinear control, or a combination of the two. The application axis includes real-time results for the control of some nonlinear systems available in our lab, such as the Quanser rotational inverted pendulum, the Cyton Gamma robotic arm, the AR.Drone 2 UAV etc. We will start with existing real-time control implementations of optimistic planning methods for discrete and continuous inputs (see https://youtu.be/m9WowzQjk64 for some first, existing results). Apply by contacting Lucian Busoniu (lucian@busoniu.net). See also: http://rocon.utcluj.ro	motivated and able to invest themselves fully. Complementary skillsets are required, so we are looking both for people who are good at C/C++ and Matlab programming, as well as for people who enjoy more analyical, math challenges. A good command of the English language is essential to have access to the literature.	students)
9	Intelligent Sumo Robots	The Sumo Robot contest is an annual event at our faculty. Each year more and more students are interested and join in. In this project, we will start from existing sumo robot hardware (preferably the student's robot!), with the goal of developing better software, so that it could beat more expensive robots by simply being a "smarter" fighter. This will be achieved with a combination of opponent modeling and optimal trajectory control, using machine learning and planning algorithms. Please apply by contacting Lucian Busoniu (lucian@busoniu.net). See: http://rocon.utcluj.ro.	We are looking for a motivated student who is able to efficiently program robots in C on the one hand, and on the other has analytical ability to understand and further develop artificial intelligence techniques.	BSc or MSc