Teme pentru proiecte de diplomă și disertație

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Nr. crt.	Titlul temei	Scurta descriere	Cerințe / Cunoștințe necesare	Nivel (licenta/ master)
1, 2, 3	**Assistive autonomous UAVs**	Robots that assist elderly or disabled persons in their day-to-day tasks can lead to a huge improvement in quality of life. This project employs UAVs to monitor at-risk persons, and research challenges range from real-time observation and observation to high-level vision and control for person monitoring. The project is appropriate for a team of students, each of them working on a well-defined subtask, such as: • Acquiring high-precision position and orientation feedback from a system of indoor cameras. Once this is available, an extended Kalman filter or other nonlinear filter will be used for tracking and fusing camera feedback with information from the intertial measurement unit. • Similar to the above, but this time outdoors to the position and orientation is acquired with lower-precision, but always available on-board cameras. Here, the highly nonlinear model of the drone can be used together with a homography mapping to translate the 3D dynamics of the drone into the 2D image frame, followed by fusion with IMU data as above. • Control design to either navigate to a given sequence of positions, or track a dynamical trajectory. This can be done either with linear techniques in near-hovering mode, or using nonlinear, Takagi Sugeno design. • Compensation of network effects for the control of the drone via the wireless connection • Coordinated control of an outdoor team of UAVs using consensus, flocking, or formation control methods.	Vezi descrierea.	Licenţă sau Master

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		• Vision-based human following and monitoring for risks such as falls. • Cooperative vision-based tracking of one or several at-risk humans. The hardware used consists of five Parrot AR.Drone 2 UAVs and a system of four OptiTrack Flex13 cameras. Initial results, where an UAV tracks a human and detects whether they have fallen, are already available. This direction involves cooperations with the University of Dubrovnik, with the Politechnical University of Timisoara, and industry collaborator Polaris Medical. Interested students should get in touch with any of the contact persons below to setup a meeting. Student skills that are interesting in this project range from fundamental math and control, through C++ and Matlab real-time coding, to high-level vision and planning using ROS		
4, 5, 6	**Assistive robot arms**	Robots that assist elderly or disabled persons in their day-to-day tasks can lead to a huge improvement in quality of life. At ROCON we are pursuing assistive manipulators, as well as UAVs for monitoring at-risk persons. This project focuses on the first direction, and presents a wide range of opportunities for a team of students, starting from low-level control design and vision tasks, to high-level control using artificial intelligence tools. Each student will work on one well-defined subtopic in these areas. Specific tasks include: • Vision for detecting the position and state of the robot arm itself, as well as that of interesting objects in the environment -- such as a light switch, an object to retrieve, or the person being assisted. • Control based on Euler-Lagrange modeling and nonlinear design. • Motion planning, where we focus on so-called active perception: we plan the motion so as to decrease sensing uncertainty about the state of the world. For example, the robot might determine the type of an object by observing it from an optimal sequence of viewpoints.	Vezi descrierea.	Licenţă sau Master

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		• Rehabilitation robotics, where the robot arm is connected to the human arm and helps him to retrain after e.g. a stroke. Initial results, where an asistive mobile manipulator turns off light switches, are showcased in the demo movie below. Current applications we target include domestic robotics, assistive manipulation in industrial settings, and rehabilitation robotics in collaboration with Polaris Medical. Available relevant hardware includes a Cyton Gamma 1500 robot arm, Kinect 3D vision systems, and a OptiTrack 6DOF positioning systems. Interested students should get in touch with any of the contact persons below to setup a meeting. Student skills that are interesting in this project range from fundamental math and control to ROS, C++ and Matlab real-time coding.		
7, 8	**AI planning and learning for nonlinear control applications**	Planning methods for optimal control use a model of the system and the reward function to derive an optimal control strategy. Here we will consider in particular optimistic planning, a recent predictive approach that optimistically explores possible 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. Reinforcement learning methods preserve this generality, and can additionally handle problems in which the model and even the reward function is unknown. In this project the student will work either on fundamental developments in optimistic planning, on their real-time application to nonlinear control, or a combination of the two. Fundamental directions include e.g. novel algorithms for switching, hybrid, and continuous-input systems, analyzing the near-optimality of these methods, as well as the analysis of the stability properties of the optimal or near-optimal solutions. The application axis includes real-time results for the control of some nonlinear systems	Vezi descrierea.	Licenţă sau Master

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		available in our lab, such as the Quanser rotational inverted pendulum or the Cyton Gamma robotic arm. We will start with existing real-time control implementations of optimistic planning methods for discrete and continuous inputs; the movie below shows some existing results. This project is suitable for students who are 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. The project involves a cooperation with the University of Lorraine, Nancy, France, so Erasmus stays there are possible.		
9, 10	**Optimal control of a communicating robot**	Mobile robots typically communicate wirelessly, both to receive commands and to provide sensing data. The range of communication is finite and bandwidth varies with the relative position to base wireless antennas, so communication quality is strongly affected by the trajectory of the robot. However, trajectory control design rarely takes this into account. In this project, we aim to design and study a trajectory control strategy that optimally takes into account communication needs of the robot. In particular, we consider a robot that must navigate while sending a packet of a certain size to the base station. We will consider both the scenario when the transmission rates are known in advance at each position, and when they are not; the latter situation requires machine learning-based control methods. Encouraging simulation results are already available in both scenarios, and the first objective of this project here is to apply the method to a real robot. To this end we will use either a Pioneer robot or a Parrot AR.Drone 2 drone available in the ROCON lab. For a second objective, we are interested in performance guarantees of the scheme. So we are looking for one student with strong programming skills (with robotics and real-time systems experience a plus), and a second student with strong mathematical and analytical skills; or alternately, a single student that can work on both	Vezi descrierea.	Licenţă sau Master

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		objectives. Apply by contacting Lucian Busoniu. This project is a cooperation with the University of Lorraine, Nancy, France and for the analytical part an Erasmus stay at Nancy is possible.		
11, 12	**Observation and control for a power-assisted wheelchair**	This project takes place in the context of a collaboration with the University of Valenciennes, France, involving Professors Thierry-Marie Guerra and Jimmy Lauber, Sami Mohammad at Autonomad Mobility, and PhD student Guoxi Feng. The overall objective is to control the power supplied by the electrical motor of the wheelchair, so as to push (or brake) together with the user without taking over entirely. This ensures that the user can achieve their driving task but still keeps them active. Specific tasks, each of which could be handled by a student, include: • Estimating the forces at the shoulder of a person during his moving in wheelchair. To achieve this goal, an observer has to be designed from a mechanical model of the upper body of the person and from experimentations on a wheelchair. • Estimating the fatigue level of the user, using a fatigue model together with observations of the wheel velocities. • Based on estimated user variables, optimal control of the wheelchair assistance. We use reinforcement learning to compensate the unknown dynamics of the user. We are looking for motivated students, able to invest themselves fully into this project. Familiarity with Matlab programming is mandatory. Erasmus mobilities to France are possible, to work directly at the lab in Valenciennes. Interested students should apply by contacting the persons mentioned below.	Vezi descrierea.	Licenţă sau Master