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|  | **Universitatea Tehnică din Cluj-Napoca****Facultatea de Automatică și Calculatoare**Domeniul: **Ingineria Sistemelor**Programul de studiu: **Automatică și Informatică Aplicată** | **anul universitar: 2017-2018** |

**Teme pentru proiecte de diplomă și disertație**

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| **Nr. crt.** | **Titlul temei** | **Scurta descriere** | **Cerințe /****Cunoștințe necesare** | **Nivel (licenta/ master)** |
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| 1, 2, 3 | **Bosch Future Mobility Challenge** | The main objective of the Bosch Future Mobility Challenge is to have several student teams realize the best performing model vehicle guidance system for different scenarios, which have been derived from requirements arising from a realistic environment. Bosch will provide the model vehicle platforms for the student teams and they will be responsible for the conceptualization and implementation of automated 1:10 scale model vehicles. During the competition, the students will present their know-how in front of judges from industry and academia while competing with other teams. Also, several driving tasks have to be executed as fast and precise as possible. At the end, it is not necessarily that the fastest model vehicle wins. The team with the best overall package of design and driving performance, project planning, and overall arguments wins.Bosch Future Mobility Challenge will take place in the May-June 2018 timeframe, in Cluj-Napoca, Romania. In the ROCON group we are looking for a team of 2-4 excellent and very motivated students to represent us at the competition.  | Vezi descrierea. | Licenţă sau Master |
| 4, 5 | **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.
* 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.
* Coordinated control of an outdoor team of UAVs using consensus, flocking, or formation control methods.
* 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. 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. | Vezi descrierea. | Licenţă sau Master |
| 6, 7 | **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. This project focuses on assistive manipulators, 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:* Control design based on Euler-Lagrange modeling and nonlinear, so-called Takagi Sugeno methods.
* 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.
* 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 already available. We are using a Cyton Gamma 1500 robot arm, as well as a Baxter robot available at Accenture.Student skills that are interesting in this project range from fundamental math and control to ROS, C++ and Matlab real-time coding. | Vezi descrierea. | Licenţă sau Master |
| 8 | **Observation and control for a power-assisted wheelchair**  | This project takes place in the context of a collaboration with the University of Valenciennes, France. 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 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. Experience with mechanical systems is a plus. Erasmus mobilities to France are desirable, to work directly at the lab in Valenciennes.  | Vezi descrierea. | Licenţă sau Master |
| 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 distance from the base station (wireless antenna). In this project, we aim to design a control strategy that optimally takes into account both the navigation and communication needs of the robot. In particular, we consider a robot that must navigate to a goal position while sending a packet of a certain size to the base station. Encouraging simulation results are already available, 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 TurtleBot available at industry partner Accenture, or a Pioneer robot available in the ROCON lab. For a second objective, we are interested in performance guarantees of the scheme, so that full packet transmission and goal reaching are guaranteed. 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 a single student that can work on both objectives. | Vezi descrierea. | Licenţă sau Master |
| 11, 12 | **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. 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 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 results of optimistic planning methods.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.  | Vezi descrierea. | Licenţă sau Master |