TECHNISCHE UNIVERSITÄT MÜNCHEN

Human-centered Assistive Robotics

UNIV.-PROF. DR. GORDON CHENG

October 17, 2022

A D V A N C E D   S E M I N A R
for
student name, Mat.-Nr. matriculation number

The impact of personalization on human robot interaction

Problem description:

Nowadays robots are expected to work alongside and with people. Assistive robotics is a field that aims to develop robots helping humans, especially with disabilities, at their home or in care environments with daily tasks that they cannot do. Because their is a large variety of people characteristics, needs and behaviors, personalization is studied to adapt the robots to different end-users and situations. The aim of this seminar is to make a literature review on methods of personalization and of their impact on human robot interactions (HRI) quality (trust, safety, efficiency,..etc).
Tasks:

- Literature review on the concept of personalization in order to define it [2]
- Read on various methods of personalization and examples of use cases [5] [4]
- Identify the positive and negative impact of personalization for HRI [6] [3] [1]

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TECHNISCHE UNIVERSITÄT MÜNCHEN
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UNIV.-PROF. DR. GORDON CHENG

October 26, 2022

A D V A N C E D   S E M I N A R
for
Student's name, Mat.-Nr. XXXXXXX

A review on Feedback Motion Planning approaches for reactive motion generation and control

Problem description:

The majority of robotic applications consist in essence of two main modules: a Motion generation loop that outputs a desired motion plan according to a pre-defined path and a timing law, and a control loop (e.g Impedance Control) used to follow this motion plan. Traditionally, the motion generation loop is programmed to output a trajectory parameterized with time, and therefore is completely decoupled from the control loop and the actual robot dynamics. This can certainly pose some problems in dynamic environments, and therefore, an alternative solution proposed in the literature is the concept of feedback motion planning where motion generation is reactive, in the sense that the planner continuously receives a feedback of the robot state, which is taken into consideration for planning the next robot action. Feedback motion planning can be realized in various forms, for example the well known concept of potential fields [2] where the robot motion is shaped according to the gradient of a conservative potential designed based on the given application. Another common example in the literature is the idea of first order Dynamical systems [3] commonly used to model robotic tasks and often deployed in learning from demonstration [1] and reinforcement learning [4]. In this HS, your tasks are:

- Understand the concept of feedback motion planning
- Conduct a literature research on the various related works
- Identify the limitations of the proposed works, and possible future improvements.

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October 26, 2022

A D V A N C E D   S E M I N A R
for
Student's name, Mat.-Nr. XXXXXXX

A review on learning-based shared control approaches for collaborative human robot task execution

Problem description:

Despite the recent advancements in robot motion planning and control, teleoperation is still a viable solution in domains that consist of delicate or dynamic environments, or can benefit from the human cognitive and problem solving abilities. To that end, the notion of Shared Control (SC) was introduced and proved to be useful in many applications. The basic idea in SC is that a human is assisted with an autonomous agent that encodes some form of task knowledge, thereby reducing the operator workload and facilitating task execution. For instance, SC can be used to guide the human along a desired path, avoid certain areas of the environment (forbidden region virtual fixtures) [2] and reach optimal grasping poses [1]. Recently, with the increasing popularity of machine learning, Learning strategies such learning from demonstration and reinforcement learning has been introduced for the design of shared control techniques, where task knowledge is obtained through demonstrations provided by an expert, which are then encoded by a regression model that can be adequately deployed to guide a novice user achieve the desired task e.g [4, 3]. In this HS, your task is

- Understand the concept of Shared Control and the various SC architectures
- A literature review on the shared control approaches that deploy learning (supervised or not) and the scope of their applications
- Identify the limitations of the proposed works, and possible future improvements.

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October 18, 2022

A D V A N C E D S E M I N A R
for
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Threshold definition for biofeedback for improved postural control and the role of limits of stability - A systematic review

Problem description:

Vibrotactile biofeedback can facilitate postural control in not only healthy young and old adults[5], but also e.g. in patients with vestibular disorders [7]. Feedback is usually given as soon as a certain threshold is exceeded [7]. However, there is no consensus about how to define the threshold. It is often defined by parameters assessed during quiet standing, such as positional or spatio-temporal parameters of the trunk or center of pressure [2, 4, 8, 6]. However, body sway during bipedal quiet standing is usually greater in anterior-posterior direction, while the functional limits of stability (LoS) are narrower in anterior-posterior direction [1, 3]. Thus, a LoS may be a better parameter to represent postural instability [1, 3]. Though, there is still no standardized threshold definition and no recommendations for the application in different situations and medical conditions. Furthermore, to be able to approach a LoS-based threshold by only assessing quiet standing, e.g. in individuals who are restricted in performing the limits of stability, knowledge about the relationship of the LoS and body sway during quiet standing for different age groups and medical conditions is required. Therefore, your task will be the following:

- Conduct a systematic review on the threshold definition of vibrotactile biofeedback for improved postural control and the relationship of limits of stability and quiet standing in different age groups and medical conditions
- Document your procedure
- Provide an overview of used sensor, position of sensors and feedback, used input parameters for feedback, threshold definition, outcome parameters, target group and results with respect to balance improvement
- Evaluate and discuss existing approaches with respect to static and dynamic balance, different age groups and medical conditions

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