TECHNISCHE UNIVERSITÄT MÜNCHEN
INSTITUTE OF AUTOMATIC CONTROL ENGINEERING
ORDINARIUS: UNIV.-PROF. DR.-ING./UNIV. TOKIO MARTIN BUSS

Advanced Seminar Autonomous System

Procedure:

The advanced seminar consists of the following events, which will be announced on TUM-online:

1. Kick-Off Meeting: presentation of individual topics and description of the schedule for the advanced seminar.
2. Presentation techniques seminar: participants will be given advice and suggestions on presentation techniques, i.e. how to give scientific talks.
3. Report submission: submission of the final report, presentation and electronic copies of all publications read during the advanced seminar.
4. Final presentation: each participant has to present the results of his advanced seminar.

Participation in all events is a requirement for successful completion of the advanced seminar. Participation will be documented by means of an attendance list.

Final report submission:

A printed copy of the report and a CD have to be submitted to Miss Renner (Room N2515). The CD must contain the presentation, report and all relevant scientific material. Thus, the presentation must be finished by the deadline. The report should be about 10 pages (title page, table of contents and bibliography excluded) and must be written using LaTeX or word. The supervisor should give you the template for the presentation and the report. The second page of the report has to contain the assigned topic sheet. The report should only be stapled two times on the left side (no spiral or adhesive binding).

The CD should be composed of two directories: Documents and Presentation. In the documents directory, either a Microsoft word document or all Latex files (including images) should be present as a zip file. In addition, a pdf copy of the report should also be present in this directory. The presentation directory should contain a PowerPoint presentation or a pdf version. All relevant (electronic) references have to be saved on the CD as a zip file entitled „references".

Final presentation:

The duration of the final presentation is 10 minutes. The presentation format/style can be based on obtained from the supervisor. After a 5 minutes discussion will take place in which everyone should actively participate. The contribution to the discussion is included in the final grade. It is compulsory to attend all presentations.

Grading:

The grading of the advanced seminar is based on the template attached below. In the assessment contains various criterion related to the preparation of the advanced seminar, the final report, presentation and participation during the discussion session.

I. Preperation phase

Nr.	Criteria	Grade
1	**Introduction:** understanding and overview given the difficulty of the task	
2	**Own Contribution:** creativity, Richness of ideas, initiative, self organization and decisiveness	

3	**Organization:** organization, time management, persistence and Diligence	
4	**Scientific Work:** rigor, systematic approach, analysis of results	

II. Written report (Documentation)

5	**Formatting:** structure, completeness, sources Formatting and graphic design	
6	**Didactics:** style, expression, comprehension, conciseness of pictures and diagrams	
7	**Scientific Content:** technical correctness, discussion and evaluation of results	

III. Participation

8	**Active participation:** Discussion during presentations	

IV. Final presentation

7	**Technical content:** scientific content, classification and evaluation, discussion	
8	**Presentation:** presentation style, time discipline, slides and videos etc.	

Role of Supervisors:

The supervisor is the reference person in case of any inquiries. Together with the supervisor you agree on the specifics of the topic and the expectations. The supervisor supports you in technical matters, final report and presentation of the results. If desired students can give their presentations prior to the final presentations in order to get some feedback concerning style and content. Your supervisor also shows you the workstations available for students and can introduce you to the computer programs required to complete the seminar.

It is necessary that the written report and the final presentation be submitted to the supervisor at least 1 week before the deadline.

Literature research:

The literature review should be carried out independently. Your supervisor will support you by providing appropriate reference books and scientific papers. In order to facilitate your introduction to the topic, your supervisor also provides a list of introductory articles. In addition the central library as well as the institute's library can be used.

Regulations for absence:

There are strict regulations concerning unexcused absence from the advanced seminar. Unexcused absence in any of the advanced seminar events will lead to failure in the course. In case of illness, a doctor's certificate must be presented. Overlap with other courses is not a sufficient excuse, because in this case a decision must be made in favor of one course at the beginning of the semester.

Timetable:

Events	Date	Time
Kick-off meeting	02.05.2017	12:30 – 14:00 (5016@2906)
Lecture on presentation techniques	09.05.2017	9:00 – 11:00 (N0507)
Registration deadline	30.09.2017	23:59 (TUM Online)
Final report submission	07.07.2017	12:00 (Ms. Renner / N2515)
Final presentations	12.07.2017	09:00 – 10:30 (5016@2906)

* 5016@2906 is a seminar room (5016) on the fifth floor in Karlstr. 45, München.

19.04.2017

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I have read and acknowledge the above information and guidelines for the advanced seminar:

Matriculation number: ____________________

First Name, Last Name: ______________________________

Date: ____________________

Signature: ______________________________

14.10.2017

ADVANCED SEMINAR

Challenges encountered in teleoperation

Problem description:

Teleoperation means remotely controlling a robot/machine by a human operator. Teleoperation is useful when it is impossible to co-locate a human operator with a robot. Examples include nuclear waste handling, deep sea manipulation and space applications. The human operator acts based on the sensory feedback, for instance video of the installed cameras around the robot or haptic feedback. There are several challenges which arises when teleoperating a robot as compared with direct manipulation by an operator [1]. Some of the most common issues are transmission delays, safety of the robot or environment, limited perception for the operator etc
In this seminar work the student will:

- Study different problem that are commonly encountered in teleoperation.
- Identify the existing solutions that have been developed to tackle those problems.

Bibliography:

[1] Kuan, Cheng-Peng, and Kuu-young Young. "Challenges in VR-based robot teleoperation." Robotics and Automation, 2003. Proceedings. ICRA 03. IEEE International Conference on. Vol. 3. IEEE, 2003.

Supervisor: M.Sc. Affan Pervez

(D. Lee)
Univ.-Professor

TECHNISCHE UNIVERSITÄT MÜNCHEN

LEHRSTUHL FÜR STEUERUNGS- UND REGELUNGSTECHNIK

ORDINARIUS: UNIV.-PROF. DR.-ING./UNIV. TOKIO MARTIN BUSS

14.04.2017

ADVANCED SEMINAR

Role of Lower Limb Elasticity in Human locomotion

Problem Description:

A simple model of an inverted pendulum at intermediate walking speeds (<7km/h), can match the data obtained from experimental walking [1]. Pandy et al. showed that the M shaped vertical ground reaction force obtained during walking cannot be replicated by these inverted pendulum models [2]. Weber et al. and Lee et al. [3] suggested that the center of mass undergoes lower amplitudes as shown by the inverted pendulum model. Seyfarth et al. with his bipedal energy conserving SLIP model showed that making the legs compliant helped in obtaining similar force profiles during. This model apart from predicting the center of motion also provided a strong correlation with the sagittal plane ground reaction forces. These studies showed that leg compliancy and the deflection of center of mass under gravity are a major influence on the trajectory of center of mass in terrestrial locomotion.

In this seminar the student will:

- Carry out a literature survey about the basic locomotion models used to understand human walking and the effects of lower limb compliance.

BIBLIOGRAPHY

[1] A. Z. G.A. Cavagna, H. Thys, “The sources of external work in level walking wand running,” *J. Physiol.*, vol. 262, no. 3, pp. 639–657, 1976.

[2] M. G. Pandy, “Simple and complex models for studying muscle function in walking,” *Philos. Trans. R. Soc. B*, vol. 358, no. 1437, pp. 1501–1509, 2003.

[3] C. R. Lee and C. T. Farley, “DETERMINANTS OF THE CENTER OF MASS TRAJECTORY IN HUMAN WALKING AND RUNNING,” vol. 2944, pp. 2935–2944, 1998.

SUPERVISOR: M.Sc. Karna Potwar

D. Lee
(Univ. Professor)

TECHNISCHE UNIVERSITÄT MÜNCHEN
LEHRSTUHL FÜR STEUERUNGS- UND REGELUNGSTECHNIK
UNIV.-PROF. DONGHEUI LEE

14 April 2017

A D V A N C E D   S E M I N A R
for
xx, Mat.-Nr. xx

Fast Reinforcement Learning in Robotics

Problem description:

Robots that learn novel tasks by self-practice have the chance to be exploited in a wide range of situations, including industrial and social applications. Reinforcement Learning allows a robotic agent to learn novel tasks by self-practice [1]. In order to effectively apply RL in robotics, one of the most important challenges is to increase data efficiency and consequently to reduce the number of performed trials (rollouts) on real devices.

In this Advanced Seminar, we aim at investigating fast reinforcement learning algorithms [2, 3, 4]. These algorithms need relatively few rollouts to find an optimal control policy and execute novel tasks. Considering advantages and disadvantages of fast RL algorithms, the student will come up with the most promising approach(es) for robotics applications.

Bibliography:

[1] J. Kober, J. A. Bagnell, and J. Peters. PILCO: A Model-based and Data-Efficient Approach to Policy Search, in *International Journal of Robotics Research*, 2013.
[2] M. P. Deisenroth and C. E. Rasmussen. PILCO: A Model-based and Data-Efficient Approach to Policy Search, in *International Conference on Machine Learning*, 2011.
[3] J. Takeuchi and H. Tsujino. One-Shot Supervised Reinforcement Learning for Multi-targeted Tasks: RL-SAS, in *Artificial Neural Networks*, 2010.
[4] J. Fu, S. Levine and P. Abbeel. One-Shot Learning of Manipulation Skills with Online Dynamics Adaptation and Neural Network Priors, in *Arxiv Preprint*, 2015.

Supervisor: M. Sc. Matteo Saveriano

(D. Lee)
Carl-von-Linde Fellow

TECHNISCHE UNIVERSITÄT MÜNCHEN
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April 13, 2017

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

Deep Reinforcement Learning for Robotic Grasping and Manipulation

Problem description:

The generation of motion for robotic manipulators in unstructured, dynamic environments has been a key research topic in the last years. Nevertheless, due to the high complexity of the problem, a ultimate solution has not been defined and the issue is far to be solved. In order to tackle uncertainties and unexpected events, several methods and diverse scientific communities have contributed to the development of artificial cognitive systems that aim at working in unknown, dynamic environments. Such methods include classical control theory, optimal control, machine learning, and perception based motion planning. Recently, approaches based on deep reinforcement learning have been proposed [1]. The objective of the advanced seminar is to carry out a literature research on deep reinforcement learning approaches proposed specifically for robotic grasping and manipulation.
Task:

- literature research on deep reinforcement learning approaches proposed specifically for robotic grasp and manipulation

Bibliography:

[1] Sergey Levine, Chelsea Finn, Trevor Darrell, and Pieter Abbeel. End-to-end training of deep visuomotor policies. *Journal of Machine Learning Research*, 17(39):1–40, 2016.

Supervisor: Dr. Pietro Falco

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April 2017

A D V A N C E D   S E M I N A R

Hybrid Dynamical Systems

Problem description:

Many practical systems cannot be explained by a continuous dynamical system. For example, the velocity of a rigid body becomes discontinuous in the collision with other rigid bodies, an electrical switch induces discontinuity in the flow of the current, and a discontinuous control law like sliding mode control makes the feedback system discontinuous. Hybrid dynamical systems or hybrid systems combine continuous dymanical systems with discrete dynamical systems to model such complicated behaviors. Consequently, hybrid systems can cover a large class of practical systems that have both continuous and discrete behaviors. However, this generalization requires to extend theories for classical systems like existence and uniqueness of solutions, dependence on initial conditions, stability, robustness, invariance, etc [1]. In this advanced seminar, an elementary study of the hybrid dynamical systems will be carried out.

- Literature survey of the hybrid dynamical systems
- Documentation

Bibliography:

[1] R. Goebel, R. Sanfelice, A. Teel, "Hybrid Dynamical Systems," In *IEEE Control Systems*, 2009

Supervisor: M. Sc. Sang-ik An

(D. Lee)
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TECHNISCHE UNIVERSITÄT MÜNCHEN
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UNIV.-PROF. DR.-ING./UNIV. TOKIO MARTIN BUSS

October 12, 2016

A D V A N C E D   S E M I N A R
for
xxx, Mat.-Nr. xxx

Image segmentation using deep learning method

Problem description:

Robots can learn certain tasks by observing human demonstration. To understand the observation from image data, hand segmentation plays a key role. Especially, as the hand is in contact with other skin-colored objects, conventional pixel based classification method can fail in this case.
Recently, deep learning based method achieved state-of-the-art performance for semantic segmentation task [2] [3] [1]. Using convolutional layers, classification result of each pixel depends on the context information of the whole image. This could potentially solve the above mentioned issue with skin-clored objects.
The goal of this advanced seminar is to i) carry a literature research concerning semantic segmentation using deep learning method. ii) describe these methods and compare them by stating advantages and disadvantages. iii) identify a suitable solution for hand segmentation from hand-object-interaction scenario.

Bibliography:

[1] Liang-Chieh Chen, George Papandreou, Iasonas Kokkinos, Kevin Murphy, and Alan L Yuille. Deeplab: Semantic image segmentation with deep convolutional nets, atrous convolution, and fully connected crfs. *arXiv preprint arXiv:1606.00915*, 2016.
[2] Jonathan Long, Evan Shelhamer, and Trevor Darrell. Fully convolutional networks for semantic segmentation. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pages 3431–3440, 2015.
[3] Hyeonwoo Noh, Seunghoon Hong, and Bohyung Han. Learning deconvolution network for semantic segmentation. In *Proceedings of the IEEE International Conference on Computer Vision*, pages 1520–1528, 2015.

Supervisor: M. Sc. Shile Li

(D. Lee)
Professor