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| 9:00-09:05 | Welcome by Dr. Hannemor Keidel, TUM Delegate officer for the scientific exchange with France |  |
| 09:05-09:35 | Justin Carpentier, INRIA | **Towards Online Optimal Control of Legged Robots** Abstract:Locomotion of legged robots is a complex process involving highly-dynamic and non-holonomic physical quantities. In particular, the correct synchronization of these quantities is required to produce a balanced and efficient motion on the real hardware. Over the past few years, optimal control appears as the magic toolbox to compute feasible actions that fulfil all these requirements. In this talk, I will introduce and discuss some recent contributions made in this field with the aim of driving the locomotion of legged systems towards highly-dynamic movements. I will further investigate the reasons for this success and introduce some of my recent contributions in this field. I will conclude with some personal research perspectives. |
| 09:35-10:05 | Atabak Nejadfard, TU Kaiserslautern | **Design of a biarticular actuation and its implications to bipedal locomotion** Abstract: Muscular structure of the human body has a fundamental influence on the efficiency of locomotion. We present a compliant robotic leg (CARL) inspired by the characteristics of the human musculoskeletal system. As part of CARL, we introduce an efficient actuation system RRLAB-SEA that is developed to emulate biological muscles. Our leg is designed to replicate the structural characteristics of the human musculoskeletal system. Biarticular actuators are used to adopt the muscle redundancy of a human body. This architecture enables a better distribution of actuation mass over the leg, with heavier actuators located closer to the trunk. We introduce the design challenges of such an actuation system adopting to the moment arm profiles of a human leg. The redundancy of biarticular actuators can be used to reduce the consumption of negative mechanical energy and henceforth help increasing the overall efficiency of movements. |
| 10:05-10:35 | Coffee break |  |
| 10:35-11:05 | Jean-Baptiste Mouret, INRIA  | **Whole body control with imperfect models and learning** Abstract: The current whole-body control approaches are successful at controlling modern humanoids, but they still require a tedious trial-and-error process to tune both the tasks and the model. In addition, they assume that the model does not change over time (e.g., damage, unexpected event). In our work, we aim at relaxing the need for a near-perfect model by leveraging reinforcement learning algorithms and/or gradient-free optimizers. In this talk, we will introduce our whole-body controller for iCub and show our progresses regarding tele-operation, online adaptation to imperfect models, and offline tuning for robustness to differences in the models. |
| 11:05-11:35 | Sven Behnke, University of Bonn | **Flexible Driving-stepping Locomotion and Human-like Manipulation for Disaster Response”** Flexible Driving-stepping Locomotion and Human-like Manipulation for Disaster Response Abstract: Events like the Fukushima earth quake and tsunami demonstrate that today’s disaster-response robots lack capabilities in mobility and manipulation which would be needed for effective intervention, e.g. in a damaged nuclear power plant. To advance the state of the art in disaster-response robotics, DARPA held in 2015 its Robotics Challenge, where robots had to solve a variety of tasks relevant for affected man-made environments. For this challenge, our team developed the mobile manipulation robot Momaro. Using a hybrid wheeled-legged base, it is capable of omnidirectional driving, can adapt to the terrain, and overcomes obstacles by making steps. The robot is equipped with an anthropomorphic upper body for human-like manipulation. In the H2020 project CENTAURO, the Centauro robot was developed, which follows the same concept. Using an immersive teleoperation interface, Momaro demonstrated several disaster-response tasks at the DARPA Robotics Challenge, where our team NimbRo came in as best European team. We also developed autonomous navigation and manipulation behaviors for Momaro, which were demonstrated at the DLR SpaceBot Camp 2015. The Centauro robot demonstrated several complex locomotion and manipulation tasks in two evaluation campaigns which took place at the premises of the CENTAURO application partner Kerntechnische Hilfsdienst GmbH. |
| 12:05-12:35 | Mirko Wächter, Karlsruhe Institute for Technology | **ARMAR-6: A Collaborative Humanoid Robot for Maintenance Tasks in Industrial Environments** Abstract: We present the collaborative humanoid robot ARMAR-6, which has been developed to perform a wide variety of complex maintenance tasks in industrial environments, collaborating with human workers. We present the hardware, software, and functional architecture of the robot as well as its current abilities. Those include the recognition of the need of help of a human worker, the execution of maintenance plans, compliant bimanual manipulation, vision-based grasping, fluent object handover, human activity recognition, natural dialog, navigation and more. |
| 11:35-12:05 | Pierre-Brice Wieber, INRIA | **Can we expect cheaper legged robots?** Abstract: Biped and quadruped robots are beginning now to master the skill of walking dynamically in most standard situations, but this currently requires very precise and expensive sensors, very precise and expensive actuators, and very fast and expensive electronics and computers, resulting in terribly expensive robots. This is because the dynamics of the Center of Mass (CoM) of these robots over the feet resting on the ground is unstable, and therefore very sensitive to all sources of uncertainties. However, how fast and precise, and therefore how expensive should the sensors, actuators and electronics be has never been investigated in the existing scientific literature. A precise quantification of the effect of uncertainties and sampling period on legged balance control seems to be missing, and it is the goal of this talk to initiate this discussion. |
| 12:35-14:00 | Lunch with posters  |  |
| 14:45- 16:00 | labtour at DLR | workshop finishes at DLR around 16:00 |