UNIVERSITÀ DI PISA

DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

Dottorato di Ricerca in Ingegneria dell'Informazione

Doctoral Course

"Short course on humanoid robots: modeling, planning and control"

Prof. Marilena Vendittelli

Sapienza University of Rome - Italy

Short Abstract: Aim of this short course is to introduce basic notions and methodologies for modeling and control humanoid robots. Starting from the analysis of biped locomotion dynamics and the most popular approaches to walking motion generation, the course will also tackle the problem of generating motion of the whole humanoid body for accomplishing both locomotion and manipulation tasks. State of the art techniques for whole-body motion generation, possibly taking into account the presence of obstacles, will be illustrated. The concluding lectures of the course will deal with problems related to the interaction of humanoids with the real world recently challenging the robotics community.

Course Contents in brief:

- Humanoid robots timeline
- The dynamics of biped locomotion
    - Lagrangian dynamics and Newton-Euler equations of motion
    - contact modeling
    - stability analysis
- Generation of walking motion
    - ZMP-based
    - The Model Predictive Control approach
    - Capturability-based
- Whole-body motion generation
- Whole-body contact detection, force estimation and reaction strategies
- Motion planning
    - Footstep planning
    - Whole-body collision free motion generation

    - Task-driven whole-body motion generation
- Vision-based state estimation and control
    - Localization
    - Locomotion
    - Task execution

Total # of hours: 20

References:

[1] Pierre-Brice Wieber, Russ Tedrake, and Scott Kuindersma. Modeling and control of legged robots. In Bruno Siciliano and Oussama Khatib, editors, *Springer Handbook of Robotics, 2nd Ed*, chapter 48. Springer, 2015.

[2] Motion Planning for Humanoid Robots, Kensuke Harada, Eiichi Yoshida, Kazuhito Yokoi, editors, Springer, 2010.

CV of the Teacher

Marilena Vendittelli received the Ph.D. in Systems Engineering from Sapienza University of Rome in 1997. She worked at LAAS-CNRS in Toulouse, France, as a post-doc in 1997-98, funded by a Marie Curie Fellowship. She is currently an assistant professor at the Department of Department of Computer, Control, and Management Engineering. Her research interests are in robot motion planning and control, with emphasis on non-holonomic and redundant systems, navigation and perception for wheeled mobile robots and humanoids, physical human-robot interaction. She has been an Associate Editor of the IEEE Transactions on Robotics (2010-13).

Room and Schedule

Room: *Aula Riunioni del Dipartimento di Ingegneria dell'Informazione, Largo Lucio Lazzarino 2, Pisa*

Schedule:

Start: November 2015

- Lunedì 16 Novembre ore 15.30-17.30
- Martedì 17 Novembre ore 09.30-12.30
- Martedì 24 Novembre ore 09.30-12.30
- Mercoledì 25 Novembre ore 09.30-11.30
- Lunedì 30 Novembre ore 15.30-17.30
- Martedì 01 Dicembre ore 09.30-12.30
- Lunedì 14 Dicembre ore 15.30-17.30
- Martedì 15 Dicembre ore 09.30-12.30