



Tuesday the 29 January 2019 at 15:00
Politecnico di Torino, DISMA, Aula Buzano (third floor)

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Microswimmers robots and their control

Prof. Davide Carlo Ambrosi introduces the seminar

Abstract

Controlling artificial devices that mimic the motion of real microorganisms, is attracting increasing interest, both from the mathematical point of view and applications.

In this talk, Dr Zoppello will present two micro-swimmer systems driven either by internal variables control or external forces. The first one is a model for a magnetically driven slender micro-swimmer, which mimic a sperm cell. Using the well known Resistive Force Theory (RTF) approach to describe the hydrodynamic forces, the micro-swimmer can be described by a driftless affine control system, where the control is an external magnetic field. In particular, Dr Zoppello will focus on the Purcell swimmer system, whose segments are magnetised and react to an external magnetic field applied to the fluid. By an asymptotic analysis, she will prove that it is possible to steer the swimmer along a chosen direction when the control functions are prescribed as an oscillating field.

The second system on which Dr Zoppello will focus is the scallop one. She will present a strategy to overcome the scallop theorem present in literature. She will focus on how to obtain a net motion and consequently controllability, exploiting the fluid's type change during a periodic deformation. The change is linked to the sign of the angular velocity of opening and closure of the valves. An interesting feature of the latter model is the introduction of a delay-switching rule through a thermostat. Dr Zoppello will remark that the latter is fundamental to get both forward and backward motion and therefore global controllability.

1. F. Alouges, A. DeSimone, L. Giraldi, and M. Zoppello, *International Journal of Non-Linear Mechanics*, 56: 132-141 November (2013).
2. L. Giraldi, P. Martinon, M. Zoppello, *Physical Review E* 91, 023012 (2015).
3. F. Bagagiolo, R. Maggiro, M. Zoppello, *Meccanica* 52(14): 3499-3511(2017).

Biography

Marta Zoppello is a post-doc in Mathematical Physics at the University of Padova. She received her PhD in Mathematics from the University of Padova, Italy, in 2016. From 2016, she made a one-year post-doc in mathematics at University of Trento and a two-years of post-doc in Mathematics at University of Padova. Her research interests are interdisciplinary. During the PhD thesis she studied geometric control theory and optimal control applied to deformable bodies immersed in a fluid. During the post-doc in Trento, she studied controllability properties of systems with hysteresis and optimal control problems on networks. Now she is exploring the controllability and optimal control issues of nonholonomic dynamical systems.

Save the date for the next event: February 05, 2019

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