# **CONFERENCESCIPICS.com** JOINT EVENT

2<sup>nd</sup> International Conference on **Design and Production Engineering** & International Conference on

Mechatronics, Automation and Smart Materials

November 13-14, 2017 Paris, France



# **Christian Duriez**

INRIA, France

#### Soft-robots: Modeling, simulation and control

Soft robotics is bringing a renewal of robot design: future robots will no longer be rigid, but made of complex deformable Structures, composed of stiff and soft regions, close to organic materials that we can find in the nature. Soft robotics opens attractive perspectives in terms of mechatronic integration of smart soft materials, new applications, and reduction of manufacturing costs, robustness, efficiency and security. It could constitute a great jump in robotics in the following years, with applications in surgery, medicine, domestic robotics, game, arts. But traditional control methods do not fully apply to such robots, which are theoretically composed of an infinite number of degrees of freedom. New control strategies and models need to be found. Our team has recently focused on providing numerical methods and software support to reach the real time constraint needed by robotic systems. We have demonstrated that we can use finite element method (FEM) to compute deformations in real-time, in order to capture the behavior of these soft robots. We can also simulate their interaction with their environment, and in particular to anticipate the additional deformations created by the contact with the obstacles. Finally, in soft-robotics, sensing, actuation and motion are coupled by the deformations. We have proposed new strategies in which the deformable models are placed at the heart of the control algorithm design. This presentation will also include some demonstrations and will outline some application perspectives of these soft robots.



Example of trunk like soft robot, actuated with cables. The FEM simulation (bottom) is used to pilot the robot in its environment (up)

#### **Recent Publications**

- 1. Coevoet E, Escande A and Duriez C (2017) Optimization-based inverse model of soft robots with contact handling. IEEE Robotics and Automation Letters 2(3):1413-1419.
- 2. Duriez C and Bieze T (2017) Soft robot modeling, simulation and control in real-time. Soft Robotics: Trends, Applications and Challenges DOI: https://doi.org/10.1007/978-3-319-46460-2\_13 Springer International Publishing.

## **CONFERENCESCIPICS.com** JOINT EVENT

2<sup>nd</sup> International Conference on

### Design and Production Engineering

&

International Conference on

### Mechatronics, Automation and Smart Materials

November 13-14, 2017 Paris, France

 Faure F, Duriez C, Delingette H, Allard J and Cotin S (2012) Sofa: A multi-model framework for interactive physical simulation. Soft Tissue Biomechanical Modeling for Computer Assisted Surgery DOI: 10.1007/8415\_2012\_125. Springer Berlin Heidelberg

#### Biography

Christian Duriez received his Engineering Degree in Lille, France and a PhD degree in robotics from University of Evry, France. His thesis work was realized at CEA/LIST followed by a Postdoctoral position at the CIMIT SimGroup in Boston. He arrived at INRIA in 2006 to work on interactive simulation of deformable objects and haptic rendering. In 2009, he was the Vice-Head of SHACRA team and focus on surgical simulation. He is now the Head of DEFROST team, created in January 2015. His research topics are soft robot models and control, fast finite element methods, simulation of contact response and other complex mechanical interactions, new algorithms for haptics. All his research results were developed in SOFA, which is a framework that he co-developed with other INRIA teams. He was one of the Founders of the start-up company InSimo which uses his research results for training future surgeons.

christian.duriez@inria.fr

Notes: