After the defense sessions, a « pot de thèse » is proposed.

Université Paris Nanterre
Site de Ville d'Avray
50, Rue de Sèvres
Ville d'Avray, 92410 France

université Paris Ouest Nanterre La Défense

UNIVERSITÉ PARIS LUMIÈRES

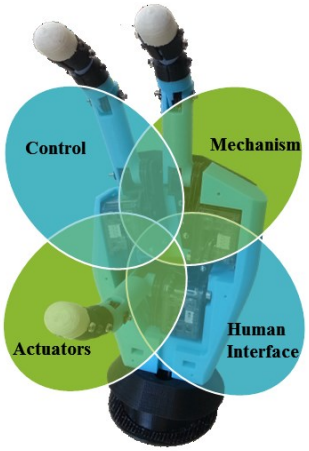
Leme
Laboratoire Energétique Mécanique Electromagnétisme

THESIS DEFENSES

December 9, 2016
Amphithéâtre A1
Universite Paris Nanterre
50, rue de Sèvres
Ville d'Avray 92410

9:00 Am
Jose Luis RAMIREZ ARIAS
Development of an artificial muscle for a soft robotic hand prosthesis

1:00 PM
Astrid RUBIANO FONSECA
Smart control of a soft robotic hand prosthesis



ProMain Project

The ProMain project is developed in collaboration between the LEME laboratory of the Université Paris Nanterre and the LIASD laboratory of the Université Paris 8. The project is funded by Université Paris Lumière.

The project concerns the development of a soft robotic hand prosthesis, which is light and directly connected to the forearm of the amputated patient in a non-intrusive way. Furthermore, surface electromyographic sensors (sEMG) are used to detect and identify the patient's movement intention allowing to control the soft robotic hand in a natural way.

The project is highly multi-disciplinary and concerns several fields; two research axes are identified in the development: i) the control and the human interface and ii) the mechanism and actuation of the hand. These axes are developed into two Ph.D. theses as follows:

- Development of an artificial muscle for a soft robotic hand prosthesis
- Smart control of a soft robotic hand prosthesis

The Ph.D. thesis defenses will be carried out in two sessions at 9:00 Am and at 1:00 Pm

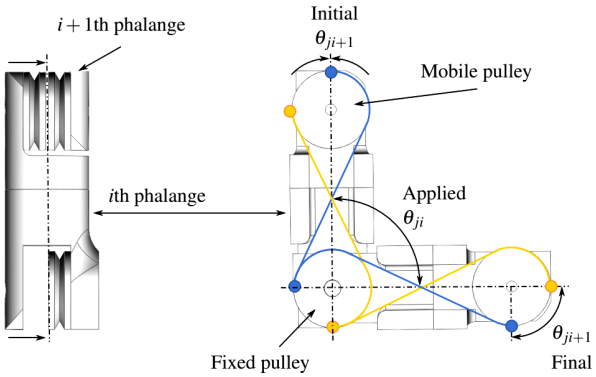
Development of an artificial muscle for a soft robotic hand prosthesis

9:00 Am Jose Luis RAMIREZ ARIAS

Supervisors: **Olivier POLIT**
Laurent GALLIMARD

The central topic of this thesis dissertation is the development of a soft actuation strategy using smart materials for a soft robotic hand prosthesis. Our approach takes into account the different matters of interest that can influence the development of an actuation strategy. Thus, we focus our study in: i) The mechanics and functionality of the human hand ii) The analysis and improvement of the robotic hand mechanism iii) The experimental assessment of the robotic hand prostheses. iv) The development and modeling of an actuation strategy using smart materials.

We introduce a driving mechanism (see image below) that is inspired by the epicyclic gear train but instead of gears we introduce a tendon based mechanical transmission that incorporates a flexible behavior to finger joints. Moreover, we introduce a new hybrid kinematic model (so-called DHKK-SRQ) that improves the representation of rotations that arise from soft robotics. Finally, we introduce a shape memory alloy (SMA) based actuation system and the formulation of a constitutive model for the SMA.



Smart control of a soft robotic hand prosthesis

1:00 Pm Astrid RUBIANO FONSECA

Supervisors: **Olivier POLIT**
Laurent GALLIMARD

The target of this thesis dissertation is to develop a new Smart control of a soft robotic hand prosthesis for the soft robotic hand prosthesis called ProMain Hand.

The friendly intuitive human-hand interaction is developed to facilitate the hand utilization. The human-hand interaction is driven by a controller that uses the superficial electromyography signals measured in the forearm employing a wearable device. The wearable device called MyoArmband (see image below) is placed around the forearm near the elbow joint. Based on the signals transmitted by the wearable device, the beginning of the movement is automatically detected, analyzing entropy behavior of the EMG signals through artificial intelligence. Then, grasping gesture are recognized using a support vector machine classifier.

The soft robotic hand prosthesis is controlled using a hybrid force-position controller, which is designed taking into account the identification of the soft robotic hand.