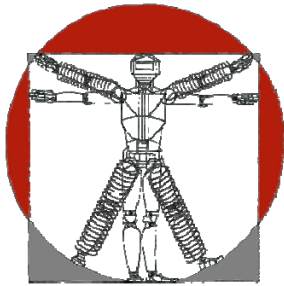


VIATORS
Variable Impedance ACTuation:
systems embodying advanced interaction behaviORS

Embodied Intelligence Workshop
Livorno, 17.03.2010

Alin Albu-Schäffer





Motivation

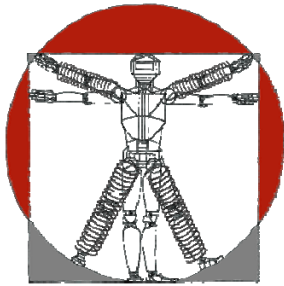


One of today's most advanced humanoids



Human top performance

Substantial part of the human performance is due to intrinsic properties of the musculo/skeletal system – not requiring complex feedback control algorithms

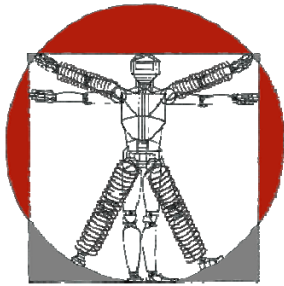


Goals of the Project



Embody in the morphology of the system a substantial amount of local “intelligence”.

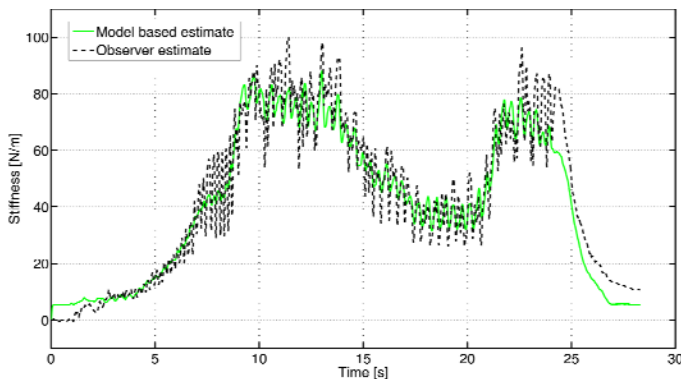
- Study of **biological principles** governing human motion
- Study of the **fundamental physical principles** which can be used for technical realization of VIA actuators
- **Design** and control of Variable Impedance actuators (VIA)
- Apply the new technology to
 - **bipedal locomotion**
 - **rehabilitation robotics**
 - **robotic manipulation**



WP1: Fundamental Principles of VSA

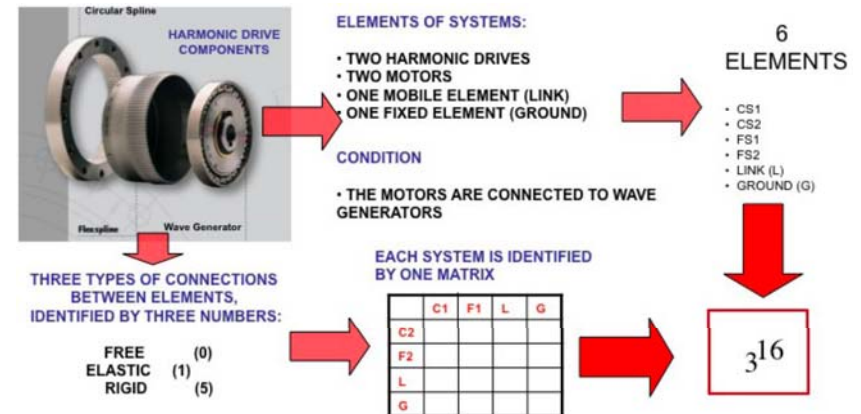


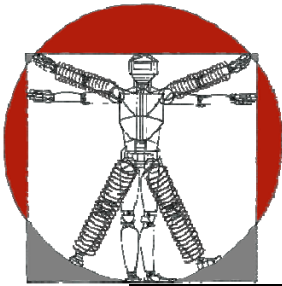
Thorough mathematical definition and measurement methods for human and robot impedance



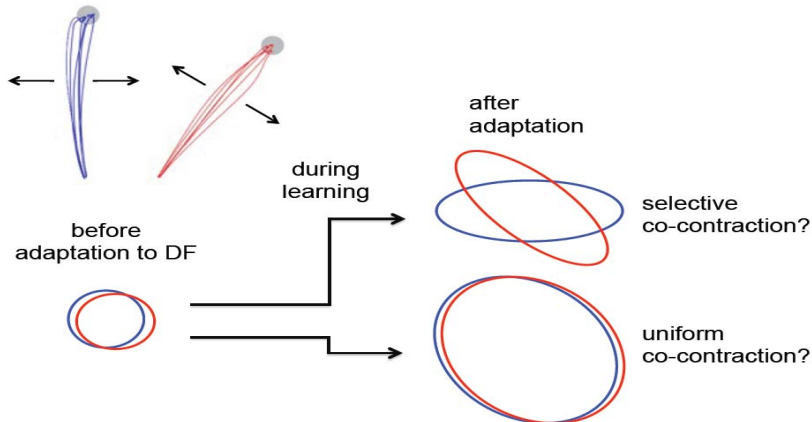
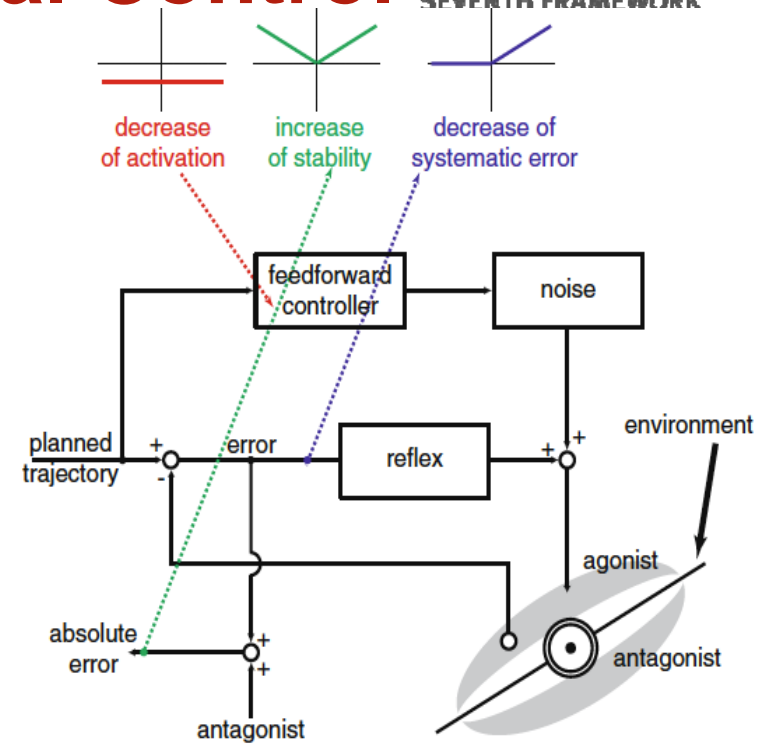
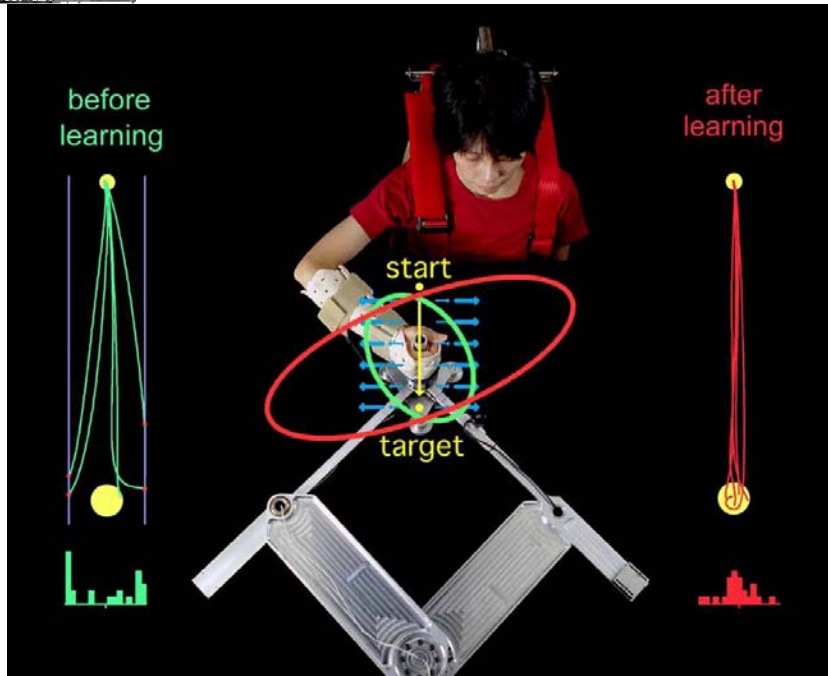
Online accurate stiffness estimator without model related information

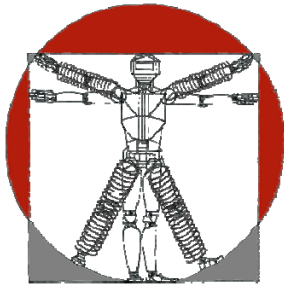
Enumeration based analysis of VSA systems performance.





WP2- Robotics of Biological Neuro-mechanical Control

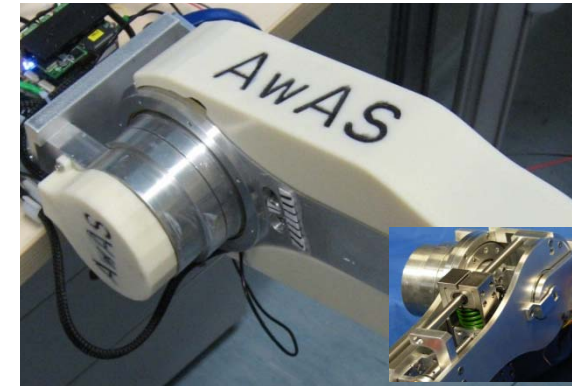




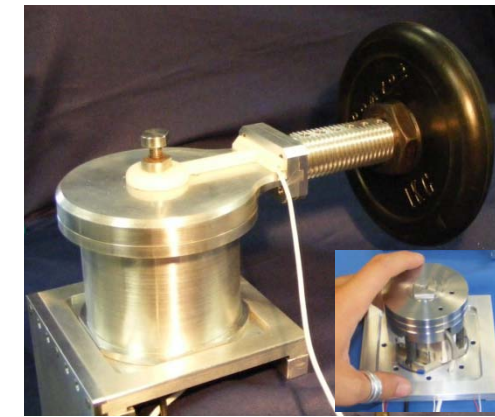
WP3: Actuator design

A large set of very different VIA actuator designs have been designed will evaluated in the applications

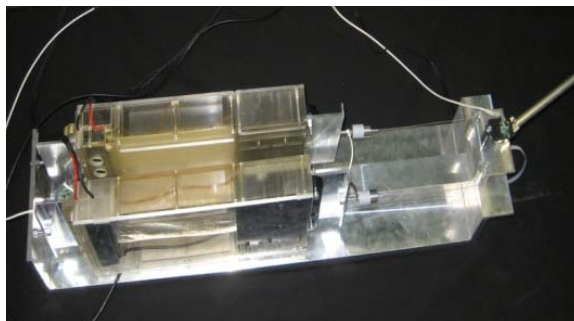
- Robotic Actuators Development
 - Conventional electromechanical actuators
 - Novel Actuators



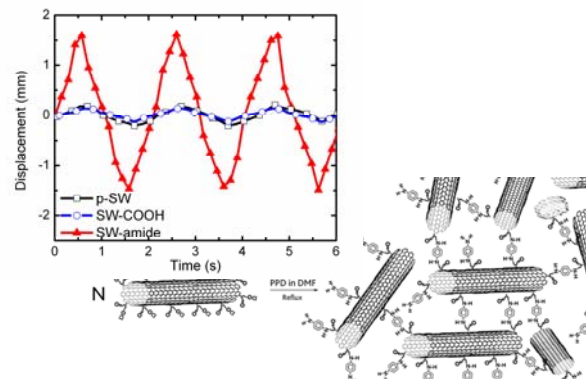
Adjustable Stiffness



Variable Physical Damping



Dielectric Elastomere antagonistic joint



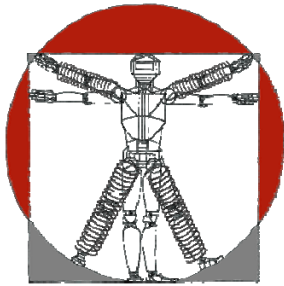
SW-amide Carbon Nanotube actuator



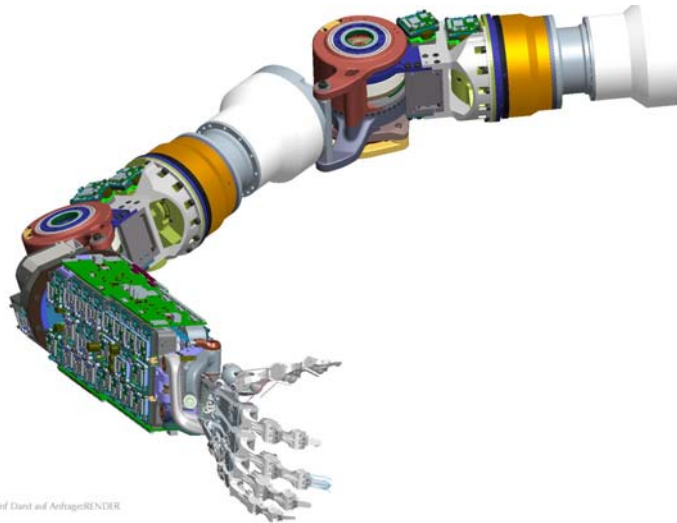
Pneumatic muscle

24/03/2010

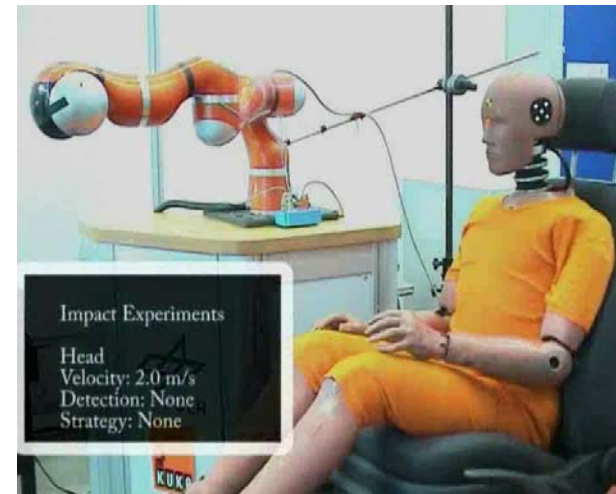
VIATORS meeting



WP4 - Skilful Manipulation with Variable Impedance Robots

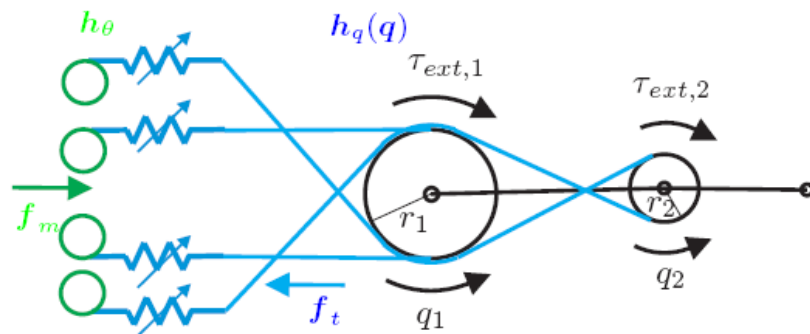


©f Daimler and AntrageRENDOR



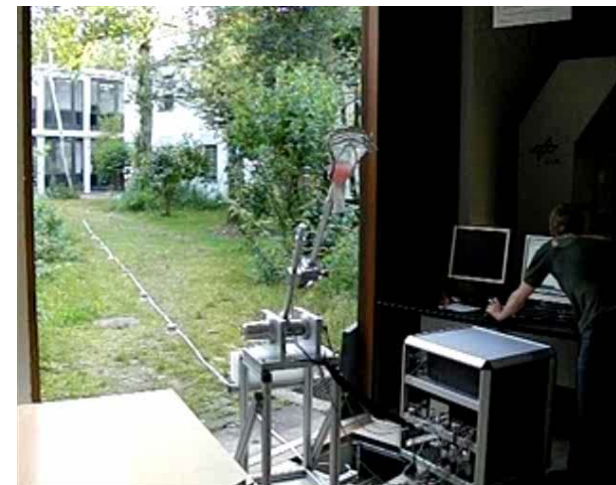
Design and control of VIA arm

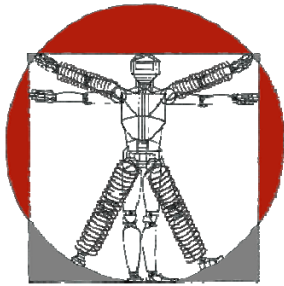
Safety and performance analysis of VIA devices



24/03/2010

VIATORS meeting

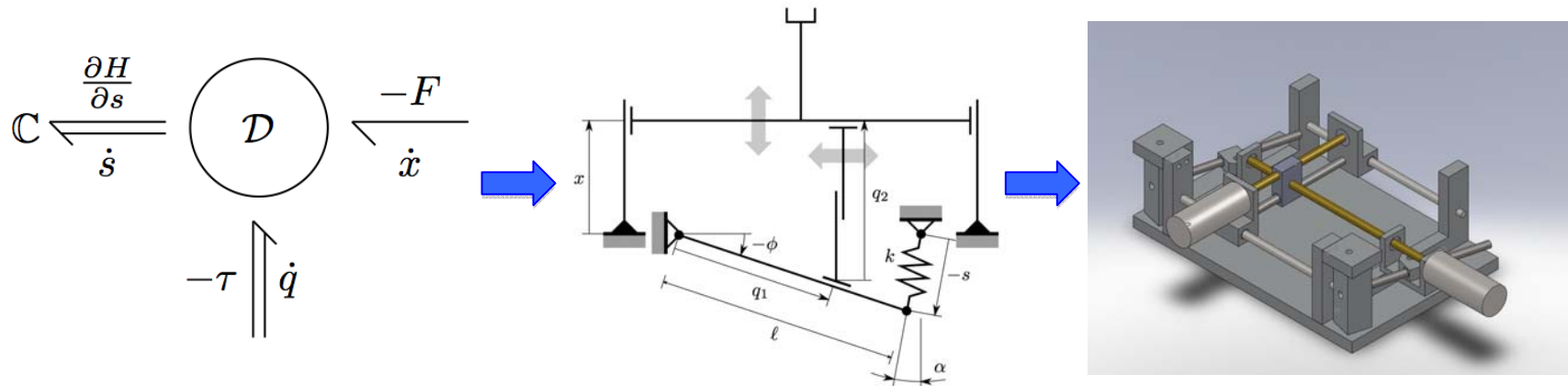


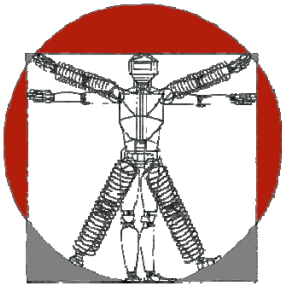


WP5: Actuators for walking

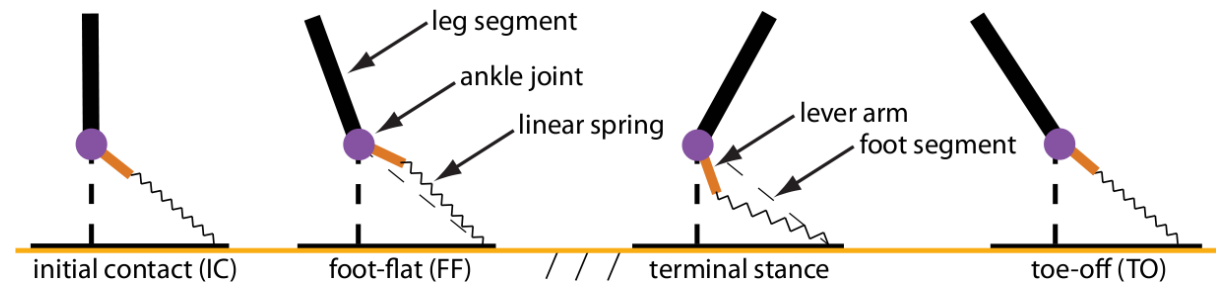
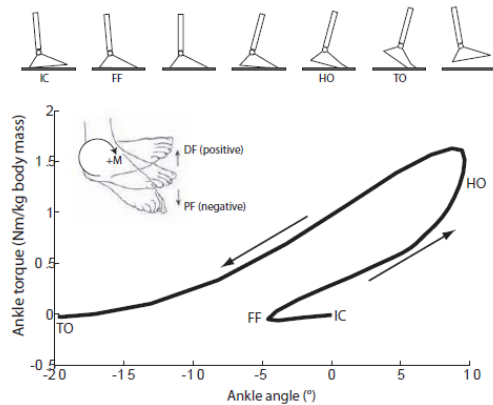


- A port-based model of variable stiffness actuator provides valuable insights in power flows
- Design guidelines for energy efficient variable stiffness actuators have been derived from the model

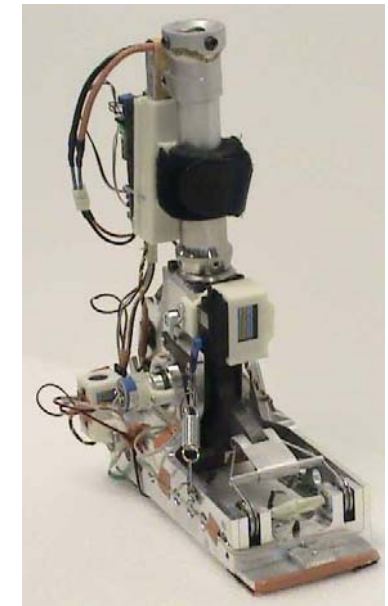


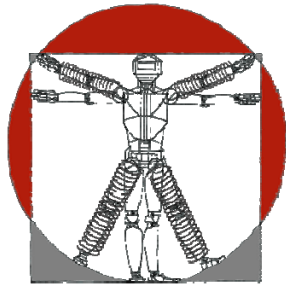


WP6- Bio-Inspired Prosthesis for Transfemoral Amputees



- Mostly passive system, built around the MACCEPA concept and a planetary gearbox. Only the locking and unlocking of the lever arm is actuated.
- Inspired by the torque-angle characteristic of the human ankle.
- Achieves leg-elongation at push-off.





Consortium Partners



Beneficiary Number	Beneficiary name	Beneficiary short name	Country	Date enter project	Date exit project
1(coordinator)	Deutsches Zentrum für Luft- und Raumfahrt	DLR	Germany	Month 1	Month 36
2	Università di Pisa	UDP	Italy	Month 1	Month 36
3	University of Twente	UT	The Netherlands	Month 1	Month 36
4	Imperial College London	IMPERIAL	U.K.	Month 1	Month 36
5	Istituto Italiano di Tecnologia	IIT	Italy	Month 1	Month 36
6	Vrije Universiteit Brussel	VUB	Belgium	Month 1	Month 36