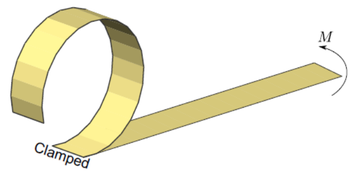
Multibody & Mechatronic Systems Lab

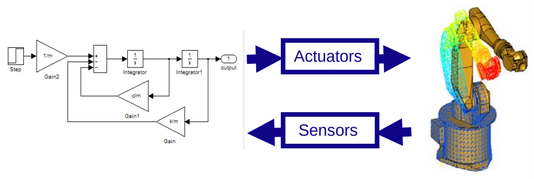
Modelling, control and optimization of mechanisms

The Multibody & Mechatronic Systems lab develops research projects in the field of **modelling methods** and **system dynamics** with applications in **robotics**, **deployable structures** and **biomechanics**. This includes numerical methods for the following advanced problems.

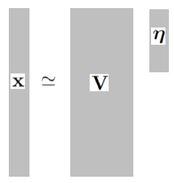
- **Flexible multibody dynamics**
  (FE formulations for beams, shells, and superelements).



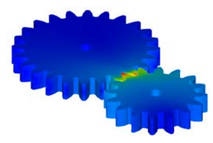
- **Mechatronic simulation**
  (control/structure interactions)



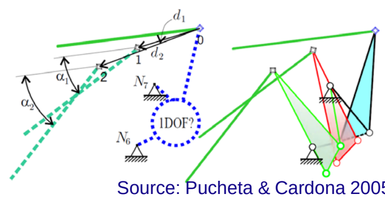
- **Model reduction**
  (real-time control & monitoring, optimization processes)



- **Contact interactions**
  (impact and friction phenomena, nonsmooth dynamics)



- **Mechanism synthesis**
  (pre-design tool)

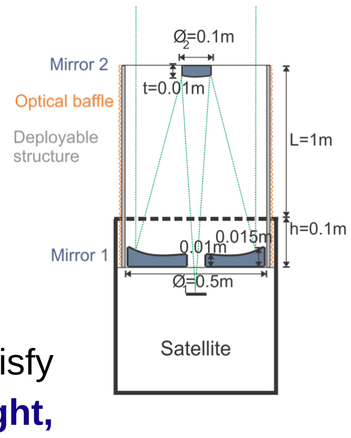


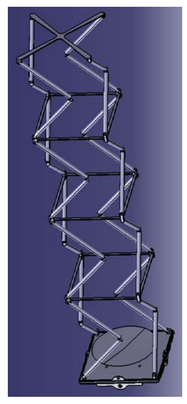
Source: Pucheta & Cardona 2005

Deployable structures

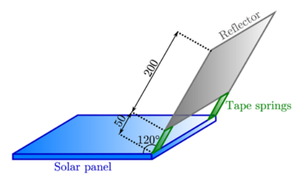
Applications in spacecraft design:

- solar panels
- antennas
- solar sails
- reflectors
- telescopes

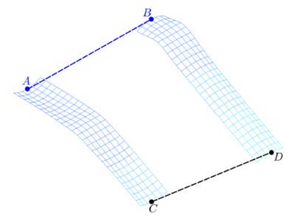


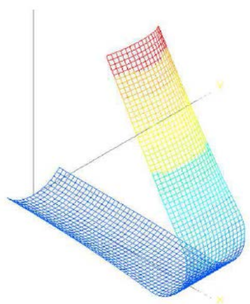


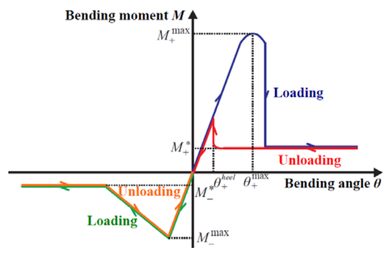
Deployable structures have to satisfy tight requirements in terms of **weight,** folded **compactness**, **geometrical accuracy** in the unfolded configuration. **Reliable models** are needed to support the design phase.

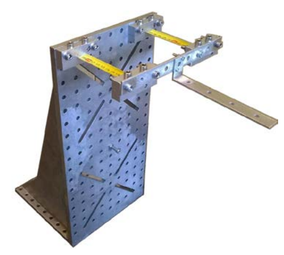


We study **compliant components** which offer significant advantages for low-cost missions. Our research activities are related with their **nonlinear modelling** and **experimental validation** as well as their **design** and **optimization**.





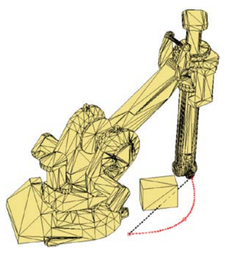




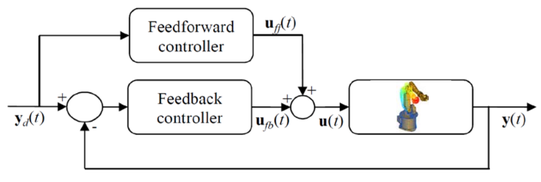
Robotics and mechatronic systems

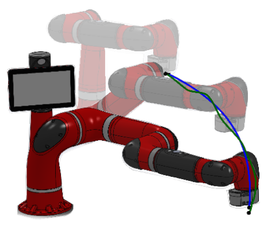
The behaviour of mechatronic systems relies on close interactions between mechanical and control components. Design procedures should thus rely on a **concurrent control/structure engineering approach**.

Trajectory planning
(collision avoidance)

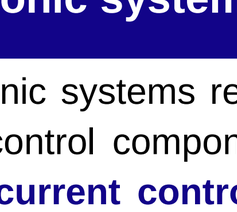


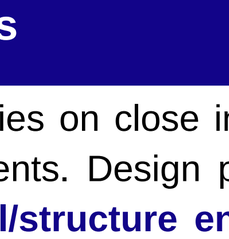
Motion and vibration control

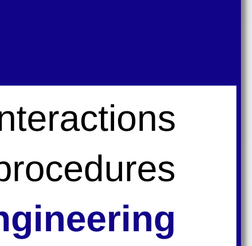




Mechatronic optimization
(control/structure design)



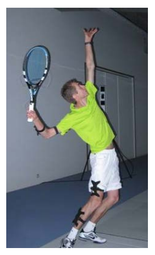




Industrial robotics & cobots

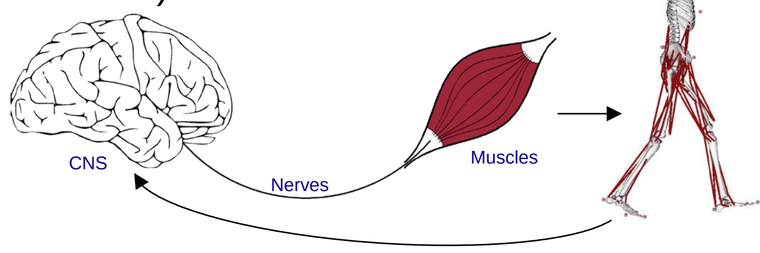
Human motion analysis and biomechanics

The Laboratory of Human Motion Analysis (LAMH) studies the motion of **elite athletes** (e.g., tennis, running) and patients suffering from **movement disorders** (e.g. Parkinson disease).
In that context, our research activities cover the following topics.

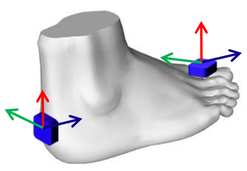


Model-based signal processing
(artefact compensation, data fusion, Kalman filtering, feature extraction)

Biomechanical & neural control modelling
(inverse dynamics, gait simulation)



Design of equipments
(prosthesis, low-cost & ambulatory sensors)



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