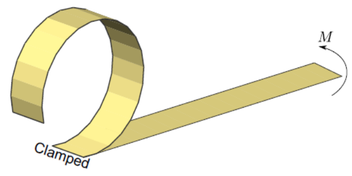
# Multibody & Mechatronic Systems Lab

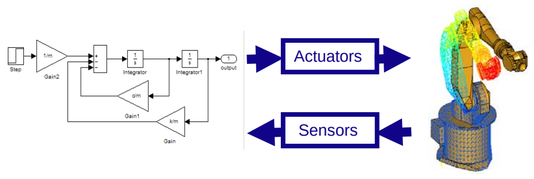
## Modelling, control and optimization of mechanisms

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.

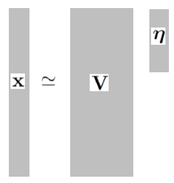
- **Flexible multibody dynamics**
  (FE formulations for beams, shells, and superelements).



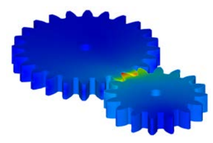

- **Mechatronic simulation**
  (control/structure interactions)



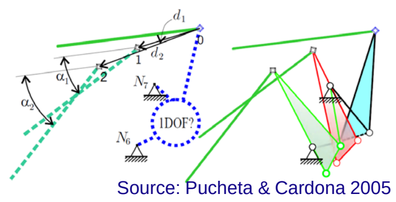

- **Model reduction**
  (real-time control & monitoring, optimization processes)




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



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

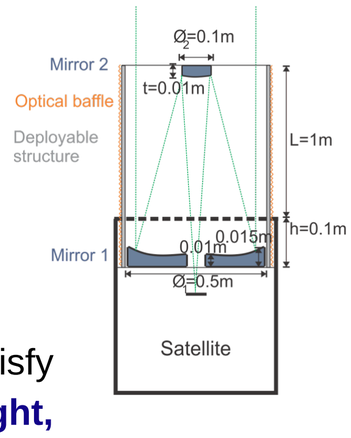


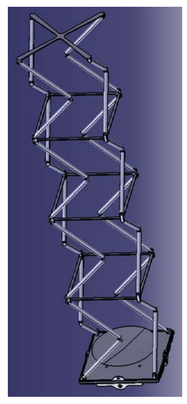

Source: Pucheta & Cardona 2005

## Deployable structures

Applications in spacecraft design:

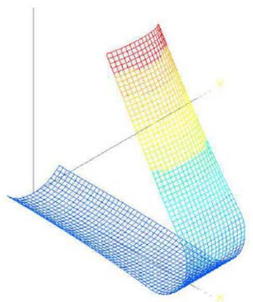
- solar panels
- antennas
- solar sails
- reflectors
- telescopes

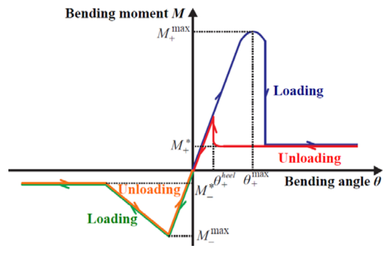


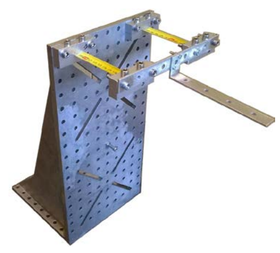



Deployable structures have to satisfy tight requirements in terms of **weight,** folded **compactness**, **geometrical accuracy** in the unfolded configuration. **Reliable models** are needed to support the design phase.

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**.



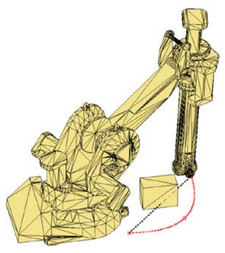


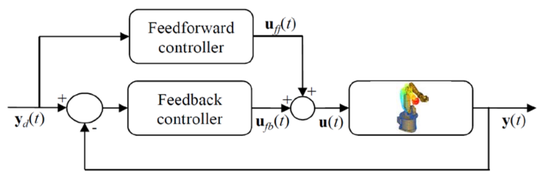
## Robotics and mechatronic systems

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)

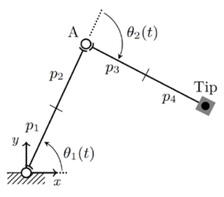


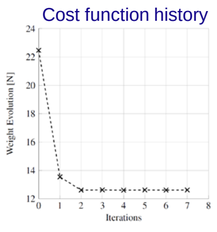
**Motion and vibration control**

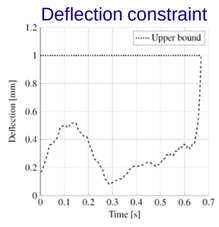




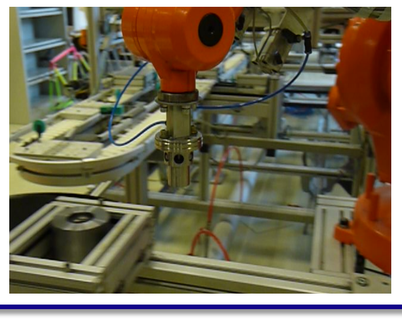
**Mechatronic optimization**
(control/structure design)



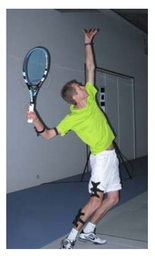




**Industrial robotics**



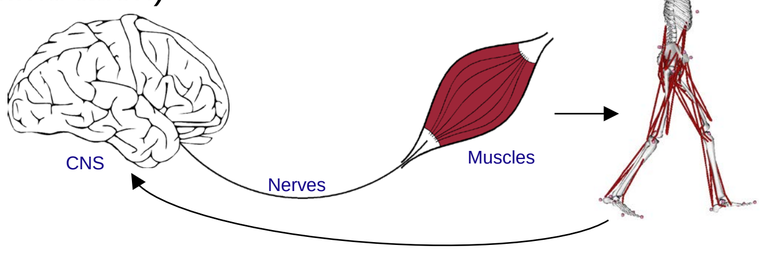
## Human motion analysis and biomechanics

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.

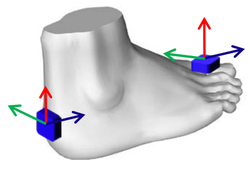


**Model-based signal processing**
(artefact compensation, data fusion, Kalman filtering)

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




**Design of equipments**
(prosthesis, low-cost sensors)



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