Project LOCOMORPH

Summer School
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Odense

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ai lab

Overview - Fact Sheet

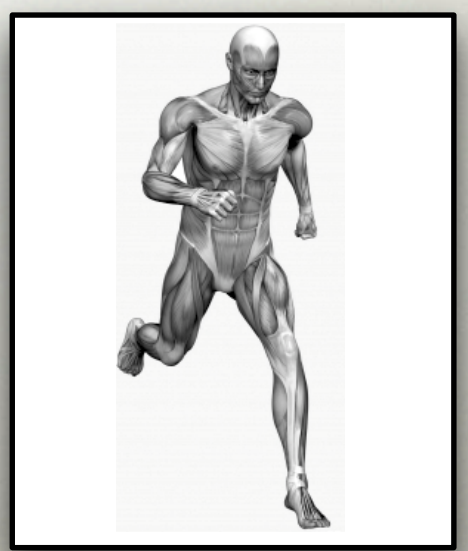
- LOCOMORPH: "Robust Robot Locomotion and Movements through Morphology and Morphosis"
- FP7 EU project
- 6 partners
- Duration 4 years
- Started: Feb. 1, 2009
- Finished by the end of March, 2013
  6th Int. Symposium on Adaptive Motion of Animals and Machines, AMAM 2013 (Darmstadt)

http://www.amam2013.org/

Motivation

- Most of todays robots are:
  - stiff, rigid, high torque servos
  - optimized for a given environment
  - not very energy efficient

- Biological systems are:
  - compliant
  - highly adaptive, very robust
  - very energy efficient



Motivation

- To look at solutions provided by nature is not entirely new (biologically inspired robotics)
- However, we **don't** want to build a certain dog or a bird
- We concentrate on "successful" **locomotion** (prerequisite for autonomous robots)
- Our approach is more general: **seek for principles for energy efficient an robust locomotion**
- transfer those principles to robots
- Don't try to rebuild animals!

Approach

- **Experiments** with animals over a wide range of different species
- **Understanding by building** robots with different morphologies (e.g., LocoKit)
- **Simulations** to verify theoretical models with real data

Guided by two basic concepts (phases):
morphology and **morphosis**

Morphology

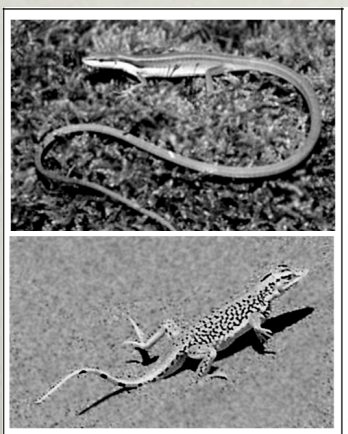
Morphology: form, shape, but also mass distribution, material properties, like compliance, damping, position of actuators and sensors, etc.

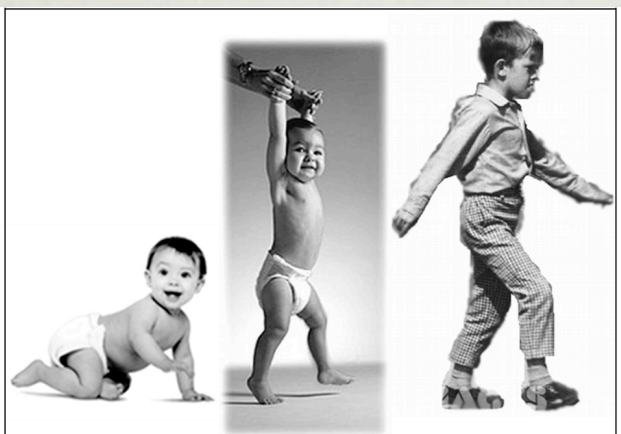
Morphosis

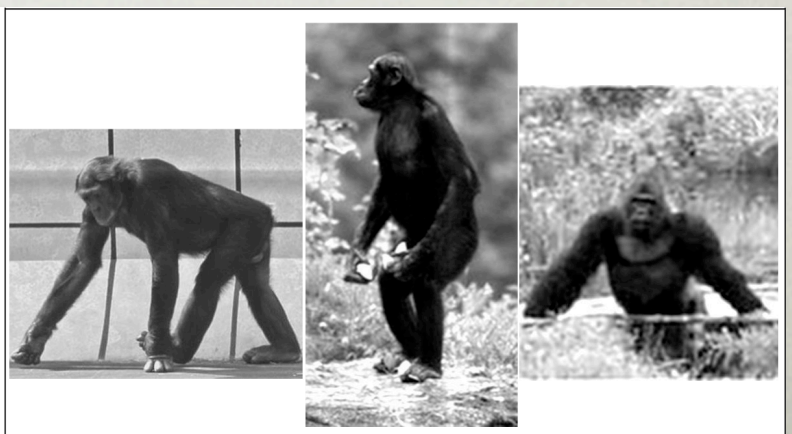
Morphosis: "The manner in which an organism or any of its parts changes form or undergoes development" (The American Heritage Dictionary of the English Language)

➡ **voluntary** - self-adjust (carry weight, quadrupedal vs. bipedal)

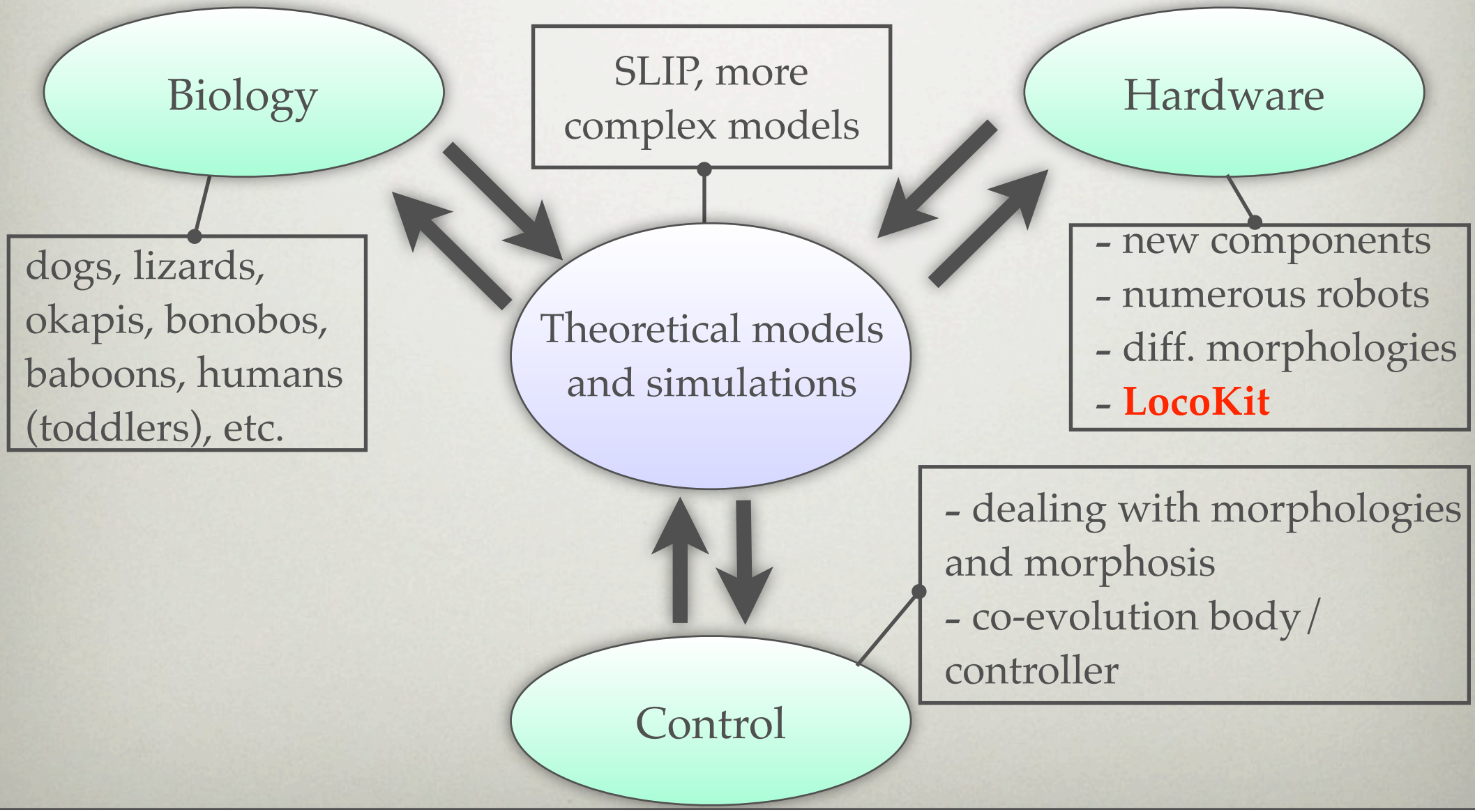
➡ **involuntary** (growth, injuries, fatigue, etc.)







Overview - Approach



Partners

- University of Southern Denmark (USD)
- University of Antwerp (UANT)
- Tech. University of Darmstadt (TUD)
- École Polytechnique Fédérale de Lausanne (EPFL)
- Ryerson University (RU)
- University of Zurich (UZH)

Outcomes

- Remarkable results from investigating biological systems with respect to locomotion
- New types of theoretical models for locomotion (i.e., M-SLIP family)
- New types of robot components, e.g., VCA and robots capable of morphosis (adaptive)

Outcomes

- New control/learning techniques capable to include morphosis (controller - body - environment)
- Established a new type of evaluation of robots using forces plates, infrared markers, and high speed cameras
- Educational toolkit LocoKit

Thank you!

Enjoy, learn, and have fun at the Summer School!