Project no. 231688

LOCOMORPH

Robust Robotic Locomotion and Movements Through Morphology and Morphosis

Small or Medium-Scale Focused Research Project

Seventh Framework Programme, Theme: ICT-2007.8.5

Future and Emerging Technologies (FET), Embodied Intelligence

Start date: 1 February 2009 – Duration: 48 months

D7.1 - Summer School on "Morphology and Morphosis"

Due date: 31 August 2012

Actual submission date: 28 September 2012

Number of pages: 12

Project Consortium

Beneficiary no.	Beneficiary name	Short name
1 (Coordinator)	Universitaet Zurich	UZH
2	Friedrich-Schiller-Universitaet Jena	UJEN
3	Ecole Polytechnique Federale de Lausanne	EPFL
4	Syddansk Universitet	USD
5	Universiteit Antwerpen	UANT
6	Ryerson University	RU

Dissemination Level

Project co-funded by the European Commission within the Seventh Framework Programme Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Abstract

The Locomorph summer school was hosted in Denmark from 23-27 August at The University of Southern Denmark. We had 27 participating students from 17 different countries. The majority of the students were Ph.D. students, however, a few MSc students and a Post. Doc also attended. At the summer school students were introduced to current knowledge and techniques in morphology and morphosis of animals and robots. Subjects included biology, biomechanics, modular robotics, robot learning, and embodied artificial intelligence and were presented by leading European experts. During the summer school, half of the time was reserved for hands-on group projects, where the students focused on building robots using LocoKit, which were used to experiment with biomechanical models or study how these models can be transferred to robotics with the additional aid of learning techniques. The seven robots built during the school gave the students deep, practical insights into morphology and morphosis in animals and robots. This deliverable is in the form of a public webpage http://locomorph.eu/home/summerschool and the attached documents are pdf versions of these webpages.

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Summer School

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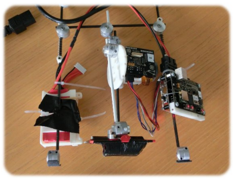

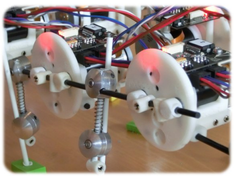

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Talks

Talks given at the summer school

Peter Aerts

from

University of Antwerp, Belgium

Presentation: Download (pdf)

Rolf Pfeifer

from

AI Lab, University of Zurich, Switzerland

Presentation: Download (pdf)

Auke Jan Ijspeert

from

École Polytechnique Fédérale De Lausanne

Presentation: Download (pdf)

Kasper Stoy

from

Modular Robotics Research Lab

University of Southern Denmark

Presentation: Download (pdf)

Helmut Hauser

from

AI lab, Univeristy of Zurich,
Switzerland

Presentation: Download (pdf)

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Tutorials

Here are the files associated with the tutorials given at the summer school.

CPG implementation

This tutorial was given by Rico Möckel from EPFL

Source code in c: CPG.c

The MSLIP model

This tutorial was given by Frank Peuker from Technische Universität Darmstadt

- Introduction slides on the SLIP model: Download (pdf)

- Presentation of the MSLIP model: Download (pdf)

- MATLAB files on the SLIP and MSLIP model: Download (zip)

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Presentations

Here are the presentations that the studens did on the last day of the summer school to show their work to everyone.

CheetahBot, download (pdf)

How force profiles are related to speed and sense of vertical motion, download (pdf)

Leg design and walking patterns, download (pdf)

"Spined" SpringyBot, download (pdf)

Crutch-SLIP walker, download (pdf)

Bipedal robot with splayed legs, download (pdf)

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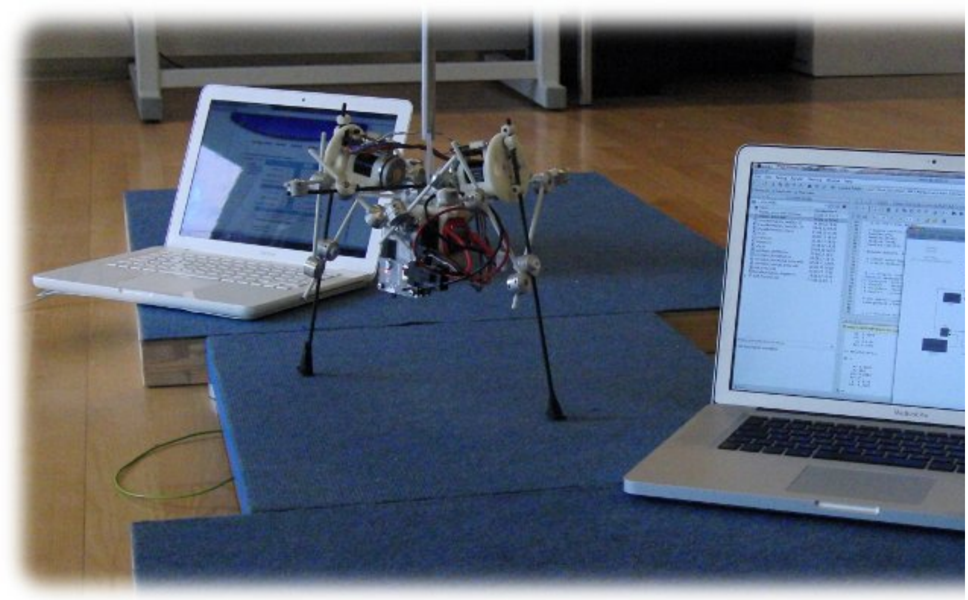
Results

During the summer school, the students were divided into seven groups performing a project each. On this page we showcase each project.

BipedalBoomBot:

Robots build with LocoKit have until now all had four legs. However, a group decided to build a bipedal robot with a slightly sprawling posture to see if they where able to recreate simulation results made with the M-SLIP model. The group attached the robot to a boom during the experiments.

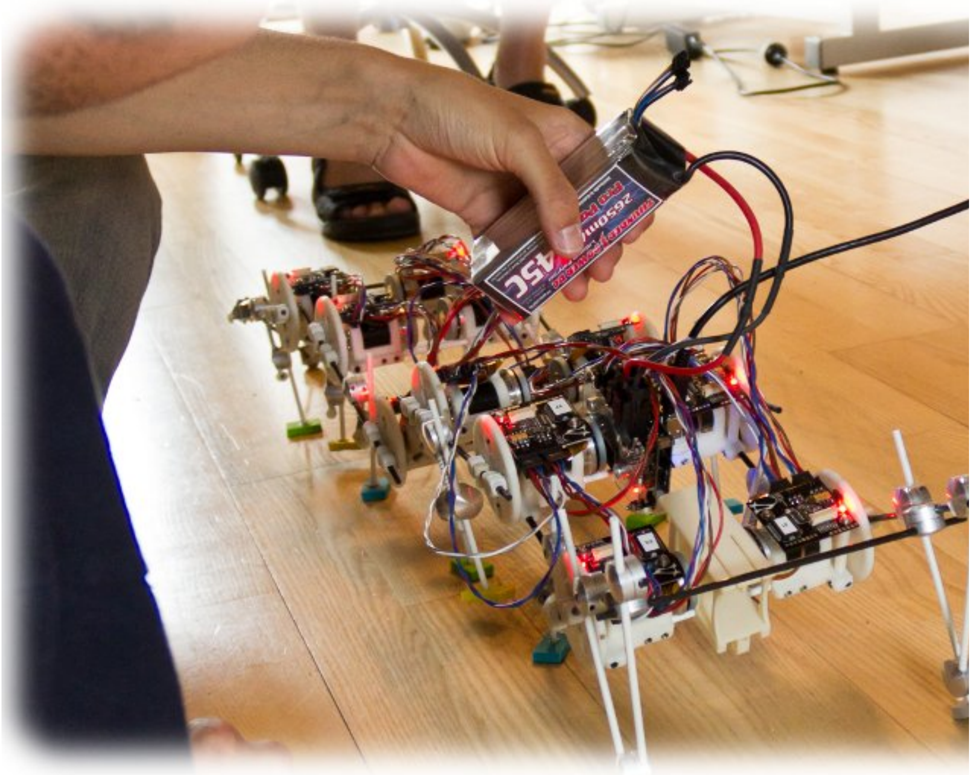


In the end, the group did not succeed with their experiments. Both due to limitations with the LocoKit but also due to a lag of time.

This robot was built by: Harold Martinez (UZH), Christian Rode (Darmstadt), Frank Peuker (Darmstadt)

Caterpillar:

This group decieded to go all in and build a robot with 14 legs!

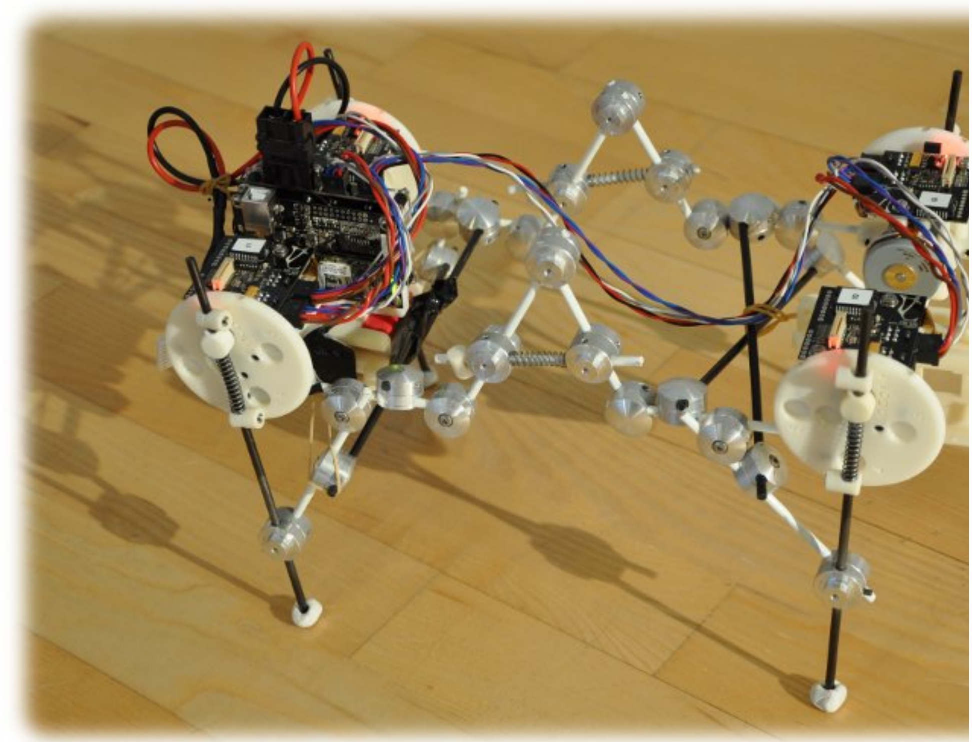


The robot moved nicely over flat surfaces using a traveling wave locomotion pattern.

The team behind this robot was: Melvin Gauci, Kees Voesenek, Elsa Quicazan, Camilla Jelen, Uros Cerkvenik, Bostjan Vihan, Caitrin Eaton

CheetahBot - Flexible Spine

This was one of two groups that wanted to study the effect of implementing a flexible spine in a robot. This group made a structure with LocoKit so they could stiffen the spine and thereby make it easier to compare a rigid and a non-rigid spine.

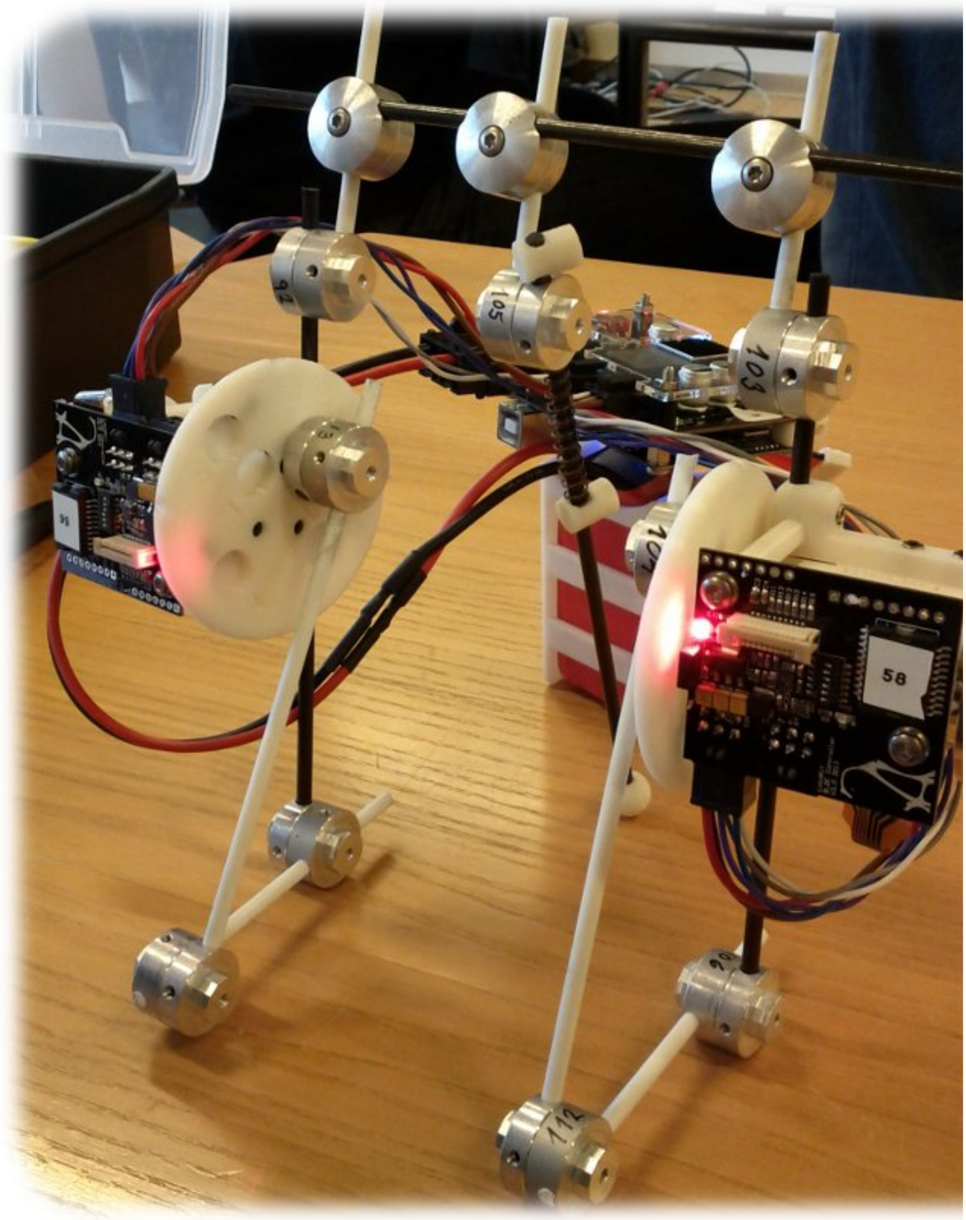


Experiments showed that the setup with the non-rigid spine had a higher forward motion speed than the one with the rigid spine. When looking at high-speed videos of the robot, it is also clear that the spine actively contribute to the locomotion pattern.

This robot was built by: Dominik Budday, Ludovic Daler, Kathrin Peyer.

CrutchSLIPwalker:

Inspired by passive dynamic walking robots, this group built this bipedal robot that would be balancing like the passive dynamic walker "Cornell Ranger". They also hoped to use the robot to demonstrate SLIP model-like walking patterns.

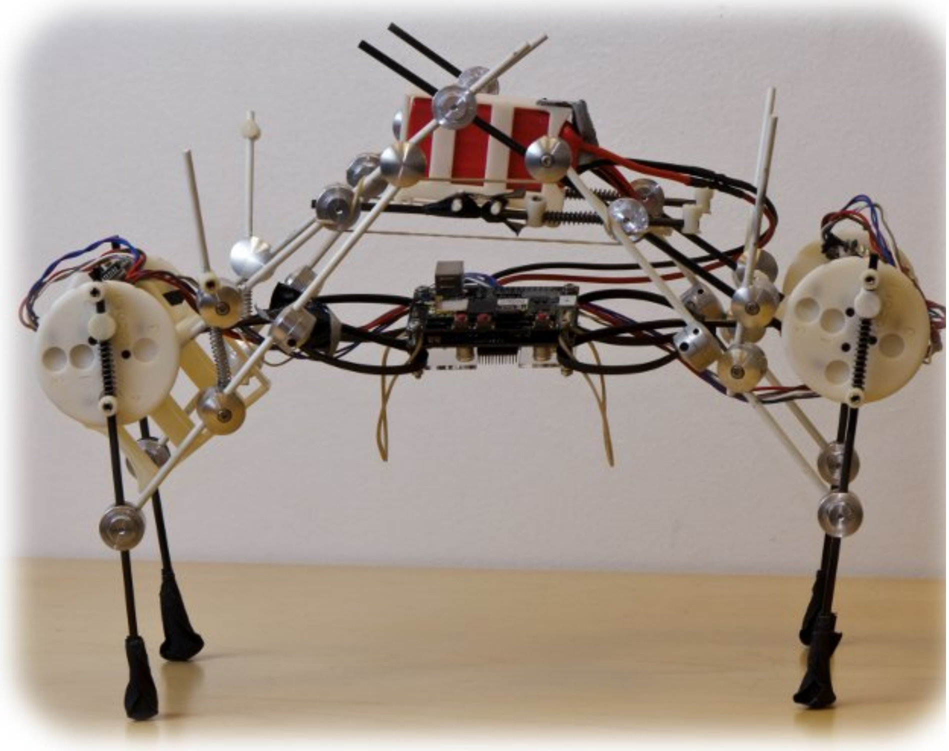


The robot never got to the point where it could ballance on its own within the time frame of the school even though the robot was rebuilt several times..

This robot was built by: Stefano Toxiri, Javier Martin

SpinyBot:

Yet another team wanted to see how the implementation of a spine in a quadruped robot would effect the walking ability of the robot. This team choose a different implementation than the other one, demonstrating the diversity of the LocoKit system.

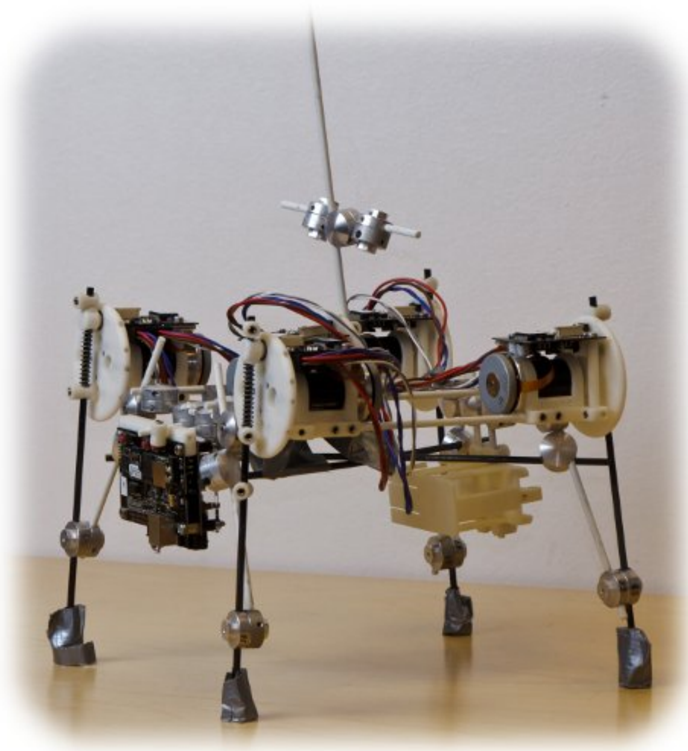


In the end, this group was also able to show that the implementation of a flexiable spine in the robot had a positive effect on the performance of the robot.

This robot was built by: Geert Folkertsma, Louise Poubel, Susanne Stadler

Head Banger:

The final team explored how the change of center of mass effects the walking of the robot. The way they implemented this was by attaching a mass on a long rod conneced to a motor and then use the motor to position the mass either to the front or the rear of the robot.

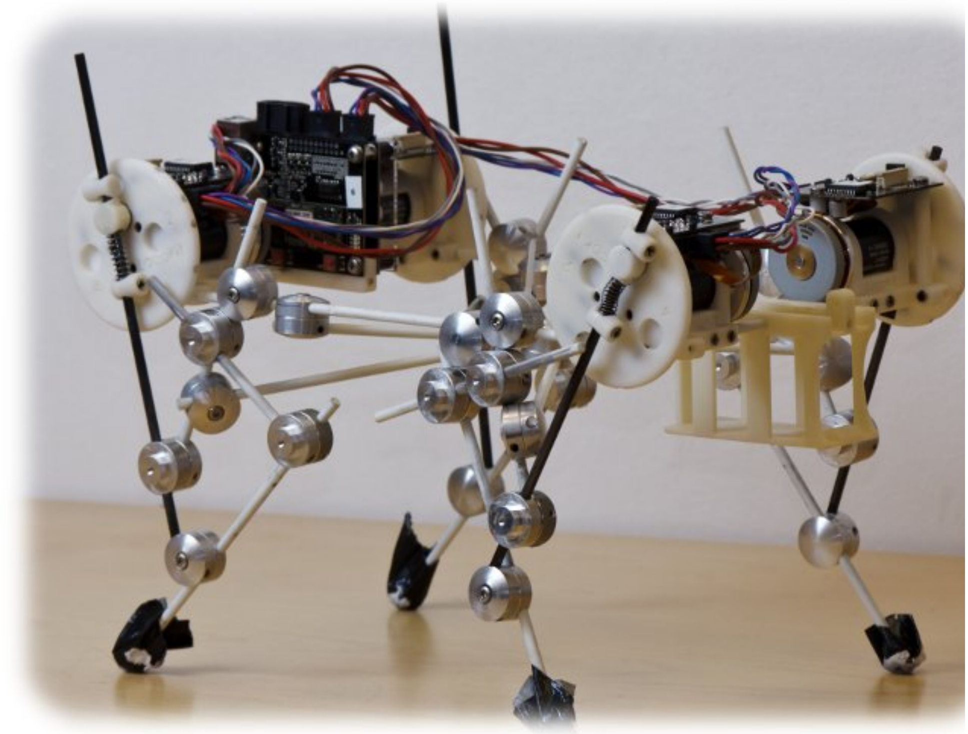


The team used the accelerometers in the robot to sense the tilt of the robot and based on this placed the mass accordingly.

The robot was built by: Avinash Ranganath, Toyotaka Kozuki, Jean-Marc Montanier, Wei Li

ConnectBot:

This group wanted to study if it was possible to create a leg mechanism with a linkage-bar structure using LocoKit. The group succeeded in doing this and after a few iterations a stable version was made.



Unfortunatly, time was not on their side, and they did not get to test the final and stable solution extensively, however, their effort still shows that it is possible to create linkage-bar mechanisms with LocoKit.

The robot was built by: Tomas Luneckas, Hamza Khan, Marc Deisenroth

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