Robotics and Embedded Systems

Technische Universität München

Introduction to the lab course of Snake Robot

Kai Huang, Long Cheng,
Zhenshan Bing, Mingchuan Zhou

People

- Kai Long Bing Zhou




chengl@in.tum.de bing@in.tum.de zhoum@in.tum.de

- In this semester, you will ‘play’ with the snake robot with us, doing, learning and having fun!

The aim

- Learn basic skills in the area of mechanical engineering
- Understand the architecture of controlling a snake robot
- If possible, know the basic model of snake robot gait
- Most importantly, obtain the experience of making a real robot by doing it yourself.

The content

- Several mechanical components that are used widely in the area
- Arduino
- I^2C bus
- Robot Operating System (ROS)
- Solidworks and RobotWorks?

Prerequisite

- C language programming
- Basic C++ or Python programming
  - For ROS
- Basic electronic knowledge

- Of course, interest and enthusiasm are the keys

Schedule

- One group
  - Or three small groups, i.e., mechanical, software, and electronics groups
- Meet at this room every Friday 2:00 pm (except holidays)
- Two presentations
  - In the middle of semester
  - In the last week

Expected goal

- Assemble the robot
- Realize the communication between modules
- Develop the interface between computer and the robot
- Control the robot to keep a specific posture

More advanced:

- ➢ Control the robot to move forward
- ➢ A GUI to control the robot

Outline of today

- What is a Snake Robot?
  - Examples
  - Advantages of Snake Robots
  - The locomotion of snakes
  - The internal structure of our robot
- Introduce yourself
  - Your strength

What is a Snake Robot

- Snake robots are hyper-redundant mechanisms consisting of a series of joints which move via internal shape changes like a snake.

- Hyper-redundant: many degree of freedom

- Movement: internal shape changes

What is a Snake Robot

Hyper-redundant

a series of joints

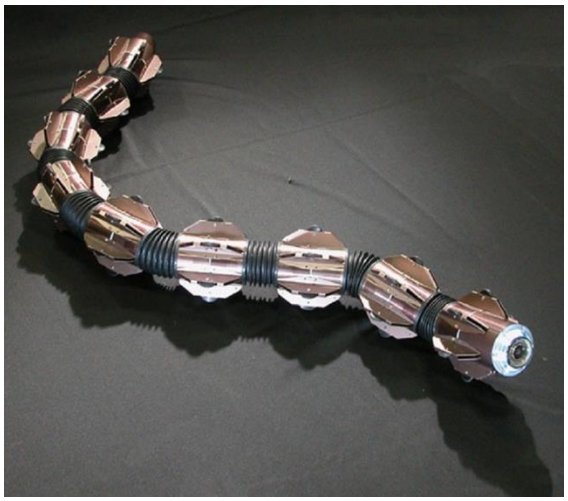
Pushed forward by motors

Hyper-redundant

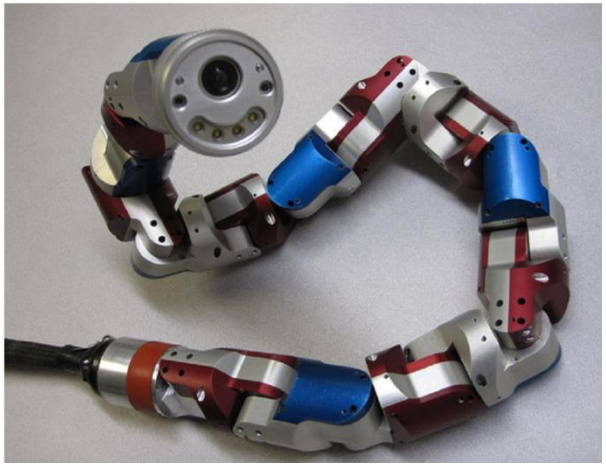
a series of joints

moves via internal shape changes

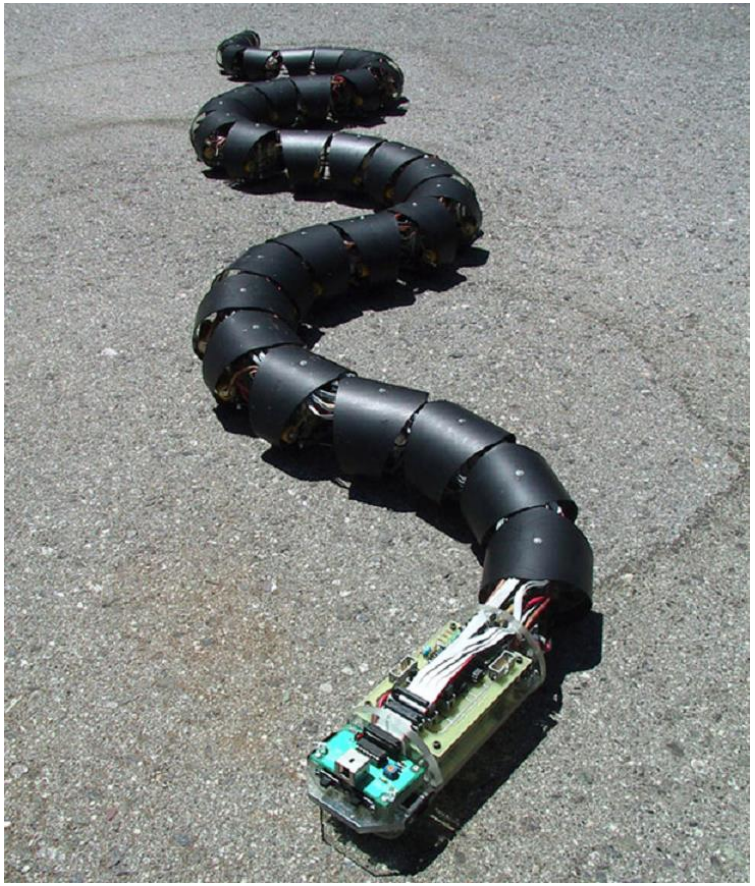
Examples



The snake robot
ACM R5



The snake robot
Unified Snake



The snake robot ***S5***

Advantages of Snake Robots

- Traversability in irregular environments
- Many degree of freedom
- Obstacle exploitation
- Obstacle avoidance

Advantages of Snake Robots

Snake robot obstacle aided locomotion

Unified Snake climbs a tree

The locomotion of snakes

- Four most common types of biological snake locomotion
  - Lateral Undulation
  - Concertina Locomotion
  - Rectilinear Crawling
  - Sidewinding

The locomotion of snakes

Lateral Undulation

Concertina Locomotion

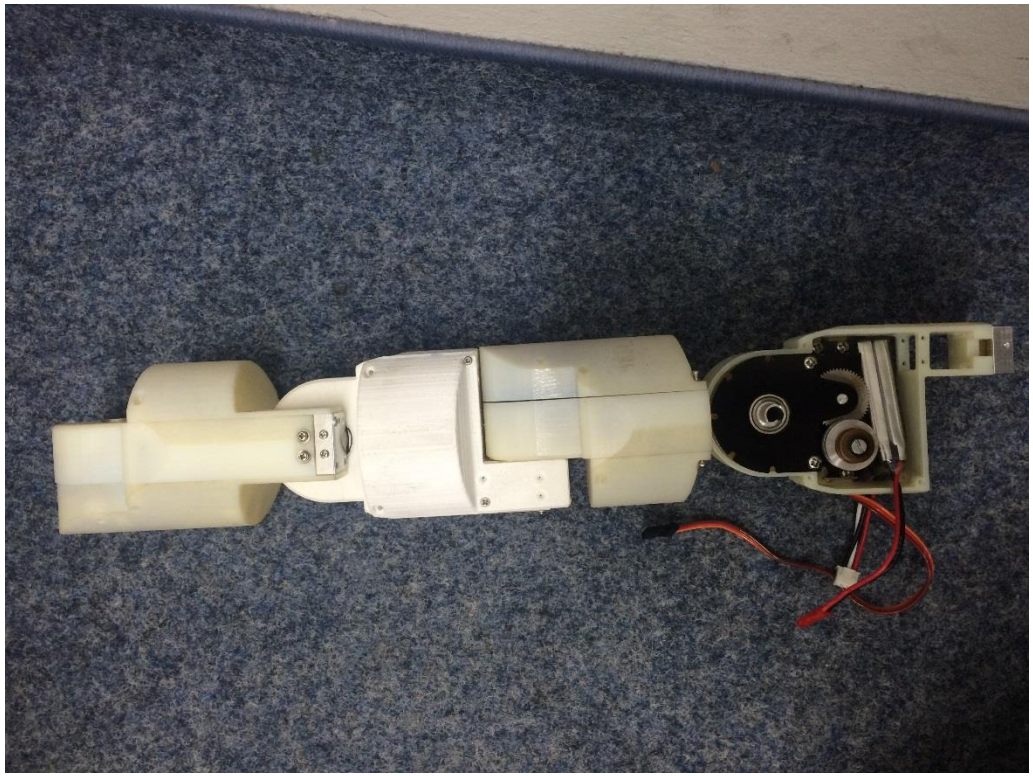
Rectilinear Crawling

Sidewinding

The composition of snake robots

- In general, several aspects should be considered while making a snake robot.
- Mechanical design
- Electronics
- Control
- Communication
- Software

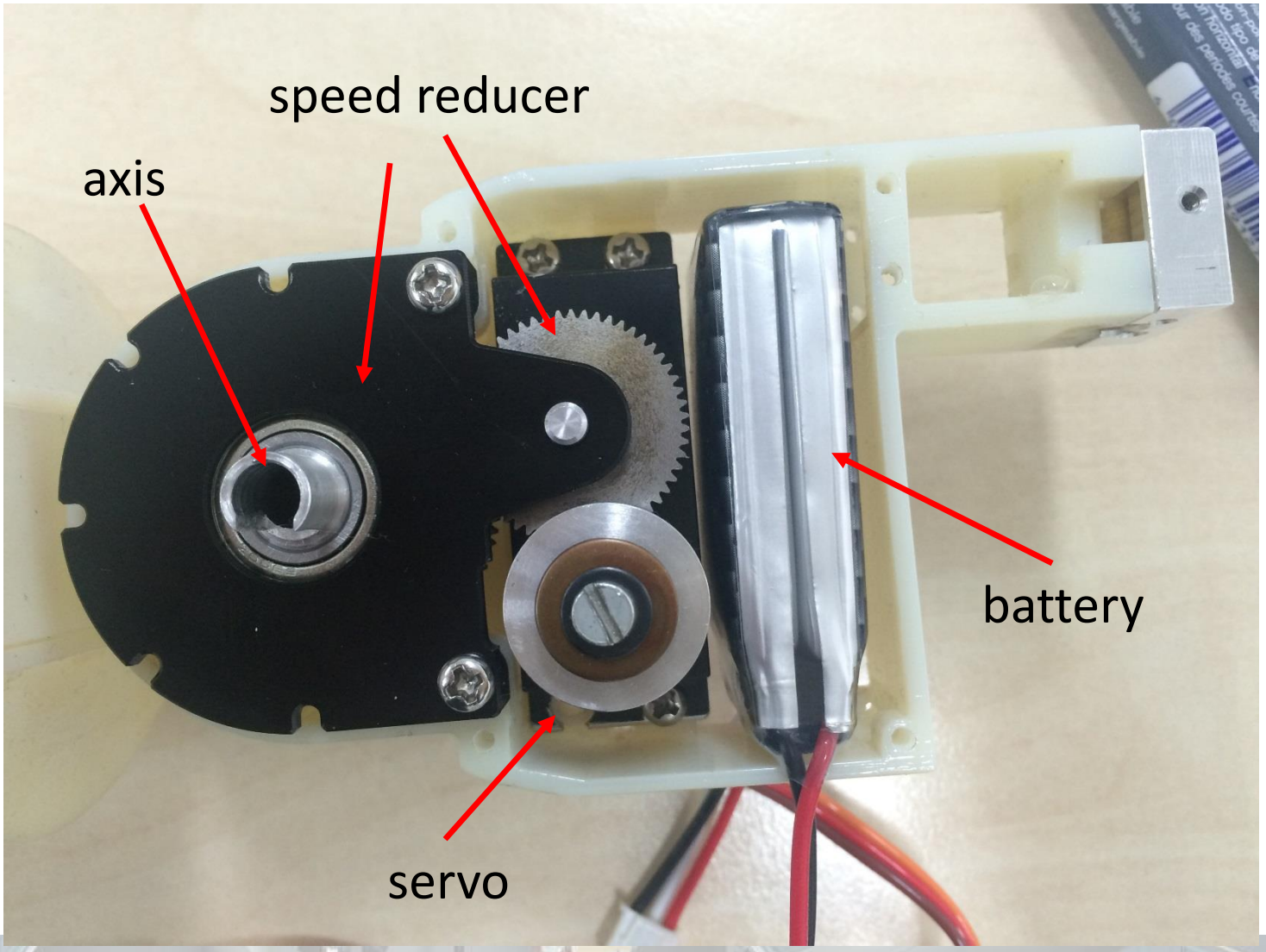
The state of our robot



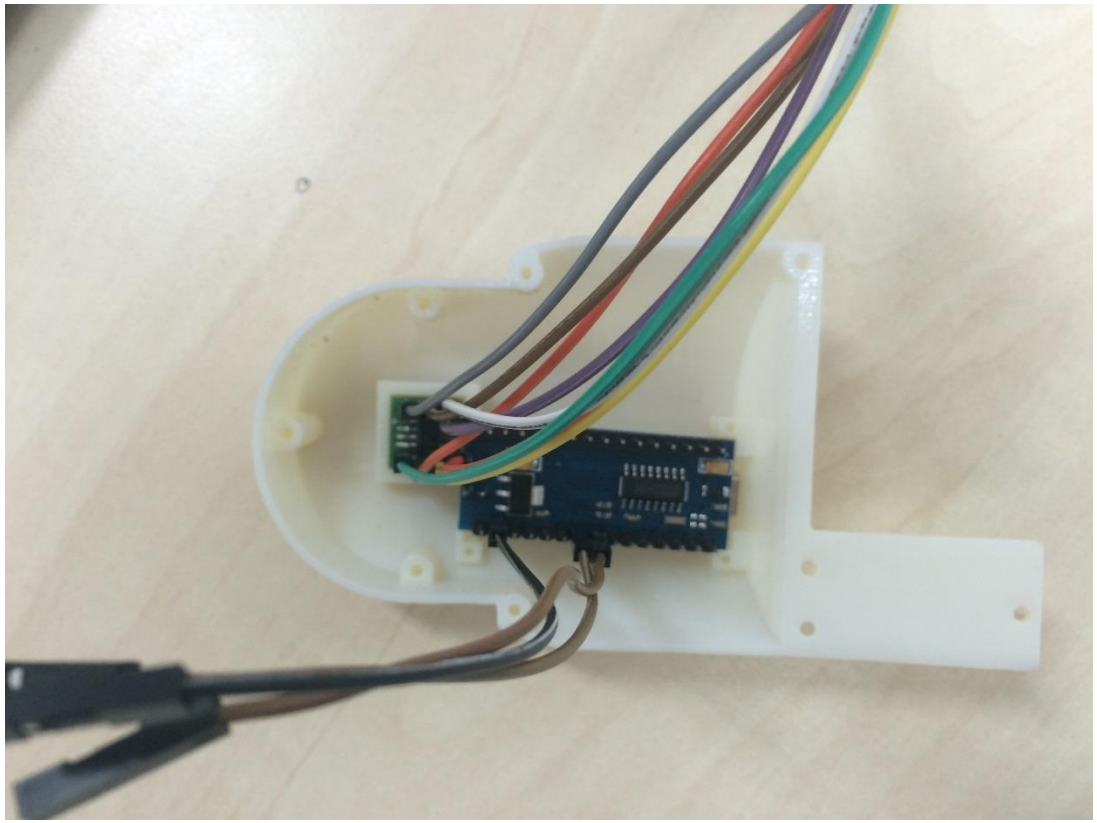
Currently, we have the components for 6 modules and only 1 module is roughly assembled.

The modules connect with each other in the manner that the axis turns 90 degrees every module such that various movement forms can be achieved.

The internal structure



The internal structure



- Magnetic rotary encoder used for measuring the joint angle
- Arduino nano micro-controller to control the servo, sample angle data and communicate with the master board.

Introduce Yourself