

LEURRE: Mixed-Societies Interaction

Swiss Federal Institute of Technology (EPFL) - Autonomous Systems Laboratory (ASL)

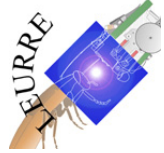
Project

LEURRE : Artificial Life Control in Mixed-Societies

- Develop mixed-societies composed of animals and robots that interact and communicate.
- Understand the link between individual and collective behaviour.
- Control the collective behaviour with the robots.

Consortium (partners):

- ULB: Bruxelles University
- UR1: Rennes 1 University
- UPS: Paul Sabatier University
- EPFL: Swiss Federal Institute of Technology



Expected contributions:

- Behavioural Model: probabilistic models of individual and collective behaviours, formalize them in a programming language
- Simulation and experimentation on "real" mixed society of insects and insect-like robots
- Controlling the global behaviour of the mixed society
- Provide a general methodology to study and control mixed societies

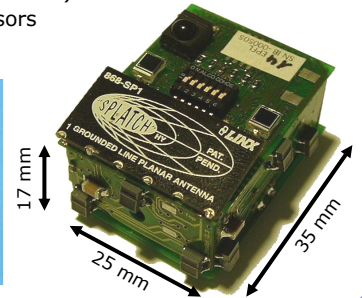
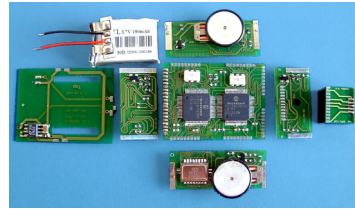
ASL main task:

- Design an insect-like autonomous mobile robot

Insect-like robot : InsBot

Specifications

- Control: 2 PIC18LF6720 (16MHz, 128KB flash)
 - hardware processor for low level tasks
 - behaviour processor for high level tasks
- Locomotion: 2 watch stepper motors
- Sensing:
 - 12 IR sensors
 - 1 linear camera (102 pixels, 8 bits)
 - 2 photodiodes
- Power supply:
 - 1 Li-Poly Battery (3.7V, 190 mAh)
- Communication:
 - 1 wireless communication (868 MHz)
 - local communication via IR sensors
 - 1 IR receiver for remote control



Experiment Scenarios

1. Identify the individual-collective behaviour of the cockroaches

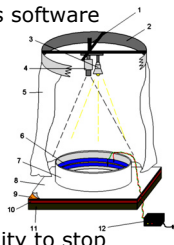
Tool: Behaviour analysis software

Individual model

- Random walk
- Wall following

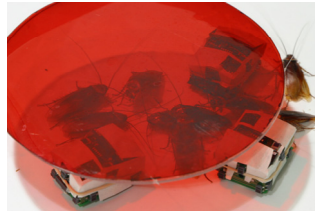
Collective model

- Individual behaviour
- Aggregation: probability to stop depending on the local density of cockroaches



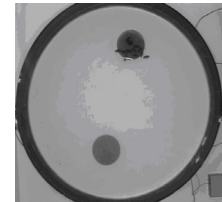
2. Implementation of the behaviour model on the InsBot

- Does the robot behave like cockroaches ?
- Is the robot accepted and integrated into the cockroach society (aggregation) ?



3. Control of the society

- Is it possible to influence the cockroaches behaviour ?



- Cockroaches tend to aggregate under the dark shelter, what does happen if robots aggregate under the bright one ?

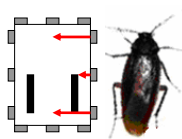
Results: robots capabilities

1) Dark and bright shelter detection

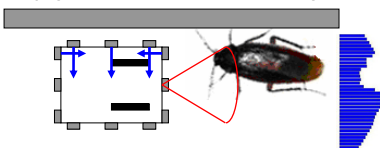
- Top light sensors

2) Cockroach detection (from 2 cm)

- Bottom IR sensors activation

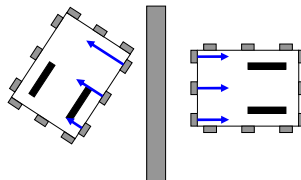


- Use of the linear camera at the setup periphery (discontinuities detection)



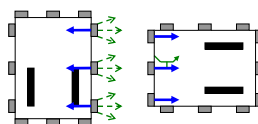
3) Wall detection (from 5 cm)

- Top and bottom IR sensors activation



4) Local communication via IR sensors

- 6 data bits + 2 stop bits
- Robot detection (no confusion with wall)



5) Low level tasks (hardware processor)

- Motor control: forward, turn, stop
- Right-left wall following
- Avoidance-attraction (cockroach, robot, light...)
- Aggregation

6) High level tasks (behaviour processor)

- Cockroach behaviour
- Probability table

