

## AIBO Programming

### Robotics' Topics

This document presents 4 topics (*Reasoning, Vision, Behaviour and FSM, Multi-Robots*) from which one can be chosen for the practical work of the course.

Students should form groups of 3-4 persons. Each group will be work on one of the robot topics and provided with some literature to be read.

- **Class Presentation:** Each group should prepare two presentations (around 45 minutes) about the problems they have studied and possible solutions that can be applied to the AIBO. During the first presentation the problem and proposed solution will be discussed in the classroom. At the end, the results of the solution in the AIBO software will be presented. A report covering a description of the problem and the discussion made should be presented some weeks after the presentation.
- **Practical work:** each group will have to check how much of the problem is already covered/implemented in the current version of the code, and then create (or extend) the code to provide a (better) solution using Tekkotsu and other AIBO tools. A small report on the work should be written, and a short final presentation (in the classroom) about the implementation made.

**Please note:** Students can propose modifications to these problems or propose new ones, but such proposals must be approved by the teachers of the course.

## Group 1) REASONING

*Issues to cover:*

- Strategic planning vs. behaviour
- Dual-coding of world state (geometric and symbolic representation)
- Adapt behaviour to world model and adapt world model to reality

*PRACTICUM:*

- Implementing strategic planning
  - Plans for playing tic-tac-toe or other scenario
- Implementing interaction between behaviours and strategic plans
- Impact of (un)expected events in the world on reasoning
- Use light weight version of 2APL for planning

*Extra issues:*

- Adapting, learning new strategies and plans
  - define sub-strategies as building blocks
  - replanning based on situation and sub-strategies

## Group 2) VISION.

*Issues to cover:*

- object detection and localization (estimate as point + error radius)
- visual radar technique (estimate of distances by camera angles)
- landmark detection
- self localization (estimate as point + error radius)
  - (e.g., no need for Gaussian distributions of probabilities)

*PRACTICUM:*

- Improve the "Search object" behavior
- Implement the "localization" behaviour
  - points approximate position of the aibo with respect to object
- Integrate and test behaviours for SLAM like test using new landmarks

*Extra issue:*

- new object recognition
  - e.g., recognize chairs

## Group 3) BEHAVIOUR AND FINITE STATE MACHINES

*Issues to cover:*

- Motion definition of more complex behaviours using FSM
  - Complex coordination of vision and motion
- Study and model behaviour using hierarchical FSMs
- Recursion, deadlock and other properties of HFSM
- Study and model the estimated effect of the behaviour
  - probabilistic estimation of success

*PRACTICUM:*

- Implement several complex behaviours. E.g. walk around the field, perform a dance
- Implement combined behaviours (walking, barking, etc.)
- Implement transition functions based on estimation of success of the action
- Implement a tool for the (graphical) specification of the behaviour through FSM usable by non-experts in AIBO programming (LEGO mindstorms idea)

*Extra issues:*

- Learning by experience on applying kicks
  - modification of the FSM based on experience
- Perfect vision-leg coordination for
  - stopping a moving ball
  - kicking a moving ball
- modelling other motion behaviours (e.g., dribble)

## Group 4) MULTI-ROBOTS

*Issues to cover:*

- Team strategy definition
- Coordinating behaviours definition
- Impact of teamwork on task planning
- Common world model

*PRACTICUM:*

- Implementing coordinating behaviours
  - Improve communication layer
- Implementing strategies as part of the task planning
- Impact of strategies and communication in behaviour selection

*Extra issues:*

- Recover strategies on failure
  - Monitor behaviour of team mates
  - Communicate failure to team mates
  - Adapt plan on perceived failure
- Predict behaviour of team mate based on team plan