Les Trois Mousquetaires Team Description

Vincent Hugel, Nicolas Jouandeau

Les Trois Mousquetaires Team Description

Vincent Hugel[1] and Nicolas Jouandeau[2]

[1] Université de Versailles, Laboratoire d'Ingénierie des Systèmes de Versailles, France
hugel@lisv.uvsq.fr,
[2] Université de Paris 8, Laboratoire d'Informatique Avancée de Saint-Denis, France
n@ai.univ-paris8.fr

Abstract. This paper presents the French team composition and describes the research objectives for its participation in the 2009 RoboCup event. This will be the first year the French team will be involved in the Standard Platform League with four NAO humanoid robots.

1 Team composition

After participating with the AIBOs in the Robocup four legged exhibition in 1998, and the RoboCup four legged league from 1999 to 2005, the French team decided to reorganize itself to be ready for the next generation of humanoid robots to be used in RoboCup.
The founders of the original French team are Pierre Blazevic, Vincent Hugel and Patrick Bonnin. The first two have been involved as advisers to the Aldebaran-Robotics company in matter of performances specifications, robotic design, and programming tools.
The team is called *Les Trois Mousquetaires* (The Three Musketeers) in reference to the novel by Alexandre Dumas, père. The main characters are *d'Artagnan*, *Athos*, *Porthos*, and *Aramis*. The four NAO humanoids of the French team are called the same. *d'Artagnan* and *Athos* are NAO RoboCup versions, and *Porthos* and *Aramis* are NAO Academics versions.
The team will regroup two laboratories from two universities, and two engineering schools. All of these institutes are located in the region of Paris (Ile de France).

In details, the institutes are :

1. LISV Laboratory (Laboratoire d'Ingénierie des Systèmes de Versailles),
   Laboratory specialized in System Engineering, Robotics and Mechatronics,
   University of Versailles,
   www.lisv.uvsq.fr – in French.
2. LIASD Laboratory (Laboratoire d'Informatique Avancée de Saint- Denis),
   Laboratory specialized in all Computer Science fields,
   University of Paris 8,
   www.ai.univ-paris8.fr - in French.

3. Engineering School EFREI,
   IT technology and computer Science Engineering School,
   www.efrei.fr – In French.
4. Engineering School ISTY,
   Science and Technology Engineering School,
   IT technology and mechatronics departments,
   University of Versailles,
   www.isty.uvsq.fr – in French.

2 Research objectives

The research purposes will focus on locomotion, vision, multi-robot behavior design and localisation/navigation adapted to autonomous two-legged robotics.

2.1 Locomotion

The main objective regarding locomotion consists of designing stable walking gaits for the NAO biped. The robot must be capable of achieving omnidirectional walk through the scheduling of high level movement commands. Currently NAO is capable of walking and turning using open-loop algorithms. As a consequence the robot that is subject to disturbances can fall down very often. Closed loop algorithms based on the feedback from the inertial sensor and feet force sensors must be implemented to enhance stability. The locomotion team will focus on the motion module that can be entirely rewritten. The low level control can also be tuned. This is interesting for varying the damping at foot impact.
In order to improve the robots capabilities to resist strong external disturbances due to stumbling or collisions with other robots, the motion module will be modified to incorporate reflex motion. Reflex motion will be superimposed to walking gaits commands to anticipate loss of balance and falls.

2.2 Vision

The vision system for the NAO robots must be redesigned compared to the system that was used for the AIBO quadrupeds. The vision operators should be general-purpose and they could be used for navigation of mobile robots in indoor or outdoor environments. The idea consists of taking into account color features and contour features at the same time during the detection [DeCabrol2006]. The team in charge of vision plans to implement a temporally optimized edge detection based on *color edges*. Using a Kirsh 4 operator, the procedure will detect transitions between colored regions, and then extract useful information about line and curve features. Depending on the CPU processing power, the temporal optimization will aim at extracting visual information at video rate without penalizing other modules such as locomotion and navigation. This operator will be useful to detect the horizon line, even in outdoor natural environments.

In addition this operator must be self-adaptive to varying lighting conditions as far as possible. Here the objective is to reduce the time and effort needed to tune the visual system in the beginning, even for people who are not vision experts. Benchmarks have to be carried out to check the time consumption of the vision processing algorithms. Quality indices must also be defined to check the reliability of the information extracted from the vision system. These indices will also be useful to compare the performances between different vision algorithms.

In the current image processing module that was implemented on the NAO for the German Open, a colour lookup table was used to perform a fast recognition of the scene. The colour lookup table stored 8 bits per pixel. Each pixel defined 8 exclusive basic pieces of information (in which the first four stand for the ball, the own goal, the opponent goal, and the green carpet ground). This table is made by software and uses a 24bits YUV color space. The resulting table allows to identify combinations of 256 levels per YUV component. To make it automatically, the table is filled and self-enhanced during simple moving sequences, based on the knowledge of ball and goals positions. Based on hierarchical scene analysis in favourable situations, each moving sequence records images and tries to fill the table. At the end of moving sequences, a control procedure that replays previously saved images, is used to validate the table.

The focus now deals with accelerating the procedure of look-up table tuning thanks to some semi-automatic procedures. In addition, the focus is also to increase the frequency of image acquisition and processing.

2.3 Collaborative behaviours

The localization system must use the white lines and the goal frames of the soccer field. The navigation module will use global positioning thanks to probabilistic methods, but also local positioning with respect to detected edges using adapted Kalman filtering.

Currently the design of behaviors is individual and is based on hierarchical finite state machine (hfsm) design. The graphical tool to design hfsm that was used for the AIBOs was adapted for the NAOs [Hugel2006].

For the implementation of high level behaviors, the team will deal with a collective strategy of role distribution, and especially focus on role switching according to external information and role stability. But the most important challenge for this year will be to design reliable and effective behaviors for the goalkeeper and the attacker in charge to strike goals. Both roles will be developed and checked using an incremental approach.

For our multirobot (MR) system, we will try to solve the cooperation problem into an incremental deliberative layer based on players interactions. This deliberative layer allows to share data and to fix common actions with fully asynchronous communications [Brenner2003] [Brenner2006]. Each robot defines its own plan and deals with others to build a global consistent strategy. The incremental part of this layer allows each robot to plan individual actions and to agree with some of them with a global MR strategy. The deliberative layer is divided into three parts:

1. the symbolic planner that defines each rule and each task for each player in the scene,
2. the specialized advice that results from particular view of each robot,
3. the interactions manager that allows to coordinate the previously mentioned information.

2.4 Addressing the localisation/navigation challenge

New locomotion walking patterns should allow us to supply scalable movements that can be put together to fit well in a global path avoiding visible obstacles. During the localization challenge, we plan to dynamically define the path according to the scene based on vision and IR sensors. With a simplified random tree search [Jouandeau2008] in the configuration space of the robot, our locomotion system should allow us to avoid collision and to move safely between stationary obstacles [Michel2007].

References

[Hugel2006] Vincent Hugel, Guillaume Amouroux, Thomas Costis, Patrick Bonnin and Pierre Blazevic. Specifications and Design of Graphical Interface for Hierarchical Finite State Machines. Lecture Notes in Computer Science. RoboCup 2005: Robot Soccer World Cup IX. Volume 4020/2006. 648–655.

[DeCabrol2006] Aymeric de Cabrol, Patrick Bonnin, Thomas Costis, Vincent Hugel, Pierre Blazevic and Kamel Bouchefra. A New Video Rate Region Color Segmentation and Classification for Sony Legged RoboCup Application. Lecture Notes in Computer Science. RoboCup 2005: Robot Soccer World Cup IX. Volume 4020/2006. 436–443.

[Brenner2003] Michael Brenner. A Multiagent Planning Language. In Workshop on PDDL (ICAPS 2003). Trento, Italy 2003.

[Brenner2006] Michael Brenner and Bernhard Nebel. Continual Planning and Acting in Dynamic Multiagent Environments. In Proceedings of the International Symposium on Practical Cognitive Agents and Robots. Perth, Australia 2006.

[Jouandeau2008] N. Jouandeau, Y. Touati, A. AliCherif. Incremental Motion Planning With Las Vegas Algorithms, (book chapter) on Robotics, Automation and Control, I-Tech book 2008.

[Michel2007] P. Michel, C. Scheurer, J.J. Kuffner, R. Dillmann, and T. Asfour. Planning for robust execution of humanoid motions using future perceptive capability. IEEE/RSJ Int. Conf. on Intelligent Robots and Systems 2007.