French-Spanish L3M SPL Team Description

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Abstract. This paper presents the French-Spanish joint team composition and describes the achievements and research objectives for its participation in the 2010 RoboCup Standard Platform League.

1 Team composition

The 2010 team is a joint team between the French team and the Spanish team named *Los Hidalgos* from last year. The team name is *Les Trois Mousquetaires* alias *Los Tres Mosqueteros* (nickname L3M) (The Three Musketeers) in reference to the novel by Alexandre Dumas.

Institutes and people involved in the L3M team are:

- Université de Versailles,
  Laboratoire d'Ingénierie des Systèmes de Versailles (LISV),
  Science and Technology Engineering School (ISTY),
  Vincent Hugel (faculty staff),
  Pierre Blazevic (faculty staff),
  Patrick Bonnin (faculty staff),
  Vincent Clavel (student staff).
- Universidad de Murcia,
  Dept. Ingenieria de la Informacion y las Comunicaciones,
  Grupo de Investigación de Ingeniería Aplicada (GIIA),
  Humberto Martínez Barberá (faculty staff),
  David Herrero Perez (faculty staff),
  Juan Jose Alcaraz Jimenez (student staff),
  Pedro Cavestany Olivares (student staff).
- Université Paris 8,
  Laboratoire d'Informatique Avancée de Saint-Denis (LIASD),

Nicolas Jouandeau (faculty staff),
Aldenis Garcia Martinez (student staff).
Loïc Thimon (student staff).
– Universidad Politécnica de Valencia,
Instituto Universitario de Automática e Informática Industrial (AI2),
Juan Francisco Blanes Noguera (faculty staff),
Manuel Muñoz Alcobendas (student staff),
Pau Muñoz Benavent (student staff).
– IT technology and computer Science Engineering School (EFREI),

2 Achievements

Both teams have gained experience in RoboCup since their first participation a few years ago in the standard AIBO league and now in the NAO SPL league. In march 2010, the Spanish team *Los Hidalgos* won the RomeCup tournament in the NAO league and the French team accessed the semi finales. The French team also participated in the German Open in April 2010, and passed the first round. These participations lead to significant achievements and improvements in the vision procedure and behavior design.

– The procedure for tuning camera parameters of the NAOs has been revised and improved in order to deal with varying lighting conditions as much as possible. Regarding the NAO camera, the most important parameters that must be tuned properly are gain, exposure time, red/blue chromas, brightness and sharpness. Auto gain, white balance and exposure should be disabled.
– Following the success of the Spanish team at the RomeCup, the L3M team has now an efficient real time calibration tool at disposal. This tool enables to build a look up table (LUT) in a few minutes for the colors used in the league, i.e. the orange ball, the blue and yellow goal poles, the green carpet and the white lines. The tool offers interesting features to accelerate the filling of the LUT and to enable the user to remove bad clusters from the color. This tool can be used for other purposes, not only for the soccer field of the SPL.
– The embedded vision module now captures images in native format, that is YUV422. The vision algorithm can process images in YUV422 or YUV format. Image processing in native YUV422 format leads to a significant time reduction of 50$[ms]$ for grabbing the image using the v1.6 naoqi middleware from the Aldebaran company that manufactures the robots. The time for capturing a full resolution 640x480 in YUV422 format takes 1 to 2 $[ms]$ with the 1.6 naoqi version.
– The panel of behaviors to score a goal was enriched thanks to the *hfsm* tool that enables to graphically design behaviors based on hierarchical finite state machines. The tool was developed for the AIBOs and adapted to work with the NAOs especially in matter of code compatibility [Hugel2006]. C++ code can be generated automatically to be cross-compiled and embedded in the robots.

3 Research objectives

The first objective expected is a fruitful cooperation between the French and Spanish institutes. This cooperation has already started by the exchange of ideas and source code. Research purposes will focus on vision, multi-robot behavior design, localisation/navigation and locomotion adapted to autonomous two-legged robotics.

3.1 Vision

The actual calibration tool that was developed for the German Open 2010 will be enriched with additional options for assisting the user in making the LUT. One of the option will be the use of specific edge-region growing algorithms [DeCabrol2006] that would accelerate the filling of the LUT. The edge-region algorithm will also be embedded with subsampling policies and benchmarked to check whether it can be used in real time to detect objects in the environment. The image processing algorithm must also include line detection. In addition, it must be possible for the decision module to call image processing procedures that are only dedicated to ball extraction, or line extraction, or poles extraction. An interesting research axis will consist of setting up learning procedures for the vision skills of the penalty kicker. Indeed the penalty kicker should be able to detect and identify the goal, the ball to kick, and the goalkeeper by itself, when being put in front of the goal where to kick.

3.2 Collaborative behaviours

Currently the design of behaviors is individual and based on hierarchical finite state machine design [Herrero2007]. Regarding individual behaviours, specific behaviors will be improved, especially that of the goalkeeper. Following the new rules, the goalkeeper can no longer stay in a stance that is wider than the width of the robot's shoulders for more than 5 seconds. It is therefore necessary to design a new strategy. At least two kinds of behaviours will be implemented. First, when the ball is close to the goal area, the goalkeeper must be able to go to the ball, kick it farther away, and go back to a defending position. Second, to get a chance to stop the ball kicked by an attacker the goalkeeper must be able to trigger a reflex move that increases the stance of the feet, then kick the ball farther away.

One of the most promising axes of improvement is robots'intercommunication, where robots would be able to exchange information and to switch roles dynamically in order to adopt a more efficient collective strategy according to external information and role stability. This involves the implementation of a distributed network architecture. 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.

3.3 Addressing localisation and navigation

The localization system must use white lines and goal frames of the soccer field [Herrero2006]. The navigation module will use global positioning thanks to probabilistic methods, but also local positioning with respect to detected edges using adapted Kalman filtering.
New locomotion walking patterns and the use of odometry make it possible to supply scalable movements that can be put together to fit well in a global path avoiding visible obstacles. For localization and navigation, 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 navigation system should allow us to avoid collision and to move safely between stationary obstacles [Michel2007].

3.4 Locomotion

Up to now non reentrant walking primitives have been used, but it is a severe limitation. The team has started to set up non-blocking and reentrant locomotion primitives. This will make the robots more reactive to external events. Robots must be able to cancel a current trajectory and start a new one, depending on the information extracted from the environment. Blocking mode will nevertheless be useful for small positioning in the case of reflex moves or kicks. As a consequence, the behavior scheme must be entirely revised. The team uses the Aldebaran locomotion primitives. These primitives have been improved from last year version, but velocity is limited, and it is not possible to control velocity when using position control. In order to have better control over locomotion, it is planned to rewrite a new and complete locomotion module for the end of the year. The new locomotion features will incorporate feedback from the inertial sensor and from the FSR foot sensors in order to keep balance as much as possible. The robot must be capable of achieving omnidirectional walk through the scheduling of high level movement commands. 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.

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