L3M SPL Team Description

Vincent Hugel[1], Juan Francisco Blanes Noguera[2], and Nicolas Jouandeau[3]

[1] Université de Versailles, Laboratoire d'Ingénierie des Systèmes de Versailles, France
hugel@lisv.uvsq.fr,
[2] Universidad Politécnica de Valencia, Instituto Universitario de Automática e Informática Industrial, Spain
pblanes@disca.upv.es
[3] Université de Paris 8, Laboratoire d'Informatique Avancée de Saint-Denis, France
n@ai.univ-paris8.fr

Abstract. This paper presents the French-Spanish joint team composition and describes the research objectives for its participation in the 2012 RoboCup Standard Platform League.

1 Team composition

The 2012 team is a joint team between the French team, the Spanish team named *Los Hidalgos*. The team name L3M is the acronym of the French novel title *Les Trois Mousquetaires* (The Three Musketeers) by Alexandre Dumas.

Institutes and people involved in the L3M team are:

- Université de Versailles (UVSQ),
  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),
  Nathan Ramoly (student).
- Universidad Politécnica de Valencia (UPV),
  Instituto Universitario de Automática e Informática Industrial (AI2),
  Juan Francisco Blanes Noguera (faculty staff),
  Manuel Muñoz Alcobendas (student),
  Pau Muñoz Benavent (student),
  Eduardo Munuera Sanchez (student).
- Université Paris 8 (UP8),
  Laboratoire d'Informatique Avancée de Saint-Denis (LIASD),
  Nicolas Jouandeau (faculty staff),
  Aldenis Garcia Martinez (student),
  Loïc Thimon (student).

2 Research interests

2.1 High priority research objectives

L3M team has defined two high priority research objectives that will be developed for RoboCup 2012 to enhance reactive skills of humanoid robots.

1. The first objective will aim at designing efficient collaborative behaviors between soccer robot players inside a team.
2. The second research objective will focus on designing a robust closed locomotion for biped robots.

1st high priority research objective: collective behaviors During past years, we have implemented a communication module that supports a simple message passing protocol [1]. It allows us to transmit current state and desired state to other players. Therefore, a decisional collective process can be activated to define next actions. It has been applied to simple collective situations and is integrated manually beside our hierarchical finite state automaton [2]. It remains interesting to address a distributed team play decision process to achieve complex actions.

Through the last SPL challenges results, we can suppose that some teams do not use any collective behaviors. This is probably due to time needed in such implementation. Through three 2010 technical reports (B-Human [3], rUNSWift [4] and Nao Devils Dortmund [5]), we can see that it is possible to establish primal data sharing system that allows collective playing. Such primal data sharing can contain only self position and ball position, as rUNSWift mentioned, or additionally state and desired state as we did. Goalie is not included in the collective process. For two other teams (B-Human and Nao Devils Dortmund), the collective behavior is more than primal and seems to be useful to score against non collective behaviors. B-Human switches between role and tactical view. The collective decision process is then well mastered. Nao Devils Dortmund considers in their technical report that XABSL has several disadvantages: the growing number of symbols to use and combine, the lack of a learning trend and the problem of decision making with instantaneous views in a constrained continuous timed process. To solve the first two ones, they use an action selection mechanism based on an artificial immune network that provides high level aspects of the game. To solve the last disadvantage, they integrate future coordinates of each player in the global decision process.

In the more classical literature, common single agents approaches exist to deal with decision process and can be easily declined to multi-agents cooperation. Potential fields, cellular automata and digital pheromone are one of those. On the one hand, as shared potential fields improve multi-robot coordination [6], we think that it can be applied first to set up an efficient collective looking for ball, and second to enhance efficiency more generally in many collective situations that could be complex.

On the other hand, extensions of XABSL have been recently proposed to specify collective behaviors [7]. Such concurrent hierarchical finite state machines are difficult to set for many players, where each single agent behavior has to contain options for each possible set of multiple agents. We think that a more graphical issue is possible to express collective behaviors over a message passing architecture. As robots can temporary lose connection with others, we think that a more consensual process is needed to maintain a coherent collective issue. We think that such architecture could allow us to anticipate future situations and to finalize such collective actions without final acknowledgments or with rendez-vous situations.

We have started to study these approaches, applying them to other domains like goods transport and tasks allocation [24–26]. We propose to experiment them in the next Robocup. We also believe that both can be extended in future years.

This research in collaborative behaviors is conducted by UP8 (University of Paris 8, France) and will be carried out in partnership with UPV (Universidad Politécnica de Valencia, Spain) and IFSTTAR (French Institute of Science and Technology of Transport, Planning and Networks).

2nd high priority research objective: robust closed loop biped 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 can be 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 French part UVSQ (University of Versailles, France) and the Spanish part (Univ. of Murcia) are already closely cooperating in the design of a new locomotion. The first step consists of implementing a robust open-loop algorithm using a preview controller as did Aldebaran-robotics company [12]. The second step deals with the estimation of the robot's center of mass that can be used for closed-loop control feedback. For measurements and control, we currently use the Matlab software interface for

NaoQi kindly provided by the Austrian team [14]. This interface is very useful since it permits to control the robot's joints remotely, get feedback from all kinds of sensors, and use the libraries of matlab for control algorithms and signal processing. The FSR sensors located in the feet can give a qualitative feedback of the portions of foot in contact with the ground. Qualitative information from foot sensors will be used to select the foot that is the most flat on the ground in the double support phase. The inertial sensor can be used quantitatively for control feedback. The third step will aim at designing a closed-loop locomotion algorithm based on center of mass estimation and preview controller. Here it is necessary to carry out benchmarks to check the real added value of the new locomotion algorithm with respect to other existing algorithms.
In order to improve the robot's capabilities to resist strong external disturbances due to stumbling or collisions with other robots, the motion module will also be modified to incorporate reflex motion. Reflex motion will be superimposed to walking gaits commands to anticipate loss of balance and falls. FSR sensors can be used here to anticipate loss of foot contact with ground.

2.2 Other research objectives

Other research objectives concern vision algorithm enhancements dedicated to color learning and detection of white lines and other interesting lines in the environment. Up to now the L3M team was using relative positioning with respect to goal poles. But this is not enough when robots are too far away from goals or when goals are obstructed by other robots on the field.

Vision: enhancement with color learning and robust white line detection The actual vision processing is based on a `yuv422` color space space analysis. The image interpretation is done by subsampling a `yuv422` image to obtain a processing time of 20ms. Our vision process includes a vertical segmentation in a similar way to other teams like [3] that wisely uses such segmentation. Our progressive subsampling steps have been studied in depth and quantified in our last report [1]. For the next year, we plan to study color learning to enable off-line and on-line enhancements like [8]. Such enhancements are also possible with simple shape segmentations [9].
Algorithms for detecting lines were already embedded on the NAOS. They can run at two or three times the video rate. However the identification and selection process of lines remains to be implemented and validated. This procedure is very tricky since false positive must be avoided. In a first step, white line detection will only be used for local situations, when the goalkeeper needs to position itself with to its goal area, and when the first attacker that is supposed to kick-off must position itself with respect to the central circle.

References

[1] V. Hugel, N. Jouandeau and J. José Alcaraz Jiménez. L3M Joint Team report, Participation in the 2010 RoboCup SPL league. Technical report. http://www.lisv.uvsq.fr/~hugel/robocup/qualification/2010_SPL_L3M_Team_Report.pdf

[2] 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.

[3] T. Röfer, T. Laue, J. Müller, A. Burchardt, E. Damrose, A. Fabisch, F. Feldpausch, K. Gillmann, C. Graf, T. Jeffry de Haas, A. Härtl, D. Honsel, P. Kastner, T. Kastner, B. Markowsky, M. Mester, J. Peter, O. Jan Lars Riemann, M. Ring, W. Sauerland, A. Schreck, I. Sieverdingbeck, F. Wenk and J.H. Worch. B-Human Team Report and Code Release 2010. Technical report. http://www.b-human.de/en/publications/

[4] A. Ratter, B. Hengst, B. Hall, B. White, B. Vance, C. Sammut, D. Claridge, H. Nguyen, J. Ashar, M. Pagnucco, S. Robinson and Y. Zhu. rUNSWift Team Report 2010. Technical report. http://robocup.web.cse.unsw.edu.au/

[5] S. Czarnetzki, S. Kerner, O. Urbann, M. Hofmann, S. Stumm and I. Schwarz. Nao Devils Dortmund Team Report 2010. http://www.irf.tu-dortmund.de/nao-devils/download/2010/TeamReport-2010-NaoDevilsDortmund.pdf

[6] J.L. Baxter, E.K. Burke, J.M. Garibaldi and M. Norman. Shared Potential Fields and their place in a multi-robot co-ordination taxonomy. Robotics and Autonomous Systems 2009.

[7] M. Risler and O. von Stryk. Formal Behavior Specification of Multi-Robot Systems Using Hierarchical State Machines in XABSL. AAMAS08-Workshop on Formal Models and Methods for Multi-Robot Systems 2008.

[8] M. Sridharan and P. Stone. Color Learning on a Mobile Robot: Towards Full Autonomy under Changing Illumination. IJCAI07-International Joint Conference on Artificial Intelligence 2007.

[9] R. Tilgner, T. Reinhardt and S. Seering. *private conversations*

[10] V. Hugel, P. Blazevic, O. Stasse, P. Bonnin. Trot Gait Design Details for Quadrupeds. Lecture Notes in Computer Science. RoboCup 2003: Robot Soccer World Cup VII. Volume 3010/2004. 495–502.

[11] 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.

[12] Gouaillier, David. Conception mécanique et commande de l'appareil locomoteur d'un robot humanoïde. PhD thesis. December 11, 2009. University of Versailles, France. In French.

[13] Gouaillier, David and Hugel, Vincent and Blazevic, Pierre and Kilner, Chris and Monceaux, Jérôme and Lafourcade, Pascal and Marnier, Brice and Serre, Julien and Maisonnier, Bruno. Mechatronic design of NAO humanoid. Proceedings of the 2009 IEEE international conference on Robotics and Automation. 2009. 2124–2129.

[14] Markus Bader. Matlab interface for NaoQi.
https://sites.google.com/a/austrian-kangaroos.com/public_en/download.

[15] Vincent Hugel and Remi Hackert and Anick Abourachid, Exploiting Bird Locomotion Kinematics Data for Robotics Modeling. CoRR. Volume abs/0807.3225. 2008. http://arxiv.org/abs/0807.3225.

[16] J. J. Alcaraz-Jiménez, D. Herrero-Pérez and H. Martínez-Barberá, Planning CoM Trajectories for an Omni-directional Dynamic Gait in Humanoid Soccer Robots, in Proc. of XI Workshop of Physical Agents, pp. 123-130, Valencia, Spain, 2010.

[17] F. Blanes, P. Muñoz, M. Muñoz, J.E. Simó, J.O. Coronel, M. Albero. Embedded Distributed Vision System for Humanoid Soccer Robot. Journal of Physical Agents.

[18] N. Jouandeau and P. Bonnin and V. Hugel and P. Blazevic. From Color Groups to Scene Interpretation, WHSR 2009, Workshop of Humanoid Soccer Robots, Paris 2009.

[19] V. Hugel and N. Jouandeau. L3M Joint Team report, Participation in the 2009 RoboCup SPL league. Technical report.
http://www.lisv.uvsq.fr/~hugel/robocup/qualification/2009_SPL_French_Team_Report.pdf

[20] F. Blanes, P. Muñoz, M. Muñoz, J.E. Simó, J.O. Coronel, M. Albero. Embedded Distributed Vision System for Humanoid Soccer Robot. Journal of Physical Agents Vol 5 N° 1, January 2011

[21] J.J. Alcaraz-Jimenez, David Herrero-Perez and H. Martínez-Barbera. Motion Planning for Omnidirectional Dynamic Gait. Humanoid Soccer Robots, Journal of Physical Agents, 5(1):25-34, 2011.

[22] J.J. Alcaraz-Jimenez, David Herrero-Perez and H. Martínez-Barbera. Omnidirectional Locomotion for the Hidalgos Humanoid Soccer Team. XII Workshop of Physical Agents, 2011.

[23] J. J. Alcaraz-Jiménez, D. Herrero-Pérez and H. Martínez-Barberá. A Closed-Loop Dribbling Gait for the Standard Platform League. Workshop on Humanoid Soccer Robots of the IEEE-RAS Int. Conf. on Humanoid Robots (Humanoids), 2011.

[24] N. Jouandeau, Z. Yan. Improved Trade-based multi-robot coordination. ITAIC 2011, 6th IEEE Joint International Information Technology and Artificial Intelligence Conference, ISBN 978-1-4244-8622-9.

[25] Z. Yan, N. Jouandeau, A. Ali Cherif. Multi-Robot Decentralized Exploration Using a Trade-Based Approach. ICINCO 2011, 8th International Conference on Informatics in Control, Automation and Robotics.

[26] A. Belbachir, S. Lacroix, F. Ingrand, M. Perrier, J. Opderbecke. Cooperative-adaptive algorithms for targets localization in underwater environment Autonomous Underwater Vehicles (AUV), 2010 IEEE/OES.