L3M-SIM Team Description

Nicolas Jouandeau[1], Vincent Hugel[2], and Thomas Da Costa[3]

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

Résumé This paper presents the French team composition and research objectives for its third participation in the 2013 RoboCup 3D Simulation Soccer League.

1 Team composition

The team name comes from *Les Trois Mousquetaires* in reference to the novel by Alexandre Dumas. The members mainly comes from the standard platform league, where the french team is named L3M. As a part of the L3M team has decided to experiment the 3D Simulation Soccer League, we chose the name of L3M-SIM.

Institutes and people involved in the L3M-SIM team are :

- Université Paris 8,
  Laboratoire d'Informatique Avancée de Saint-Denis (LIASD),
  Nicolas Jouandeau (faculty staff),
  Département d'Informatique,
  Thomas Da Costa (student staff).
- Université de Versailles,
  Laboratoire d'Ingénierie des Systèmes de Versailles (LISV),
  Science and Technology Engineering School (ISTY),
  Vincent Hugel (faculty staff).

2 Research objectives

2.1 Team play

For this third participation, we will continue to study cooperation between agents. Agents are able to communicate with short messages. Communication is done with a say effector, that supposed hearing from others to receive information. Messages have a maximum length and hearing is limited to a number of message per cycle. These restrictions constrain communication mechanisms that are admissible to fulfill the communication needs to cooperate in real time.

During past years, we have implemented in the SPL League, 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 decision 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 automata [2].

As teams are extended to 11 players in 3D-SSL League, cooperation is more important. 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. As shared potential fields improves the multi-robot coordination [3], we try to apply this to establish an efficient collective looking for ball and to establish more generally efficiency in many collective situations that could be complex.

As extensions of XABSL have been recently proposed to specify collective behaviors [4], they are known as difficult to set for many players, where each single agent behaviors have to contains options for each possible set of multiple agents. More graphical issue is currently admitted to express collective behaviors. Formation based approaches are the most common adopted solution that can lead to complex reasoning [10] and even learning [11]. The goal is here to combine skillfully :

- such strategic collective position (where players repartition tries to cover the field and all opponents expected offenses)
- opportunistic actions that could lead to score a goal or to come closer to opponents goal

Our strategic collective positions are based on Case-Based Reasoning [9]. Cases are simply represented on a grid where players have area of action, the ball have an area of position. Figure 1 shows 11 players positions definition and its corresponding situation in the field. Each player's area is identify with a specific color and enlightened squares define players default positions inside their areas. For all positions of the ball on the field, we define a set of strategies for collective positioning. Thus according to an area where the ball can be, each player have a behavior defined with an area, a position inside the area, and a role. Depending on the role, the area's limits or the inside position can be useless. Actually, roles look like :

- go to the ball and kick it
- go to the ball, align to opponents goal and go forward
- go at your position inside your area, look for ball and be ready to go
- align to the ball, stay inside your area, look for ball and be ready to go
- place yourself on your opponent path

Our strategy editor is a GUI that allows to describe players behaviors. The field is represented by a grid with dimensions that are set at the begining. Then players behaviors are added on this grid. Player that have no behavior are simply keeping their position. Finally the editor generates a file that is load by each player at start.

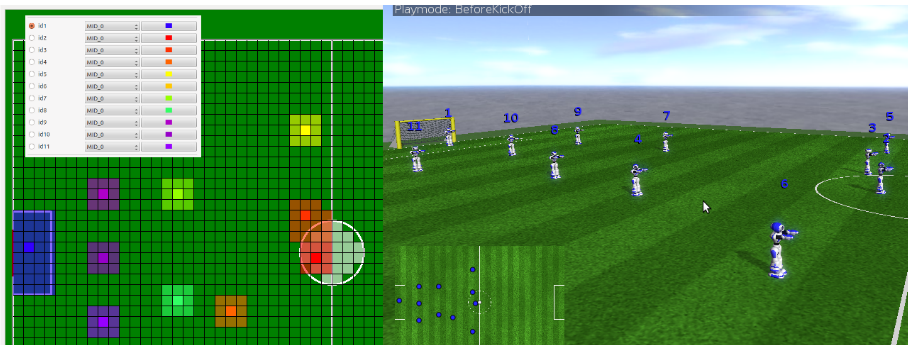

Figure 1. An example of 11 players positions definition.

Opportunistic actions are achieved with a decentralized decision making system, that is called trade-based method [5,6]. This technique is designed to simulate the relationship between buyers and sellers in a business system, to achieve dynamic task allocation by using a mechanism of unsolicited bid. The well known auction-based method and the market-based method are applied in some RoboCup teams to coordinate agents for task allocation. These methods function well but they are not suitable for RoboCup system which is an environment with quite a few constraint, especially in computational efficient and communication. Therefore, a lightweight and robustness task allocation technique is appropriate to coordinate the players in RoboCup. We have started to study such approaches and we propose to experiment them in the next 3D-SSL RoboCup. We also believe that both can be extended in future years.

2.2 Motion module

Since last year the motion module has been improved by the three following features :

- the locomotion algorithm has been tuned to increase walking speed. The walking step time is now $0.18[sec]$, which allows a maximal forward speed of $40[cm/sec]$. In addition the way to send joint commands to the server has been adjusted to enable this increase of walking speed. The interval time for sending joint commands is now $10[ms]$ instead of $20[ms]$. Developments are under way to increase speed even more to reach $60[cm/sec]$ by varying step time and controlling the placement of the Zero Moment Point (ZMP).
- direct and inverse geometric models of NAO legs and arms have been completely rewritten to be usable for 3D-SSL and SPL leagues in RoboCup. The models are made generic so that any configuration change in joint placement, joint axis orientation, and body dimensions/size can be taken into consideration by simply changing adequate parameters without rewriting pieces of code. A paper about this generic modeling is in preparation to be submitted to the RoboCup Symposium.

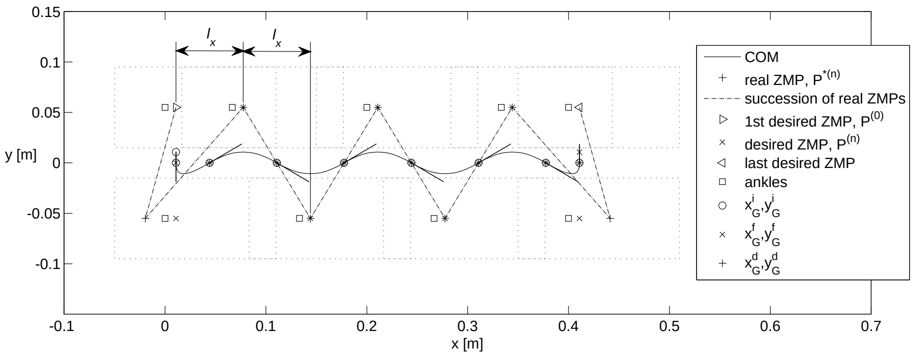

FIGURE 2. Forward walk of $0.4[m]$ from left to right. ℓ_x is the step length. Footprints are in dotted lines. The COM trajectory is depicted. Successive real ZMPs are joined for better understanding.

– predefined motions that can be parameterized have been introduced to deal with all useful movements during the game : recovery procedures from lying positions, and kicks. They have been implemented using object oriented templates to enable quick design of additional moves. Thanks to this development the time to recover from falls has been reduced by 50%.

The locomotion algorithm is based on the well known 3D-LIP model [7][8] that consists of defining walking primitives of the center of mass (COM), keeping its height constant and assuming no torque at the support foot. The COM trajectory is linked to the Zero Moment Points through the differential equations :

$$\ddot{x}_G = \frac{g}{z_G}(x_G - x_{P^*})$$
$$\ddot{y}_G = \frac{g}{z_G}(y_G - y_{P^*})$$

where (x_G, y_G, z_G) are the COM coordinates, and $(x_{P^*}, y_{P^*}, 0)$ are the ZMP coordinates. g is the gravity.

The algorithm connects walking primitives that have the shape of hyperbolic curves with continuity of velocity (Fig. 2). The added value of the algorithm resides in the rotation walking primitives that are generated differently from the linear translation walking primitives. This enables the robot to achieve fast rotation on the spot or about a center located on the longitudinal axis. The algorithm also addresses the issue of re-entrance, i.e. how to take into account a new walking request in real time without waiting for the end of the current walk. Details of implementation can be found in the paper published in the IEEE Ro-Man conference [12].

Références

[1] V. Hugel, N. Jouandeau and J. José Alcaraz Jiménez. L3M Joint Team report, Participation in the 2010 RoboCup SPL league. tech report.

[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] 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.

[4] 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.

[5] Z. Yan, N. Jouandeau and A. Ali Cherif. On the problem of task planning in multi-robot systems. Proceedings of the 9th International Conference on Informatics in Control, Automation and Robotics (ICINCO 2012).

[6] Z. Yan, N. Jouandeau and A. Ali Cherif. Towards a probabilistic roadmap for multi-robot coordination. Proceedings of the 2012 International Conference on Artificial Intelligence (ICAI 2012).

[7] K. Hara, R. Yokogawa, and K. Sadao. Dynamic control of biped locomotion robot for disturbance on lateral plane. The Japan Society of Mechanical Engineers, pages 37-38.

[8] S. Kajita. Humanoid Robot. Ohmsha Ltd, 3-1 Kanda Nishikicho, Chiyodaku, Tokyo, Japan.

[9] R. Ros , R.L. De Màntaras , J.L. Arcos and M. Veloso Beyond Individualism : Modeling Team Playing Behavior in Robot Soccer Through Case-Based Reasoning. 22d AAAI Conference on Artificial Intelligence, Vancouver, Canada, July 22-26, 2007. AAAI Press, 1671-1674.

[10] N. Lau, L.S. Lopes, G. Corrente and N. Filipe. Multi-robot team coordination through roles, positionings and coordinated procedures Intelligent Robots and Systems, 2009. IROS 2009. IEEE/RSJ International Conference.

[11] B.M. Faria, L.P. Reis, N. Lau and G. Castillo Machine Learning algorithms applied to the classification of robotic soccer formations and opponent teams Cybernetics and Intelligent Systems (CIS), 2010 IEEE Conference

[12] V. Hugel and N. Jouandeau. Walking Patterns for Real Time Path Planning Simulation of Humanoids. IEEE RO-MAN 2012. pages 424-430.