L3M-SIM Team Description

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Résumé This paper presents the French team composition and research objectives for its first participation in the 2011 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 plateforme 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),
  Zhi Yan (faculty staff),
  Nicolas Jouandeau (faculty staff),
  Loic Thimon (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 Collective behaviors

For this first participation, we want to study cooperation between agents. In the Simulation Soccer League, communications are permitted using the say effector that allows to broadcast messages. Hearing such messages is available by using hear parser that includes restrictions such as a maximal message length and maximal number of messages hear at the same time. These restrictions constrain communication mechanisms that are admissible to fulfill the communication needs to cooperate in real time.

During the past year, we have implemented in the SPL League, a communcation 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 automata [2]. As it has been done manually, it remains useless for more than three agents. Starting from this, we planned to study an interactive graphical representation that could allows us to integrate more easilly collective behaviors.

In the more classical literature, common single agents approachs 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 think on the first side that it can be apply firstly to establish an efficient collective looking for ball and secondly to establish more generally efficiency in many collective situations that could be complexe.

On the other side, extensions of XABSL have been recently proposed to specifiy collective behaviors [4]. Such concurrent hierarchical finite state machines are difficult to set for many players, where each single agent behaviors have to contains 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 aknowledgments or with rendez-vous situations.

In a previous work [5], we considered the problem of coordinating and planning multiple agents by using a decentralized decision making system, that is called trade-based method. 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 Locomotion

The real NAO robots cannot walk as fast as the NAO robots can do in 3D simulation.

The first attempt to make the nao robots walk in simulation was to record different patterns of motion from the real robot walking on the carpet or moving legs in the air. The real robots were programmed to walk using the walking primitives provided by the Aldebaran-Robotics company.

This works in simulation but motion speed is slow compared with other implementations by other teams. Moving joints faster can help to gain 30 to 50 percent speed but it is rather limited.

Another solution will be to design walking functions from scratch, first open-loop functions that enable the robot to walk without falling too often, then design closed loop functions taking into account feedback from inertial sensor. However the closed-loop algorithm used in simulation for walking primitives will not be the same as the closed-loop algorithm used for real robots. This is because real sensors do not behave like simulated sensors, and because the model of contact between foot sole and ground cannot reflect the real contact. It will be necessary to investigate the model of contact used in simulation and take it into account for the design of the dynamic walking primitives.

The open loop algorithm used for the locomotion in 3D simulation is based on the LIP-3D pendulum (Linear Inverted Pendulum) [6,?]. This technique considers that the robot can be modeled with an inverted pendulum with the mass concentrated on the top. The center of mass (COM) remains at constant height zc. The generation of the COM trajectory is derived from the following equations (longitudinal and lateral directions) :

$$d^2/dt(x) = g/zc.x$$

$$d^2/dt(y) = g/zc.y$$

The trajectory of the center of mass is composed of walking primitives. It is generated with hyperbolic cosine and sine time functions. Each walking primitive takes into account the left or right foot as support foot. Walking primitives must be connected to enable successive steps. Thanks to the COM trajectory each foot trajectory can be calculated. The inverse geometric model of the leg is then used to get the angles to send to the joints. This inverse geometric model is also useful to build predefined movements, like knee flexion/extension, hip swaying and kicks. Figure 1 shows respectively qt-opengl snapshots of the corresponding model on its left part and the left kick of the right.

Références

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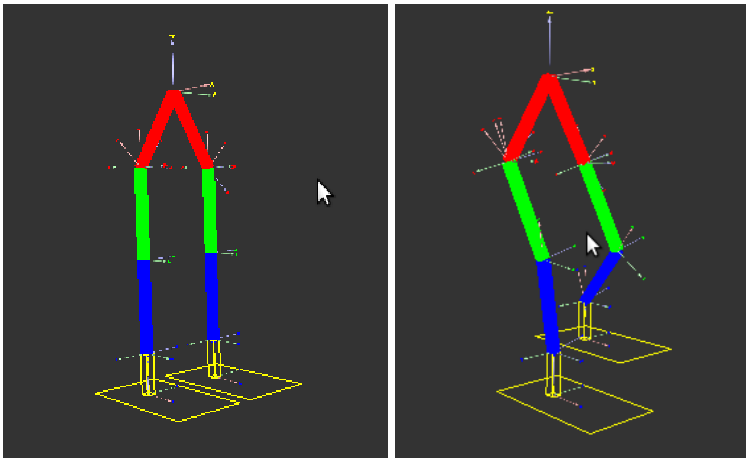

Figure 1. snapshots of the corresponding model

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