Sujet de thèse - campagne 2016-2017

Laboratoire : Institut des Systèmes Intelligents et de Robotique (ISIR CNRS UMR7222)

Etablissement de rattachement : Université Pierre et Marie Curie

Titre de la thèse : Interpersonal Interactions and Attitudes in Small Groups

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Collaborations dans le cadre de la thèse : Collaboration avec le LTCI

Rattachement à un programme:

Cotutelle envisagée:

Si oui avec quelle université & quel laboratoire :

Le sujet peut-il être publié sur le site web de l’ED SMAER : Oui

Résumé du sujet :

Most of works in human-robot interaction focus on dyadic interaction. Automatically analyzing, modeling and synthesizing nonverbal behaviors at the group level is required for efficient multi-party human-robot interactions. Such interactions involve complex behaviors and dynamics since a participant could be a side participant, an overhearer or a bystander, it could leave the interaction and other participants could join in. The main objective of this thesis is to develop models of multi-party human-robot interactions. This will be built upon computational models of the dynamics of social interaction. In particular, we will investigate the emergence of interaction between of autonomous agents (e.g. social robots) exploiting nonverbal behaviors such as turn-taking. We will develop adaptation mechanisms of each robot behavior to the attitudes of the partners of the interaction. The models will be adapted to human interactions by extracting nonverbal behaviors such as who is speaking, who is listening, body and head orientation and proxemics. We will assess the dynamics of interaction, the contribution and influence of each member of the group, by measuring various dimensions of interpersonal synchrony such as mimicry and causality. The proposed models will be applied to various scenarios of multi-party human-robot interactions such as collaborative tasks and social interactions (e.g. chat).
There is a growing interest for automatically analyzing, modeling and synthetizing non-verbal behaviors at the group level (i.e. interaction involving several participants). Structure of the group could be static or dynamic with at least three participants. Multi-party interactions involve complex behaviors and dynamics since a participant could be a side participant, an overhearer or a bystander, it could leave the interaction and other participants could join in. All participants adhere to specific social norms governing, for example, their distance and body orientation in order to coordinate, to make it easier to interact with each other and to mark their social attitude toward each other.

Recently, LTCI proposed a computational model for the real time generation of non-verbal behaviors supporting the expression of interpersonal attitudes for turn-taking strategies and group formation in multi-party conversations among embodied conversational agents (Ravenet et al., 2013). The key idea is to manage the group interaction (e.g., who takes the turn, who keeps it) through the expression of non-verbal behaviors that is modulated by the attitude of each virtual agent (intention to express towards all the other group members). The agents adapt their spatial position and orientation, their turn-taking and communicative behaviors in function of their intentions and social attitudes. The expression of interpersonal attitudes is obtained, within each agent, by modulating its communicative non-verbal behavior (linked to intentions) as function of the attitude that it intends to express towards all the other group members.

In parallel, ISIR is currently investigating automatic characterization of interpersonal interaction through automatic analysis of social signals exchanged between partners (Delaherche et al. 2012). The concept of interpersonal synchrony has been employed to model dyadic and group interactions. A number of quantifiers have been proposed to characterize different aspects of synchronization between partners within an interaction as well as of the interaction itself. As a result, ISIR is able to measure and quantify the quality of the interaction.

Most of works in human-robot interaction focus on dyadic interaction (cf state of the art review paper by (Leite et al, 2012)). However, few addresses group interaction either involving several robots or humans. Among the existing works we can note group models for collaborative tasks (Triebel et al. 2015 ; Vroon et al. 2015) where robots or humans bring their complementary competences. Very few works look at modeling behaviors for social robots while interacting with other robots or humans (Skantze et al. 2015 ; Klotz et al. 2011). This thesis is set in this research topic.

Objectives:
The main objective of this thesis is to develop models of multi-party human-robot interactions. This will be built upon computational models of the dynamics of social interaction. In particular, we will consider two situations (i) without humans (only a group of social robot), (ii) with humans. The first situation will be employed to develop and study adaptation of each robot behavior to the attitudes of the partners (i.e. robots) of the interaction. This will result in a rich model of turn-taking management exploiting nonverbal behaviors such affect bursts and backchannels. We will also consider interruptions and speech overlaps as signs of dominance attitude or disengagement (Cafaro et al., 2016). It is expected to develop computational models of group dynamics describing
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the emergence of interaction in small groups of robots. The second situation (interaction with robots and humans) requires automated human behavior analysis for extracting nonverbal behaviors such as who is speaking, who is listening, body and head orientation and proxemics. These features will be employed to adapt the computational model of group dynamics. We will assess the dynamics of interaction, the contribution and influence of each member of the group, by measuring various dimensions of interpersonal synchrony such as mimicry and causality.

The final step of this thesis is the development of computational models of interpersonal interactions able to influence behaviors of humans and other artificial agents during multi-party human-robot interactions. In particular, we will study how attitudes of each member of the group dynamically evolve during an interaction.

The proposed models will be applied to various scenarios of multi-party human-robot interactions such as collaborative tasks and social interactions (e.g. chat).

The evaluation of the models will be performed through (1) experimental studies with adequate questionnaires and (2) measurement of interpersonal patterns.

Publications:

Brian Ravenet, Angelo Cafaro, Beatrice Biancardi, Magalie Ochs, Catherine Pelachaud, Conversational Behavior Reflecting Interpersonal Attitudes in Small Group Interactions, International Conference on Intelligent Virtual Agent (IVA2015), Delft, Netherlands, August 2015.


