Università di Genova | DIPARTIMENTO INFORMATICA, BIOINGEGNERIA, ROBOTICA E INGEGNERIA DEI SISTEMI

Computer Science Workshop
PhD program in Computer Science and Systems Engineering

Computational Models of Group Potency from Social Interaction in Small Teams

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Hybrid Intelligence and mixed teams

Hybrid Intelligent (HI) systems [1] combine human and artificial intelligence. One of their goals is to implement new paradigms where machines collaborate with humans in mixed teams. These systems need to analyse and understand human social behaviour, and to devise appropriate strategies of intervention to participate in a team and improve its performances.

Emergent states

The performances of a team are strictly connected with social interaction among team members and with emergent states. These are "*constructs that characterize properties of the team that are typically dynamic in nature and vary as a function of team context, inputs, processes and outcomes*" [8]. Computational approaches to analysis of emergent states is therefore a strategic breakthrough towards mixed HI teams.

Group potency

This thesis focuses on *group potency*, a motivational emergent states consisting of "*the belief that the group can be effective*" [4]. Potency has a direct link with team performances [3], thus becoming an ideal candidate for automatic analysis and target for intervention.

Main Objectives

Proposing a multi-modal computational model to analyse the behaviour of a team and predict "*group potency*" [4]. In particular, my research questions are:

1. Showing that *group potency* can be classified from multi-modal features, in the first instance as a binary classification problem and subsequently as a multi-class problem;
2. Analysing the contribution of different modalities such as speech, movement, facial expressions and verbal behaviours, and investigating fusion approaches;
3. Analysing the contribution of individual behaviours in conjunction with social interaction behaviours;
4. Analysing the dynamics of *group potency* and its pattern of emergence, taking into account the time dimension [10].

Materials

To address the automated analysis of team potency, we used 5 data sets on social interaction spanning a wide variety of tasks and scenarios (Figure 2):

- AMI [9]: team discussing about different topics at a meeting;
- MULTISIMO [6]: teams taking part in a quiz game;
- GAME-ON [7]: teams playing an escape room game with Cluedo like rules;
- TA2 [2]: teams playing Battleship and Pictionary in a video call;
- Panoptic [5]: teams seeking an agreement to divide an amount of money.

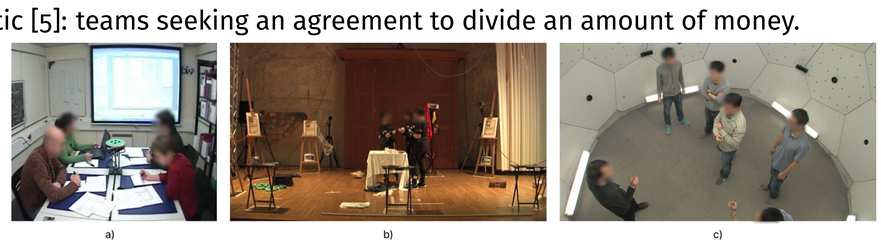

Figure 1: Sample frames of 3 data sets: (a) AMI[1], (b) GAME-ON, (c) Panoptic

[1] https://groups.inf.ed.ac.uk/ami/corpus/

Preliminary study

To investigate the feasibility of our study, we first aim to classify small teams as being high or low on potency scores by mean of machine learning algorithms such as Logistic Regression, Support Vector Machine, and Gradient Boosting classifier. We start from prosodic, turn-taking and body-movement features (e.g., root mean square energy of speech, duration of overlapping-speech and kinetic energy of the upper body) (Figure 3).
Moreover, we aim to show the contribution of each modality by comparing the results of the models trained with the modalities fused at the feature-level, against those that exploit fusion at the decision-level.

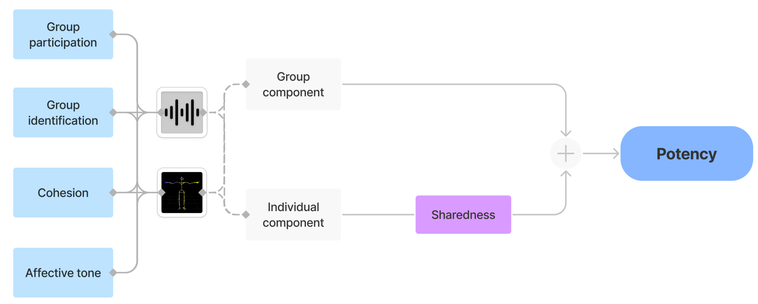

Figure 2: Multi-modal computational framework for group potency

We expect to find that our models are able to classify small teams as being high or low on potency, above the chance level. Moreover, we expect that models trained with the early fusion method can better classify teams with respect to those trained separately on each modality.
In future studies we plan to take into account a wider set of features, by exploiting additional modalities such as facial expressions and verbal features as well as to exploit DNN architectures such as LSTMs to take into account the dynamics of potency over time.

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