

A Survey of Collective self-awareness (CA) in Multi-robot Systems (MRS)

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Problem Imagine n mobile agents of a swarm are supposed to pick up a payload from a starting point and deliver to a destination which is defined relative to the starting point.

$$A = \{a_1, \dots, a_n\} \quad (1)$$

1 Individual Dynamism of Semantic segments

Lets say n words can be formed out of the alphabets from different time derivative orders as proposed in Kanapram et al. (2020)

$$W = \{w_1, \dots, w_p\} \quad (2)$$

in which each w_i is formed of centroids

2 Collective DBNs

If so far q formations (collective movement) is learned then for each of those f formations, each pair of agents should maintain a predefined relation at any time instance during the course of that formation.

$$CDBN_{ij} = \{CDBN_{1ij}, \dots, CDBN_{qij}\} \quad (3)$$

In which i, j are the two Intelligent agents. Each CDBN can be trained using sequences of quasi-constant Generalized States regions which have happened simultaneously between each pair of agents.

3 From local preception to collective behavior

$$b : \Omega \in P(W) \longrightarrow CDBN \quad (4)$$

4 Control

If c is a controller that maps a word from D to an action (e.g. in a quad-rotor, sends four power requests to four rotors, $a \in A = (p_1, \dots, p_4)$)

$$c : W \longrightarrow A \quad (5)$$

5 Online Learning

For each agent in A , choosing a random $w_i \in W$ and sending it to c to estimate the new state in order to measure the minimum abnormality change against all the CDBNs. This abnormality value could be used as the reward. if the abnormality value has increased then the reward would be negative value of the change rate, otherwise it will be a positive value.

6 Communication

Challenges

- How to convert words of Equation 2 to control inputs?

References

Divya Kanapram, Fabio Patrone, Pablo Marín-Plaza, Mario Marchese, Eliane L. Bodanese, Lucio Marcenaro, David Martín Gómez, and Carlo S. Regazzoni. Collective awareness for abnormality detection in connected autonomous vehicles. 2020.