Collective Self-awareness in Multi-Robot Systems

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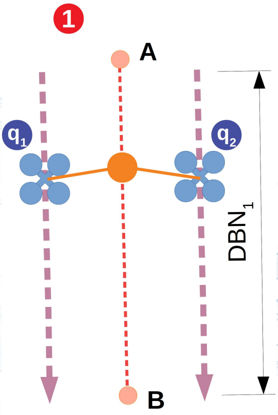
Problem Definition, Initial knowledge

Two drones (A, B) from which a payload is suspended, are being controlled by two human pilots.

- As an initial knowledge they build a causal-temporal model to predict and estimate their future states while the connecting distance vector for an experience in which the distance vector between them stays stable from

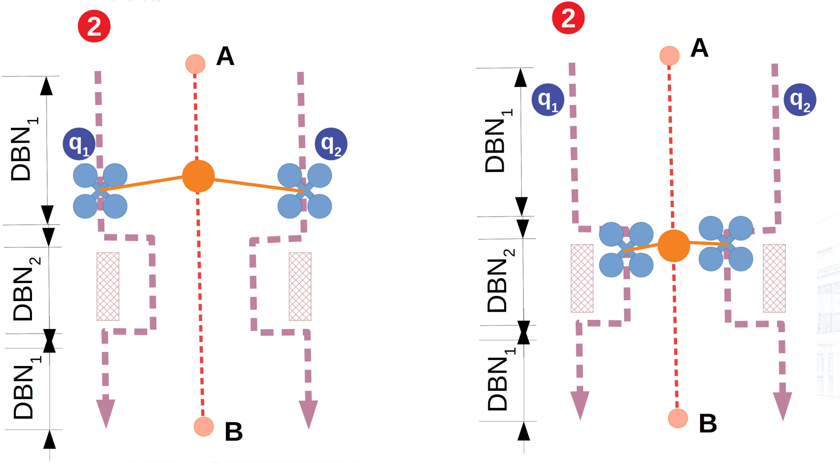
Problem Definition, Illustration of initial knowledge



Problem Definition, New experience

- As a new experience when the two pilots see a narrower corridor, they decide to temporarily reduce the distance between the two drones to avoid collision with the boundaries of the new corridor.

Problem Definition, Illustration of new experience



Relevant sensor available data

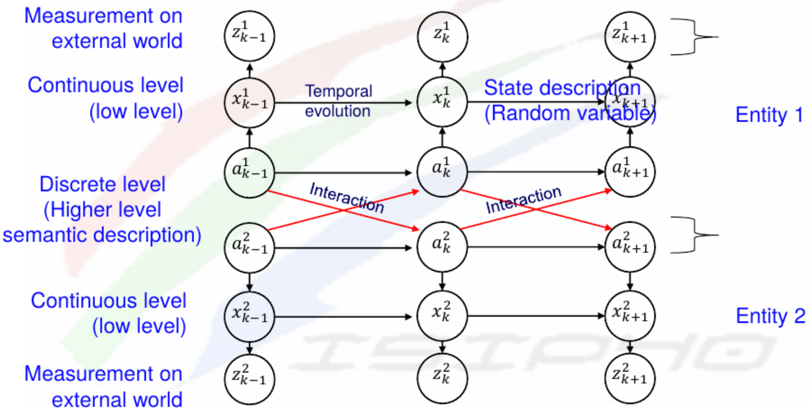
For each drone (for example for drone 1 in this case) and each identical time instance k these data could be measured by the sensors.

- Position: $x^1 = (x_k^1, y_k^1, z_k^1)$ (Orientation is also available, but seems to be irrelevant for these scenarios)
- Velocity: $\dot{x}^1$ (Angular velocity is also available but seems irrelevant for these scenarios)
- Acceleration: $\ddot{x}^1$ (Angular acceleration is also available but seems irrelevant for these scenarios)
- The motion will be shown as $m^1 = [\dot{x}^1, \ddot{x}^1]$
- The GS is $GS^1 = [x^1, \dot{x}^1, \ddot{x}^1]$

Solution 1: Interactive DBNs

- Considering m as prorproceptive data for each drone and the x as the exteroceptive.
- For each drone, using a clustering method such as SOM/GNG,... to create the super states from x (Alphabets).
- Taking each two mutually happened super states (alphabets) as a word.
- Building the transition matrix according to evolution of the aforementioned words.
- Detecting abnormality by statically comparing the predicted distribution of the next word by the transition matrix and the predicted PDF parameters of the formed word from current estimated PDF of alphabetical observations.

Solution 1: Interactive DBNs



Solution 1: Interactive DBNs

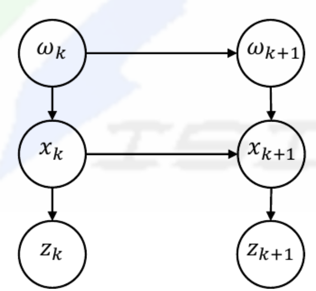
Literal: If our mutual next position region does not follow the rules(the PDF params) we expected, then we are experiencing a new relation that we never had.

Solution 2: Active-self approach

Literal: Its changes in my GS that causes changes in opposite drone's change

- Taking GS^1 as proproceptive data/Observation/Cause
- Taking GS^2 as exteroceptive data/effect/states
- Clustering GS^2
- Building DBN's transition
- If for the current time instance the estimated PDF params for GS^2 clusters is too far from the predicted PDF params, then a new experience is occurring between the drones.

Solution 2: Illustarion of Active-self approach



Solution2 : Passive-self approach

Exactly like the previous one but this time each drone considers the other one responsible for the changes in its *GS*

Solution 3: Different modalities?

I have not yet read the paper.

Question to address in the first paper.

- Which of the following solutions help better with detecting new experiences?

Why distance vector is not used explicitly?

Because I have not dependent sensor to measure the distance between the two drones.