Beetle Squad

Improving Robustness and Efficiency for Flock Control of Nonholonomic Agents

Maxime Bernard[1] and Jonatan Uziel Alvarez-Munoz[1]

[1]Extia - Pôle Innovation

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- **Motivations**
- **Experimental platform**
  - Hardware
  - Software
- **Event-based control**
- **Experiments**

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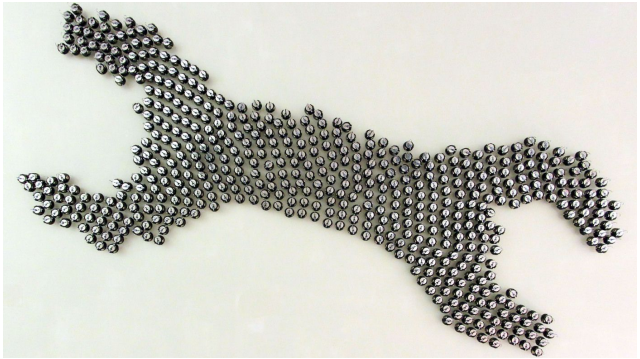
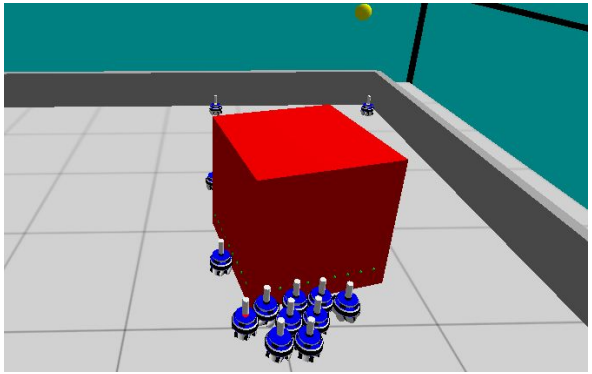
Motivations

Search and Rescue (®The Horizons Tracker)



Collective Intelligence (®Harvard University)



Collective transport (®A. Parwal)

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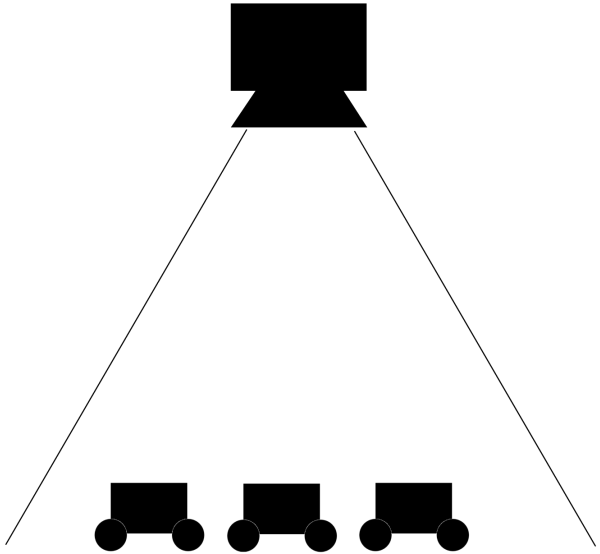

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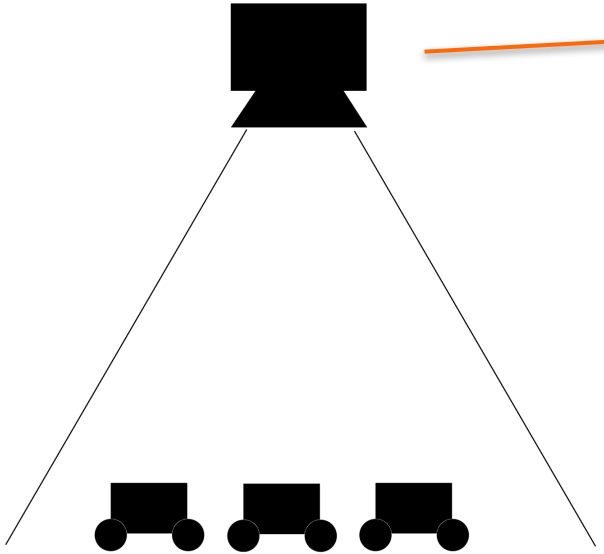
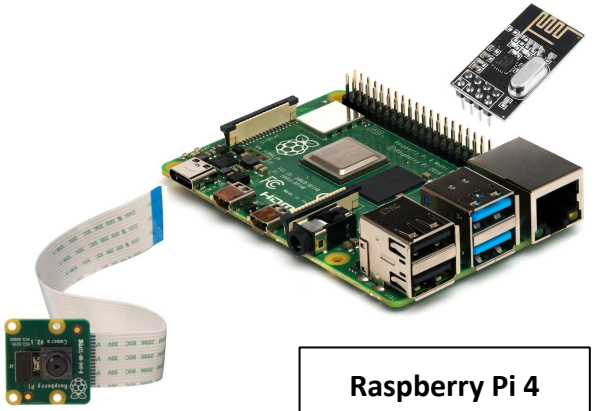
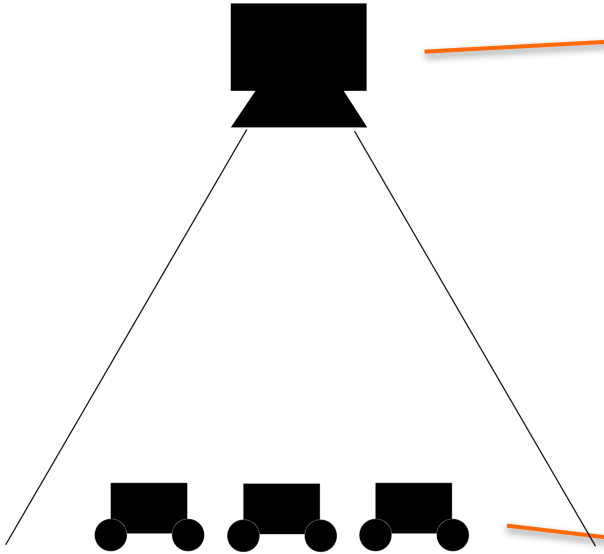
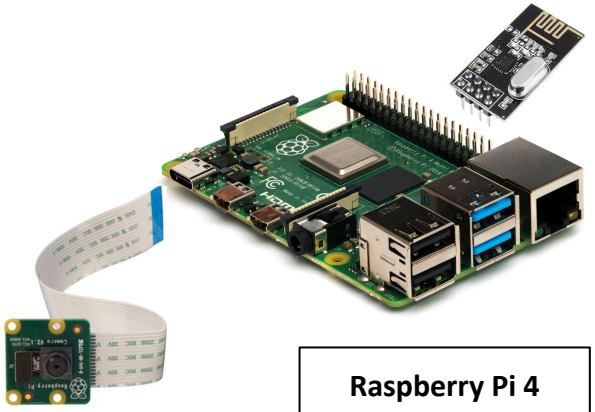




Raspberry Pi 4
Pi Camera Module
nRF24 transceiver

Experimental platform





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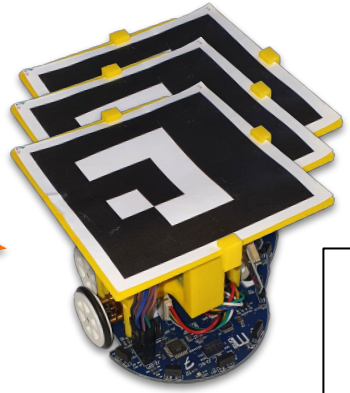

Mona Robots (ICE 9)
ArUco Markers
nRF24 transceiver

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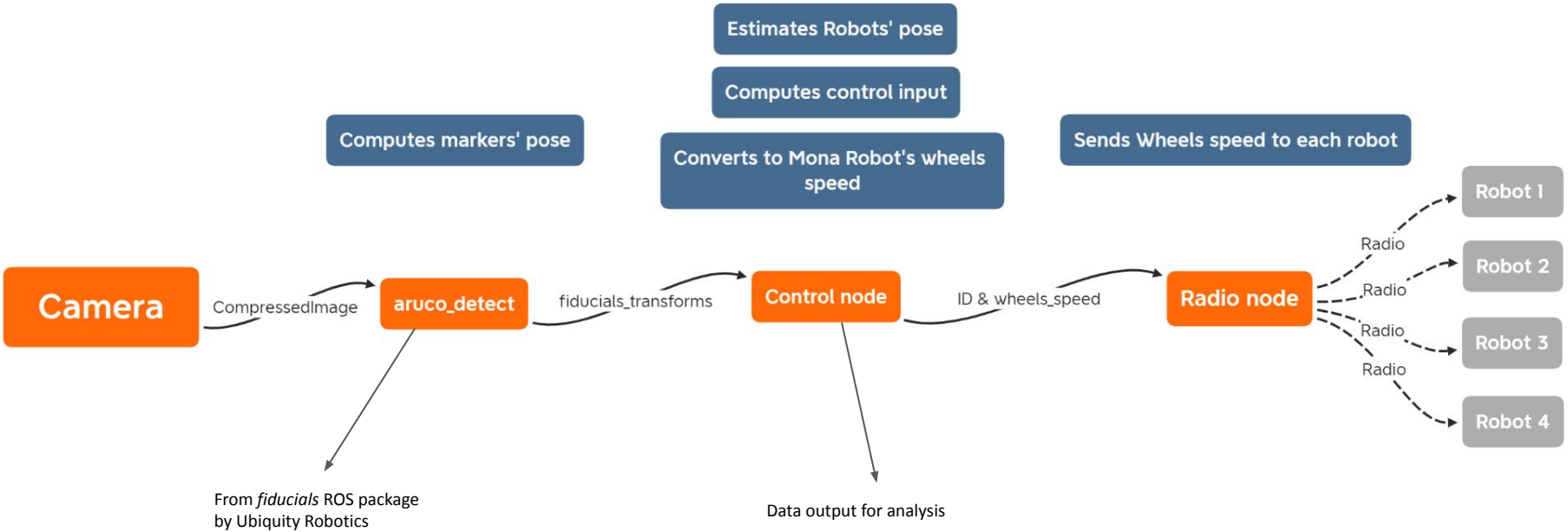
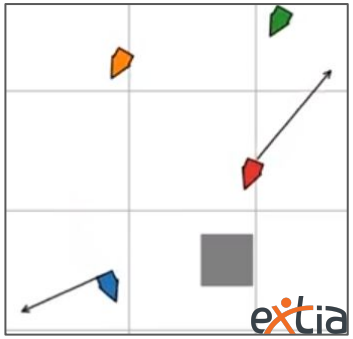
ROS architecture

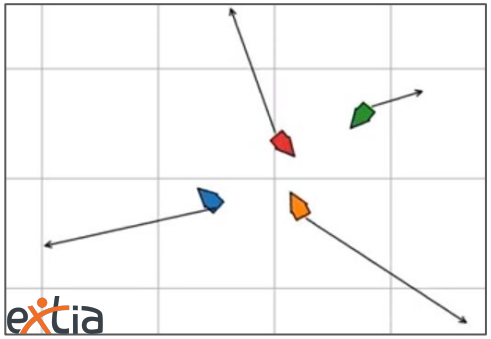


Additional features

Obstacles and peers avoidance

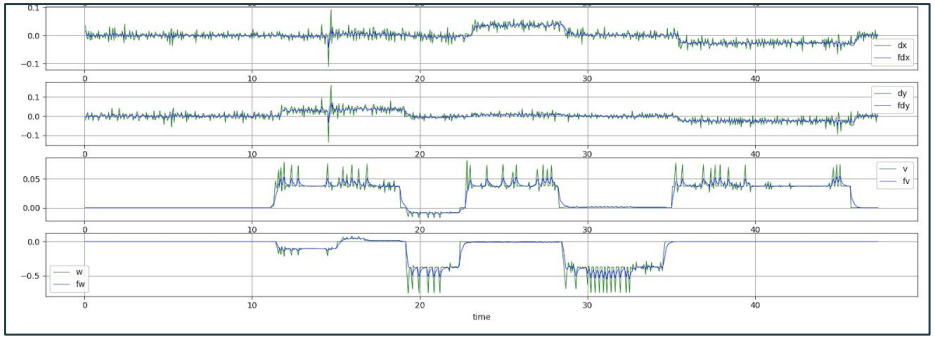
Inspired from flocking's repulsion force.





Kalman Filter

Smoothing of position and speed measurements.



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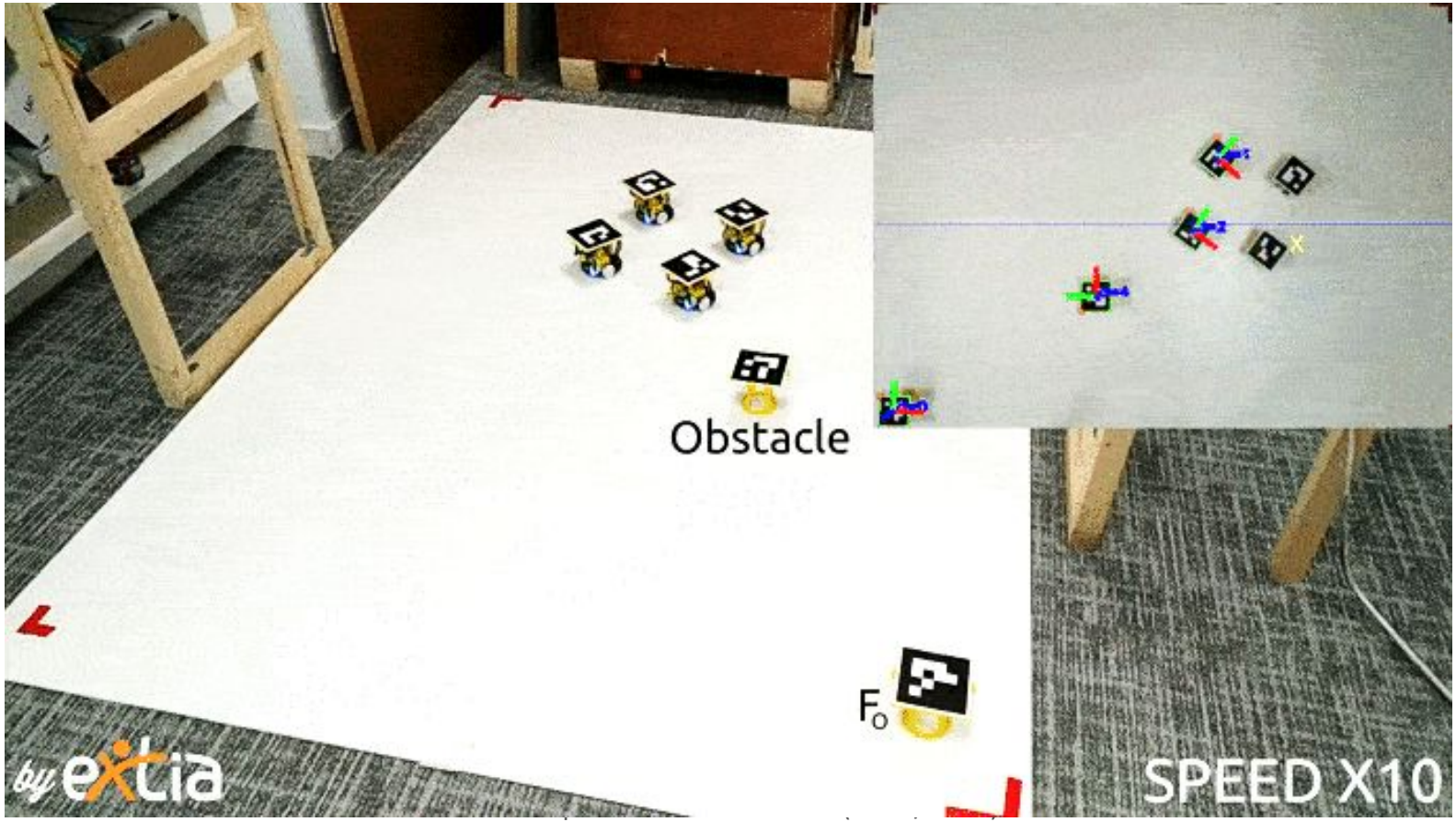

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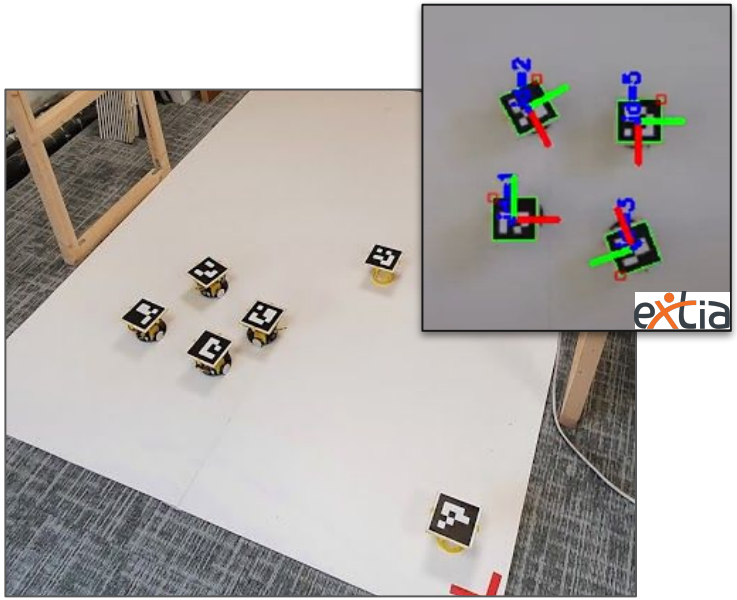
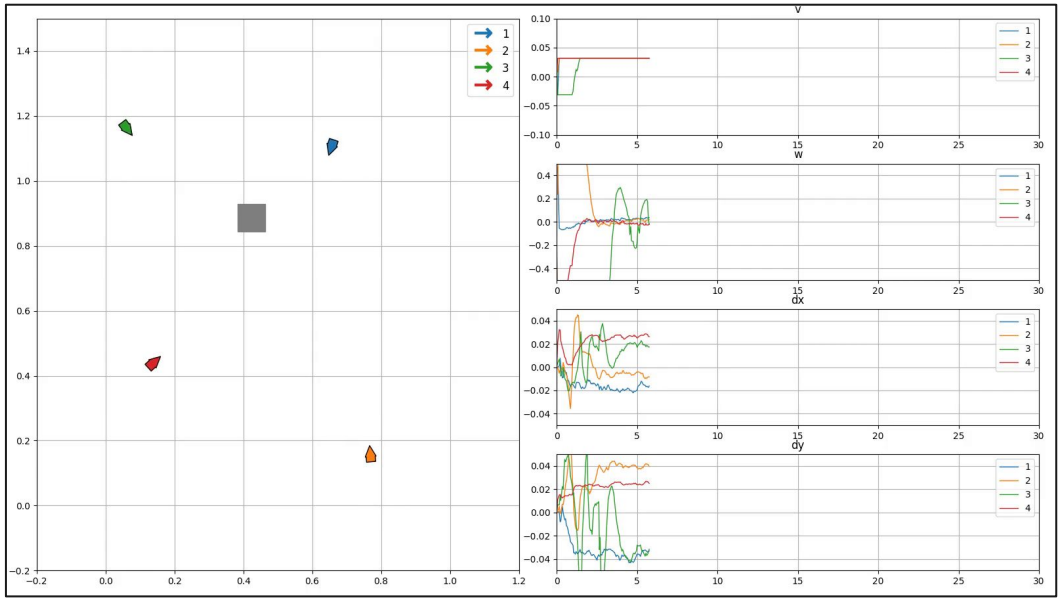


Position tracking

ArUco markers, Raspberry Pi and ROS package.



Python animation

Position, control force and linear speed animation using ROS bags' data.

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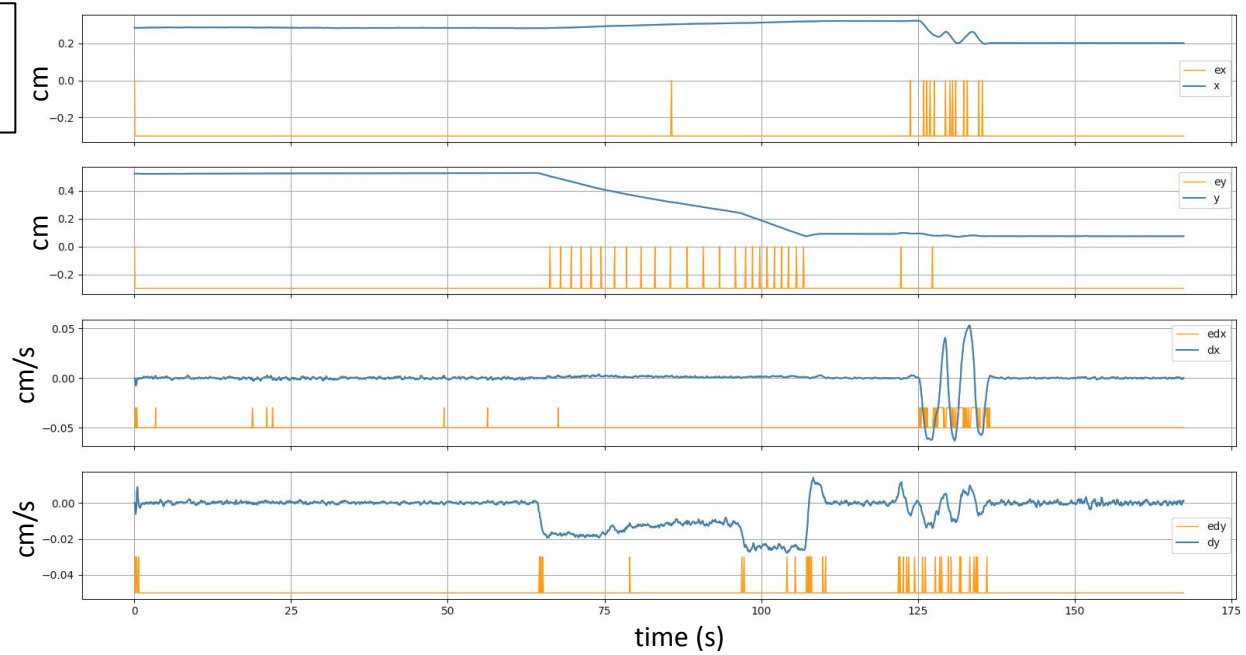
Event Based control

Postulate: No need to send **position** and **speed** data if it is **constant**.

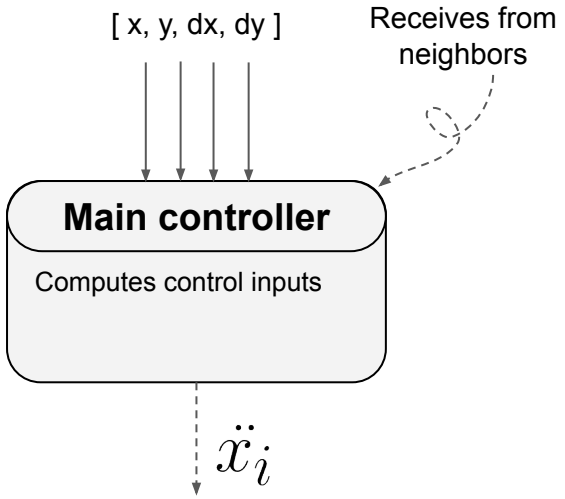
→ Detects variation on the observed data: this is an **event**.

→ Triggers communication to peers on event detection.

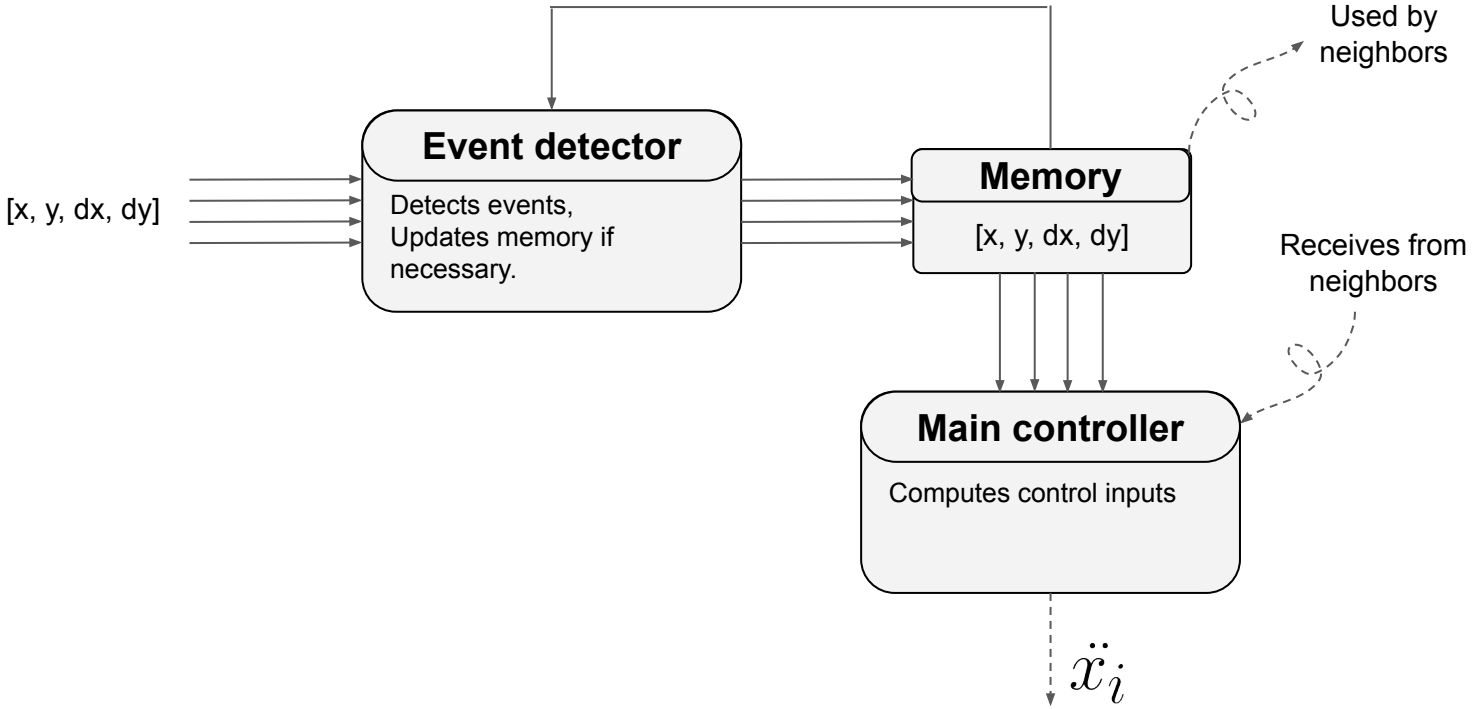


Event Based control

$$\ddot{x}_i = A.err(x_i) + B.err(\dot{x}_i)$$



Event Based control



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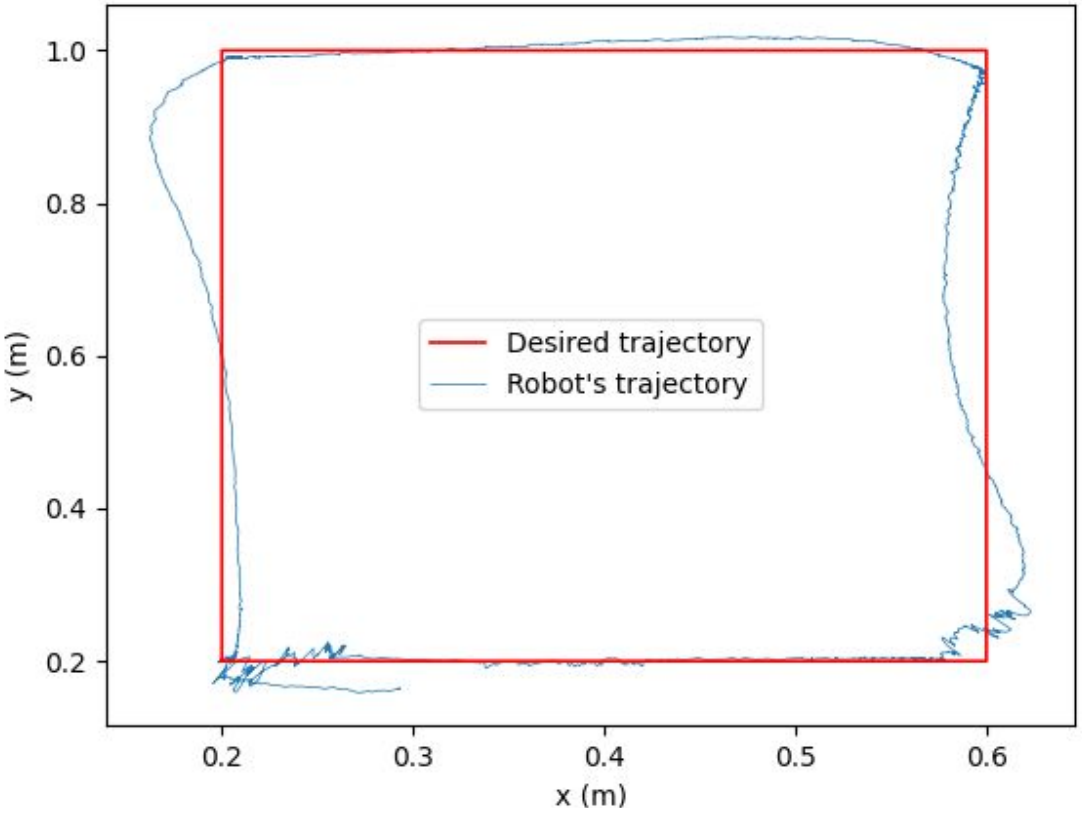
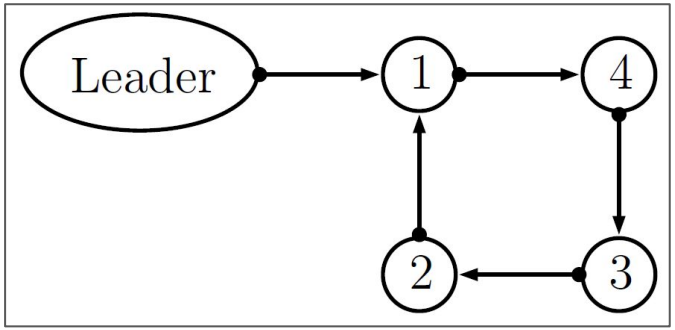
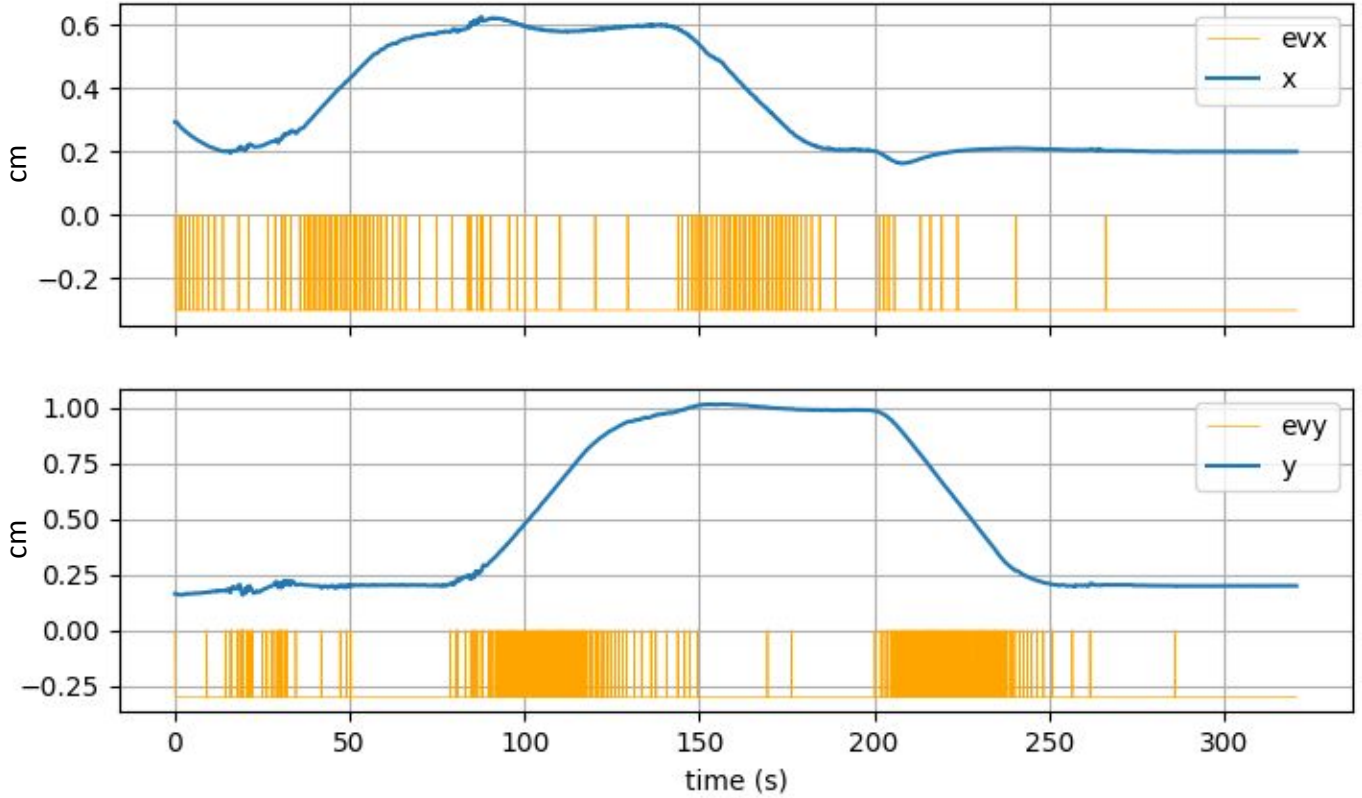
Experiments

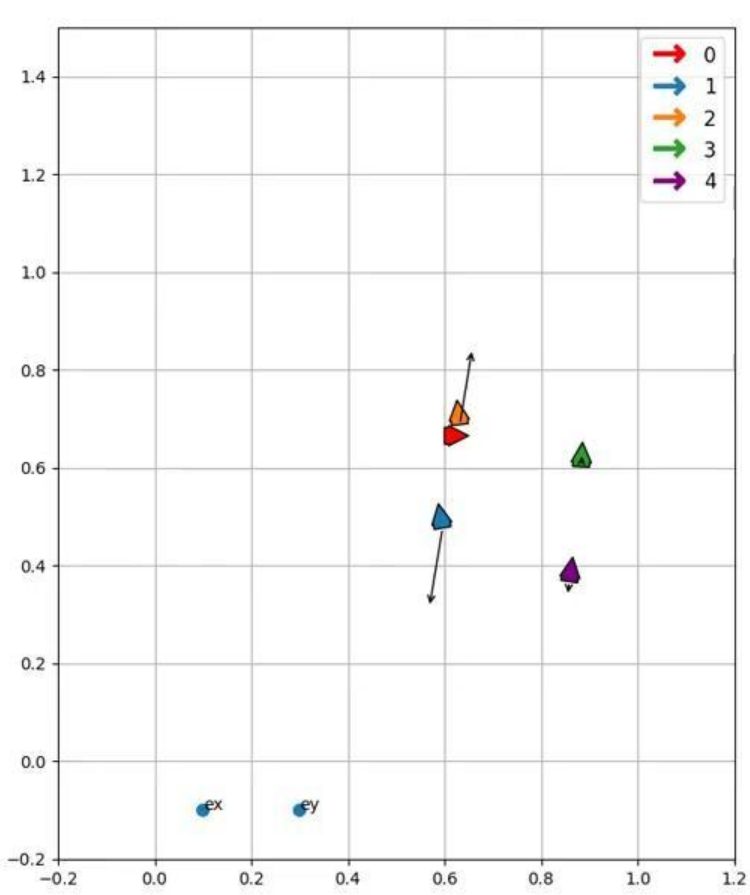




Connection graph for the experiments.

Experiments

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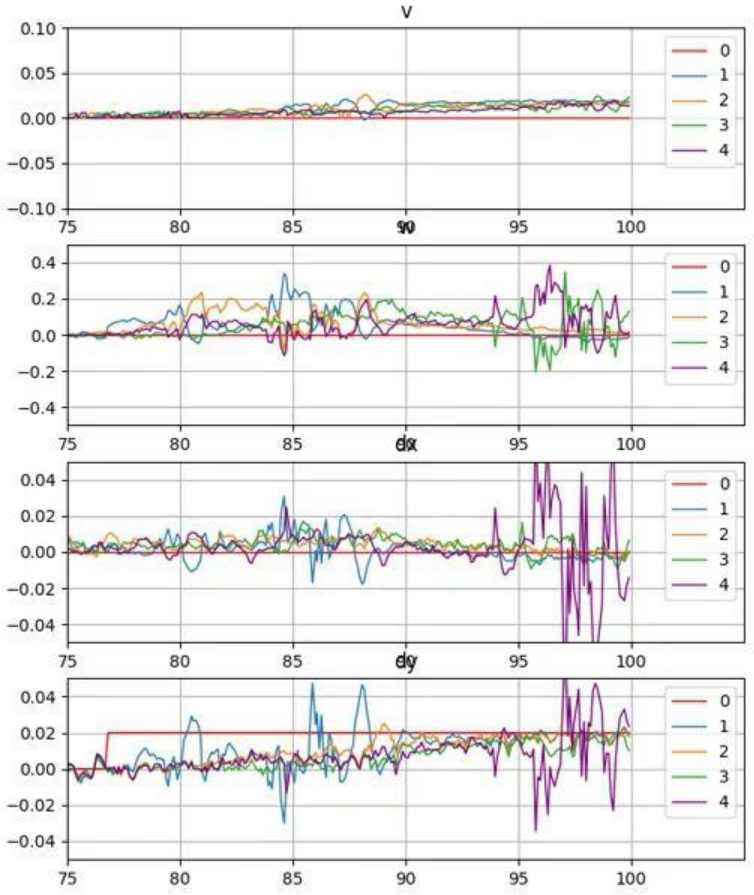
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References

[1] Event-based broadcasting for multi-agent average consensus*, Georg S. Seyboth, Dimos V. Dimarogonas, Karl H. Johansson*, 2019

[2] Time-delay Tolerant Control of an Omnidirectional Multi-agent System for Transport Operations, *J. Alvarez-Munoz, J. Escareno, F. Mendez-Barrios, I. Boussaada, SI. Niculescu, D. Nieto-Hern'andez*, 2018