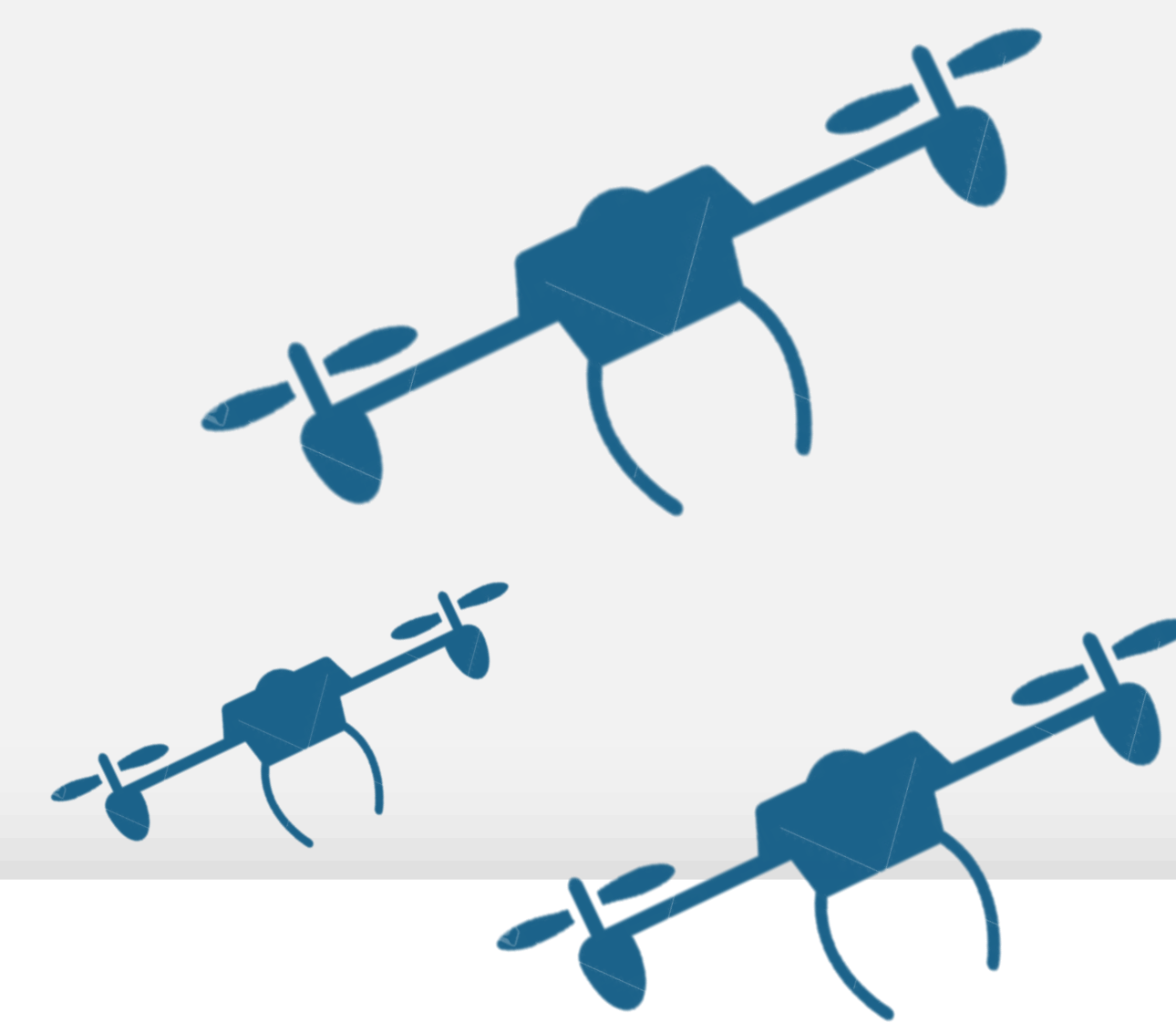


Is increasing the time delay in a multi-agent system always a bad idea?



CONCLUSION

Stability may come back with higher delays

In some multi-agent systems, **increasing** the **delay** could be **beneficial**. However, eventually, instability prevails after a certain delay threshold.

BACKGROUND & AIM

How time delays affect the stability and performance of a multi-agent system?

When it comes to studying multi-agent systems, **time delays** are ubiquitous. They stem from sensor's measurements, processing overhead, actuator dynamics, etc. Usually, they come with **performance degradation** in the terms of slower settling time, increased oscillations, and, eventually, instability. However, **is this always true?**

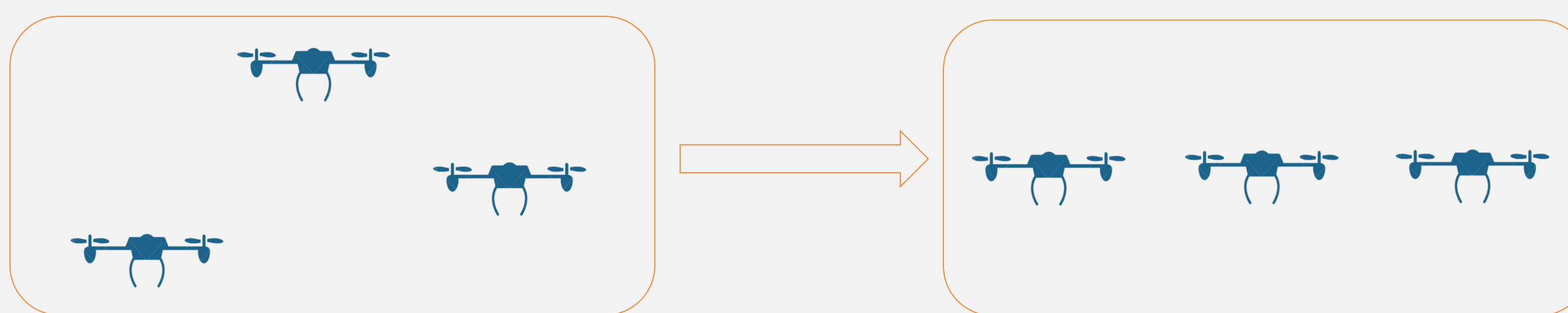
WHAT'S NEW?

A method allowing the prompt analysis of a **large-scale** multi-agent system stability in the presence of time delays

APPLICATION

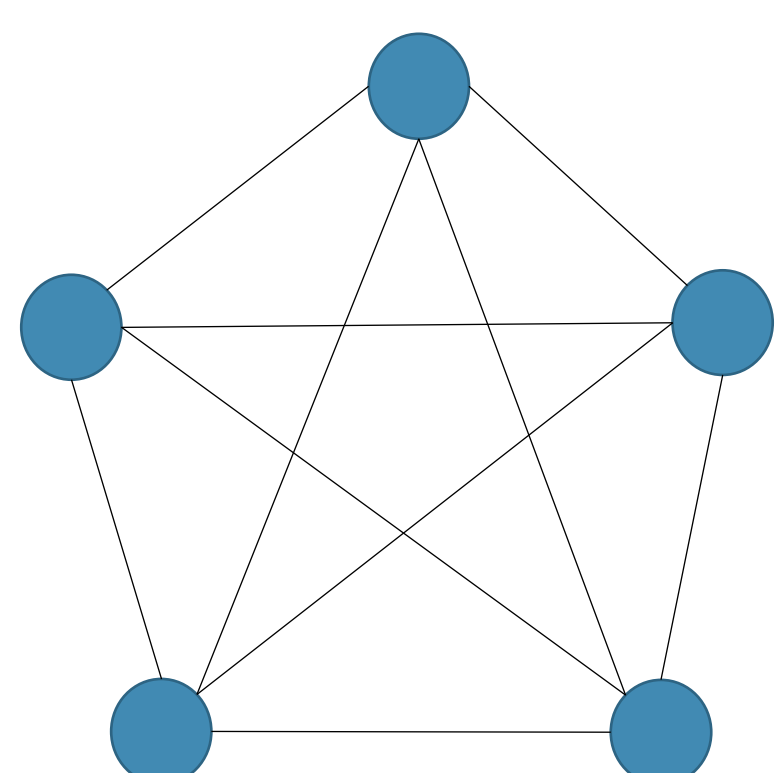
Distributed **agreement** on a group variable

- Altitude;
- Velocity;
- Relative Distance;
- ...

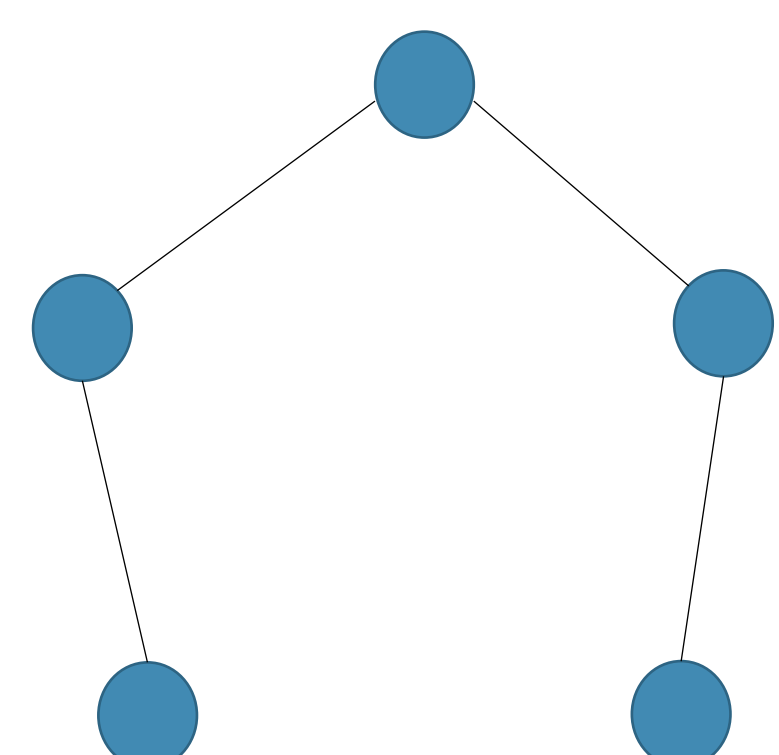


METHODS

Exploiting the Interaction Graph Properties



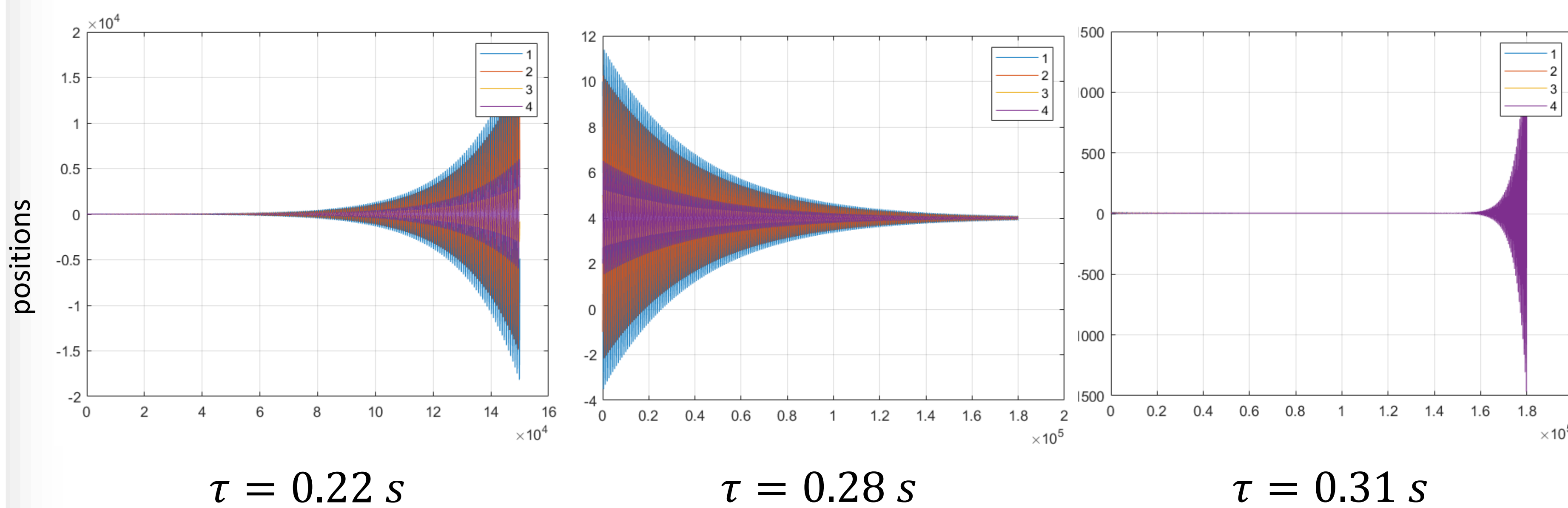
- High connectivity
- Fast Settling Time
- Low Delay Threshold



- Low connectivity
- Slow Settling Time
- High Delay Threshold

RESULTS

Increasing the delay could bring stability back



Four Agents interacting to reach the **same position**.
When $\tau = 0.22 \text{ s}$, the system is clearly unstable.
However, increasing the delay to $\tau = 0.28 \text{ s}$ makes the system stable.
Eventually, the system will become unstable for $\tau = 0.31 \text{ s}$.

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