CUSCUS
CommUnicationS-Control distribUted Simulator

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MOTIVATION
Simulation of Networked Control Systems

Flying Robot Simulators

Network Simulators

No Integrated Solution

Fine control of control laws as well as packet-level simulation
Target Applications

Simulation:
- Networked Robotic Systems
- Drone Fleet Operations
- Distributed Control Algorithm
- Test the resilience to disruption
IDEA

Join together the capabilities of a Network Simulator (NS3) and a Robotics Simulator thanks to their ability to:

• Operate In Real Time (NS3)
• Use linux network interfaces (Flair)
COMPOSITION
Network Simulator v3

- **Mainstay simulation tool.**
- **Proved accuracy and versatility**
- **Disadvantage**
  - Too simple mobility models (for robotics)
- **Main advantage:**
  - Operate in real-time/emulation mode
  - Generate traffic to and from real networks using TAP devices.
FLAIR: Framework Libre-Air

- In-house project of UTC Compiègne
- Modular architecture
- Can manage at the same time real and virtual drones
- Simulator Environment and Drones are independent
- All the control-related communications use real or virtual network interfaces.
OPERATION

All the Flair communications are intercepted by NS3 and routed through simulated networks.
• Use Linux Containers (LXC) and Bridge Interfaces
• Each UAV Flair application is loaded in its own container
• For each UAV in Flair there is a Ghost Node in NS3
• NS3 and Flair exchange information through a shared memory linux structure
- Circling scenario around a central pivot
- Control law leader-following with distance-keeping
- Networking: broadcast of positioning from an opti-track system.
- Two kinds of delay: architectural and network
Percentage of CPU and RAM varying
- Linear in respect to the number of drones
- Suitable for networked control

- Percentage of used CPU and RAM for the simulation
- Major consumer: Ns3
On the TAP-Bridge-LXC chain, what are the fixed time delays introduced solely by the architecture? These delays in packet transmission inside the system are stable architectural delays. The averaged value around 70 microseconds in our setup.
NEW SCENARIO

- The nodes take the positional information for the formation control from their neighbors broadcasts.

Specific Control Response Analysis → Formation Error
- Modification of Beacon Time
- Negligible modifications
Thank you
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