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# Task-level Collaborative Ad-hoc AGVs for Efficient Warehouse Logistics

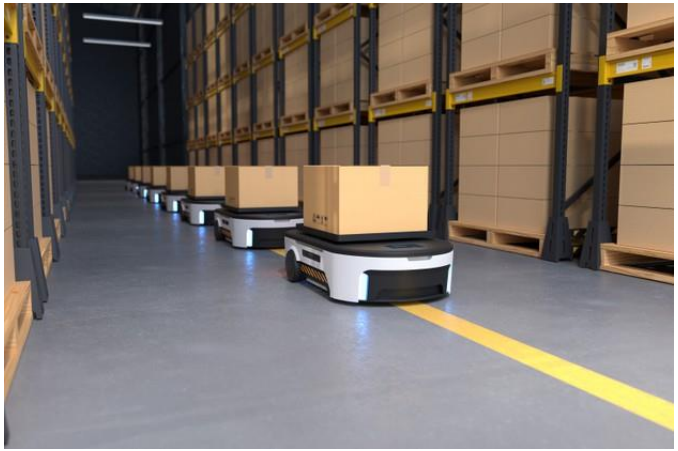
Luzi Schöb, Christoph Zweifel

Advisor: Prof. Dr. Bruno Rodrigues

From insight to impact

# Achieving Collaboration in AGV systems

**Automated Guided Vehicles**



**Autonomous task coordination**

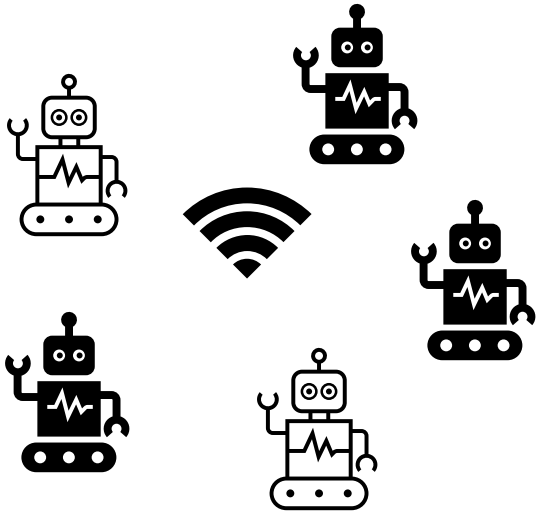
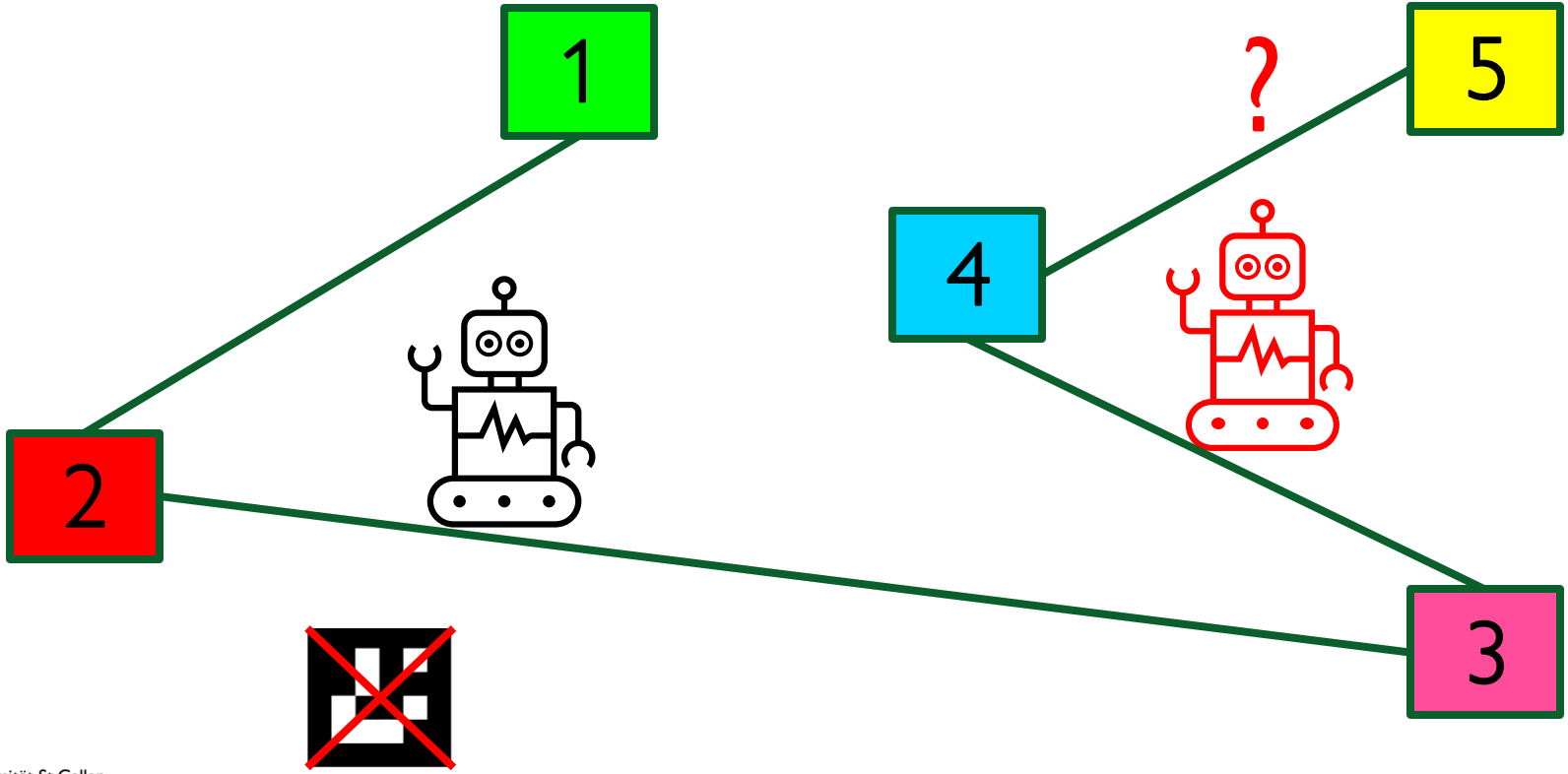
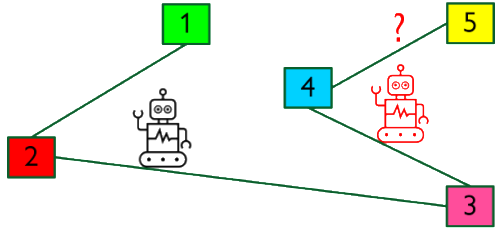


**Image source:**
https://sentralog.com/how-automated-guided-vehicles-contribute-in-industry

# Baseline Setup

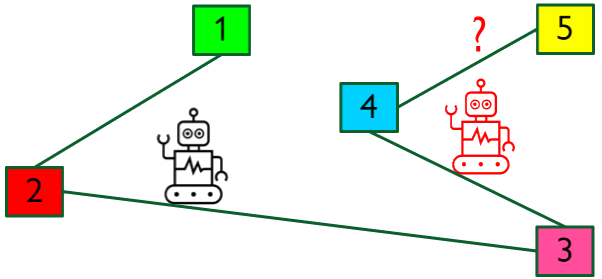


# Required Actions during Task Execution




| Conventional Approach | Collaborative Approach | |
|---|---|---|
| Robot A | Robot B1 | Robot B2 |
| Drive | Drive | Drive |
| Pick up | Pick up | Idle |
| Transport | Transport | |
| Drop off | Drop off | |
| | | Pick up |
| | | Transport |
| | | Drop off |

# Actual Operational Steps




| # actions | Conventional Approach | Collaborative Approach | |
|---|---|---|---|
| | Robot A | Robot B1 | Robot B2 |
| Driving | 0 | 0 | 2 |
| Pick up | 1 | 1 | 1 |
| Transport | 4 | 2 | 2 |
| Drop off | 1 | 1 | 1 |
| Idle | 0 | 0 | 2 |
| | **6 steps** | **12 steps (8 steps actual)** | |

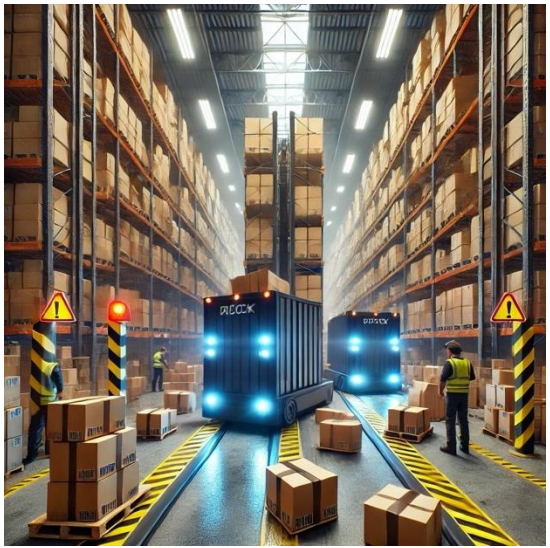
# Preliminary Results

| | Conventional | Collaborative |
|---|---|---|
| Single Task Execution | 100% | 75% slower |
| Consecutive Task Execution | 200% | 4.5% slower |
| Consecutive Task Execution | 300% | 2% slower |

# Discussion

- Pick-up and drop-off times can highly vary due to environment and mechanic‘s of the individual robot

- Warehouse layout, including floorplans and travel distances, have a high influence on the cooperation of robots.
  - Relatively longer paths may benefit from task-level cooperation as it can reduce idle times
  - Relatively shorter paths may degrade performance due to the latency induced by robotic arms handling parcels



Further problems arise in more complex environments as a node or edge is being blocked

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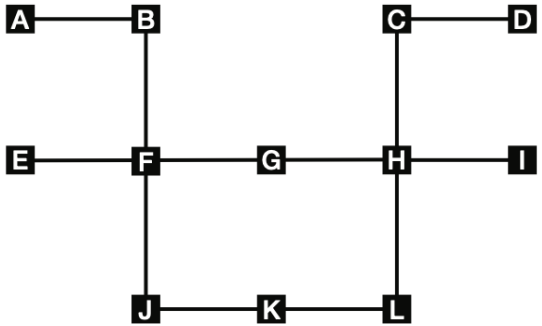
**Image source:**
ChatGPT

# Further Ideas

## Extend Environment

- More nodes and edges
- Up to eight robots




## Simulation

- Handle more edge cases
- Easily scalable
- Likely more time-efficient

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# Join our robots at our booth for a *competitive* race

**Image source:** ChatGPT

# Q & A

# Questions?


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**Luzi Schöb**
MSc Student

luzi.schoeb@student.unisg.ch

Universität St.Gallen

**Christoph Zweifel**
MSc Student

christoph.zweifel@student.unisg.ch


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