Collaborative autonomous vehicles as a new mode of transportation

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Contents

- Autonomy in transportation systems
- Short overview of *distributed* formation control
- *Cooperative* autonomous vehicles as a new mode of transportation
- Challenges and outlook
Autonomy in transportation systems

- Trains, cars, planes, ships until mid 20th century
- Driverless train operation: London's Victoria line 1967
- Fly-by-wire jet airliner: Airbus A320 1984
- Autonomous car: Navlab 1995
- UAV & USV: Unmanned Aerial Vehicle & Unmanned Surface Vehicle

Coming soon:
- Autonomous ship (TRL high)
- Autonomous jet airliner (TRL medium)
  - Proof-of-concept: Northrop Grumman X-47B
- Cooperative autonomous vehicles (TRL low-medium)
Cooperative autonomous systems
Cooperative autonomous systems

Credit: Rush Hour movie by Fernando Livschitz
Formation control (in short)

- Coordination of multiple agents to accomplish an objective
- Advantages
  - Reduce system costs
  - Scalability
  - Structure flexibility
  - Increase of robustness and efficiency
- Typical characteristics
  - Onboard (local) sensing equipment
  - Onboard (local) computation ability
  - **No global information**
- Important issue = stability
Formation control (in short)
Formation control (in short)
Formation control (in short)
Group motion

- Leader-follower approach
  - has many drawbacks
- Behaviour approach
  - requires continuous central coordination and global information
- Virtual structure
  - suitable for cooperative autonomous vehicles
Formation control of drones
Challenges

› Controlling group behavior via local action
› Cooperative area mapping, localization and coverage
› Guaranteeing safety and robustness of group behavior
› Dynamic interaction with the environment
› Cooperation among different autonomous vehicles
   • Including different drones and between aerial and ground vehicles
Outlook

- Autonomy has been present in modern transportation systems
- Cooperative autonomous vehicles can be a new mode of transportation system
Thank you
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