A battle field scenario

Mission
Autonomous, distributed maneuvering of a vehicle group to reach and cover a target area

Constraints
Desired inter-vehicle distance
Obstacles avoidance
Threats (stationary or moving) avoidance

Requirement
Using only local or static information

Hierarchical Collaborative Control Scheme

High level path planning (macro level)
- Generate desired way-points
- Achieve group objectives
- Simplified vehicle dynamics (point mass)

Low level motion control (micro level)
- Generate continuous trajectory
- Track follow desired trajectory
- Consider real vehicle dynamics

Applications of UAV swarms

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Collaborative Control Hierarchical Framework

Results-Methods
- Hierarchical framework can separate the collaborative control design into two levels:
  - Collaborative path planning for achieving collective behavior
  - Local motion control to deal with local traffic, unpaved road, actuator saturation, etc.

- NMPC base approach provide a general frame work to deal with multiple constraints and objectives

- Two numerical methods were investigated

Asynchronous Sampling

Synchronous Parallel Sampling
Require global clock to synchronize movement

Asynchronous Parallel Sampling
Agents move based on their own schedule
Less stringent, more flexible
Hard to analyze

Results – Methods

- Stochastic potential based approach guarantees global objective can be achieved by simple local strategies
- The parallel sampling algorithm saves running time compared with the sequential sampling algorithm
- Asynchronous sampling eliminates the need of synchronzation, which further reduces the overhead
- Convergence analysis shows that under certain conditions, parallel sampling algorithm leads to desired group configuration