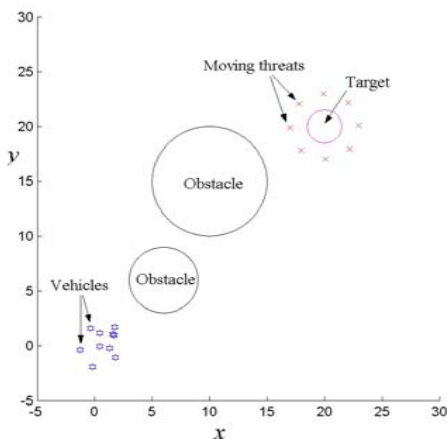


Motivation

- Explore a decentralized approach to autonomous multi-vehicle control
- Study the collective behavior arising from local interactions
- Accommodate competing objectives in a complex environment

Scenario



□ Mission

- Autonomous, distributed maneuvering of vehicles 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

Path Generation based on Potential Functions

The velocity of the i -th vehicle, \dot{q}_i , is determined by the gradient flow of its potential function:

$$J_{i,t}(q_i) = l_g J^g(q_i) + l_n J_{i,t}^n(q_i) + l_o J^o(q_i) + l_s J^s(q_i) + l_m J_t^m(q_i)$$

Gradient flow:

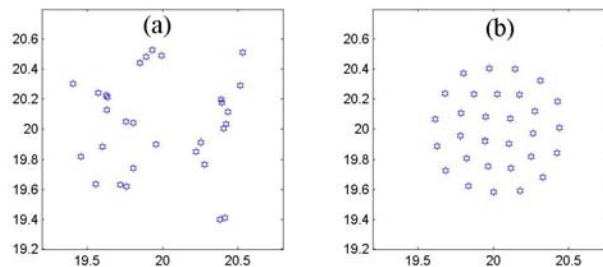
$$\dot{q}_i(t) = - \frac{\nabla J_{i,t}(q_i)}{\|q_i\|}$$

- Target (attraction) potential J^g
- Neighbor (avoidance) potential J^n
- Obstacle potential J^o
- Potential J^s due to stationary threats
- Potential J^m due to moving threats

Vehicle Behavior Analysis

□ Formations under inter-vehicle interactions

- For two or three vehicles, optimal inter-vehicle distances are achieved;
- For more than three vehicles, multiple locally stable formation exist.

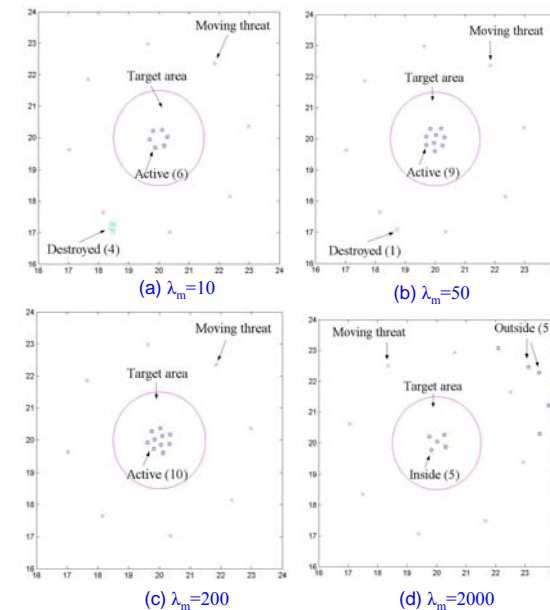


Formation of 30 vehicles from a random initialization.

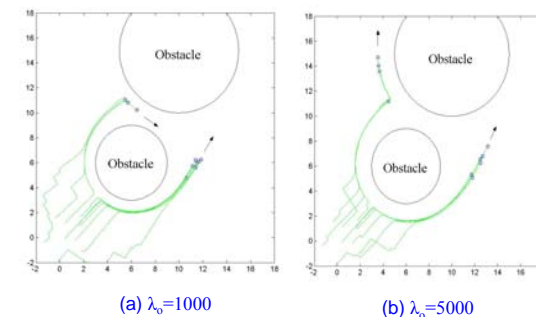
□ Effects of weighting constant λ when

$$J = \lambda J^g + J^o.$$

Simulation Results



Effect of the weighting constant λ_m for the moving threat potential. Too small: vehicles get destroyed; too big: vehicles cannot enter the target.



Effect of the weighting constant λ_o for the obstacle potential. Small: some vehicles take short-cut; big: vehicles take detour.