Active visual tracking in multi-agent scenarios

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Published in:
IEEE Int'l Conf. on Advanced Video and Signal-based Surveillance 2017

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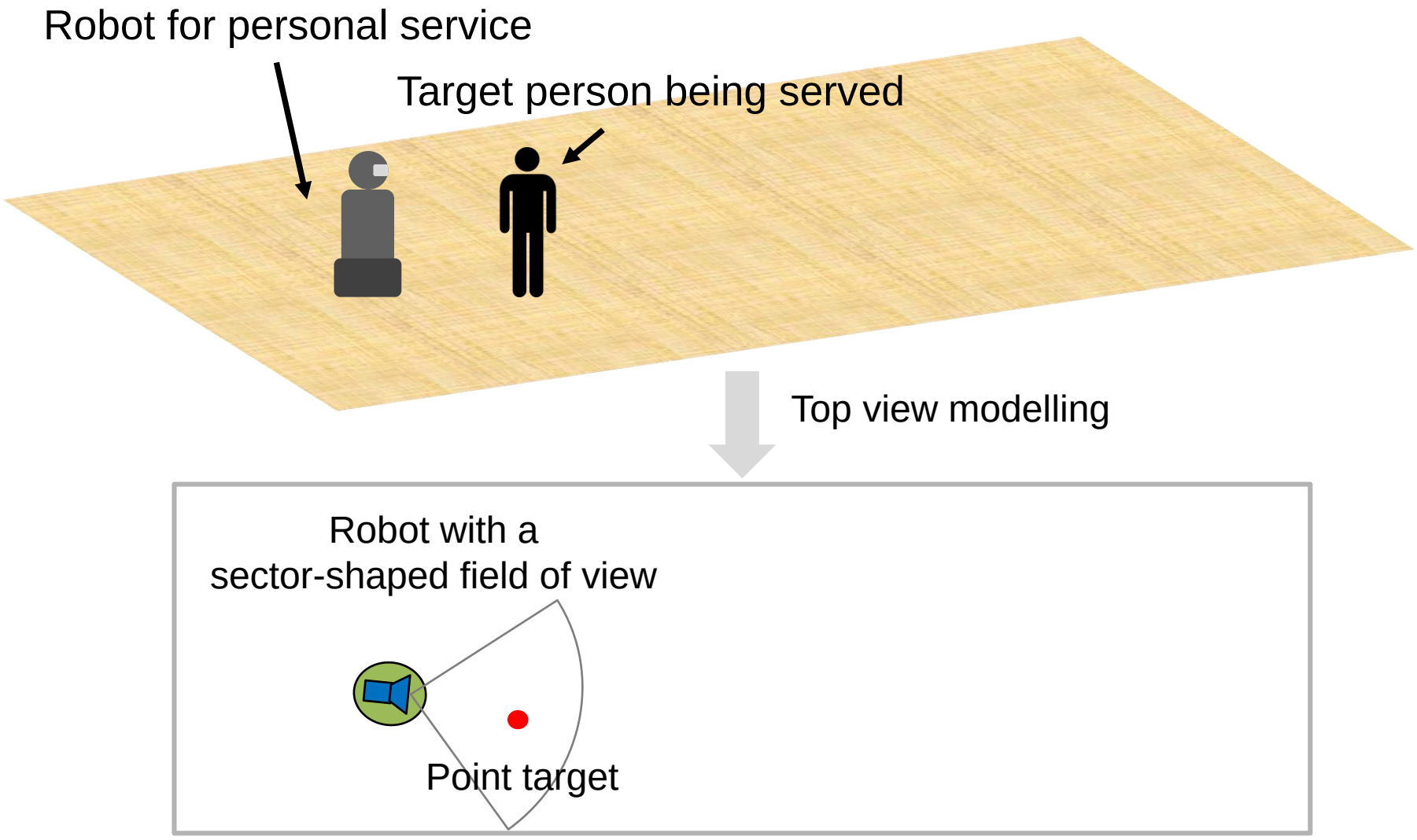
Active visual tracking with an agent



Active visual tracking in multi-agent scenes

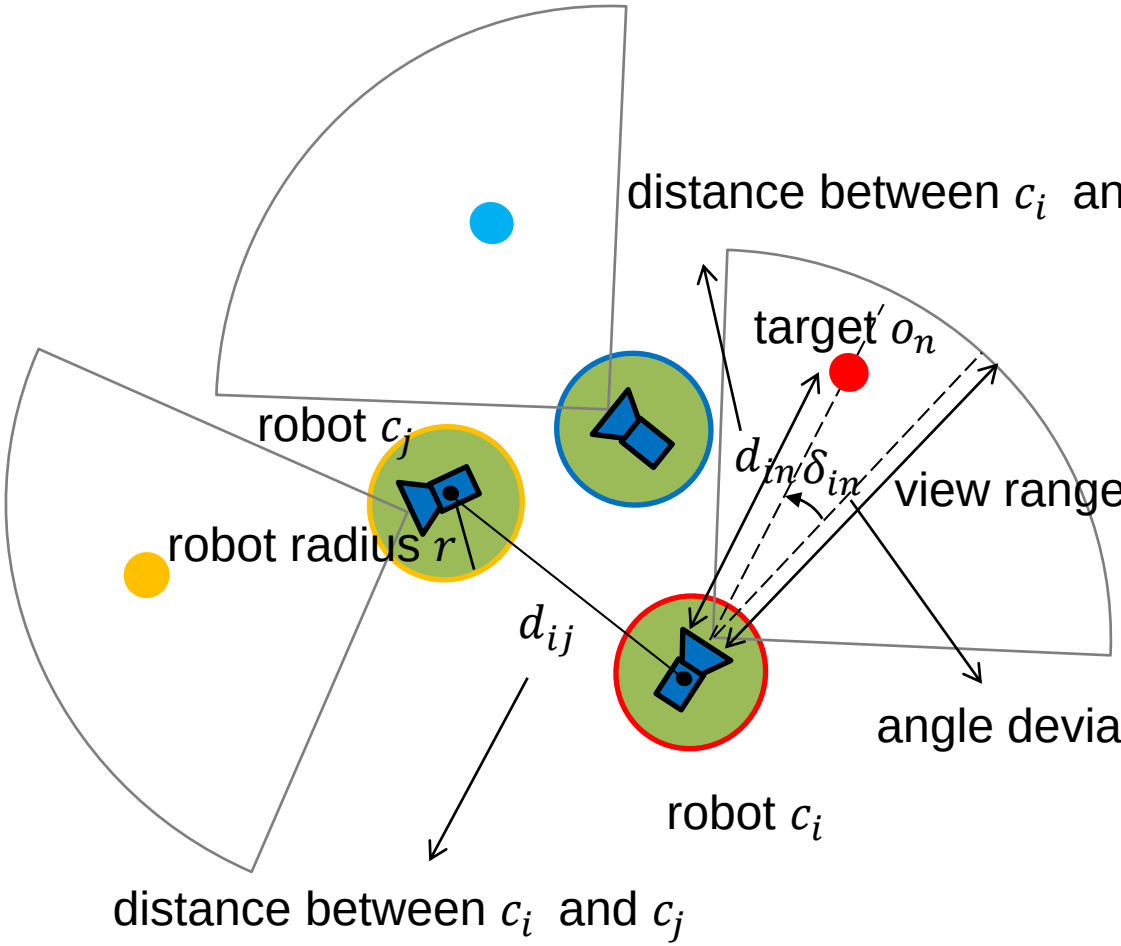
PETS2009 S2L1 sequence
www.cvg.reading.ac.uk/PETS2009

Each robot is following a person

People intersect with each other

Collision avoidance among robots!

Problem formulation



Active visual tracking

$$\delta_{in} = 0, d_{in} = \frac{r_v}{2}$$

Avoiding other agents

$$d_{ij} > 2r, \forall c_j$$

Related works

- Optimal Reciprocal Collision Avoidance (ORCA) [Berg2009]

- ORCA for navigation towards static goal positions
  - robot kinematic constraints

car-like
[Alonso-Mora2012]

differential-drive
[Snape2010, Bareiss2015]

  - various agent shapes

elliptical
[Best2016]

- Challenges in applying ORCA to active visual tracking
  - robot's motion constrained by target dynamics
  - view maintenance due to the FoV constraint

Berg, J. V. D.; Stephen J., G.; Ming, L. & Dinesh, M., Reciprocal n-Body Collision Avoidance, *Int'l J. of Robotics Research, Springer Berlin Heidelberg,* 2009
Snape, J.; van den Berg, J.; Guy, S. J. & Manocha, D., Smooth and collision-free navigation for multiple robots under differential-drive constraints, In *Proc. of IEEE/RSJ Int'l Conf. on Intelligent Robots and Systems,* 2010
Alonso-Mora, J.; Breitenmoser, A.; Beardsley, P. & Siegwart, R., Reciprocal collision avoidance for multiple car-like robots, In *Proc. of IEEE Int'l Conf. on Robotics and Automation,* 2012
Bareiss, D. & van den Berg, J., Generalized reciprocal collision avoidance, *Int'l J. of Robotics Research,* 2015
Andrew Best, Sahil Narang, Dinesh Manocha, Real-time Reciprocal Collision Avoidance with Elliptical Agents, In *Proc. of IEEE Int'l Conf. on Robotics and Automation*

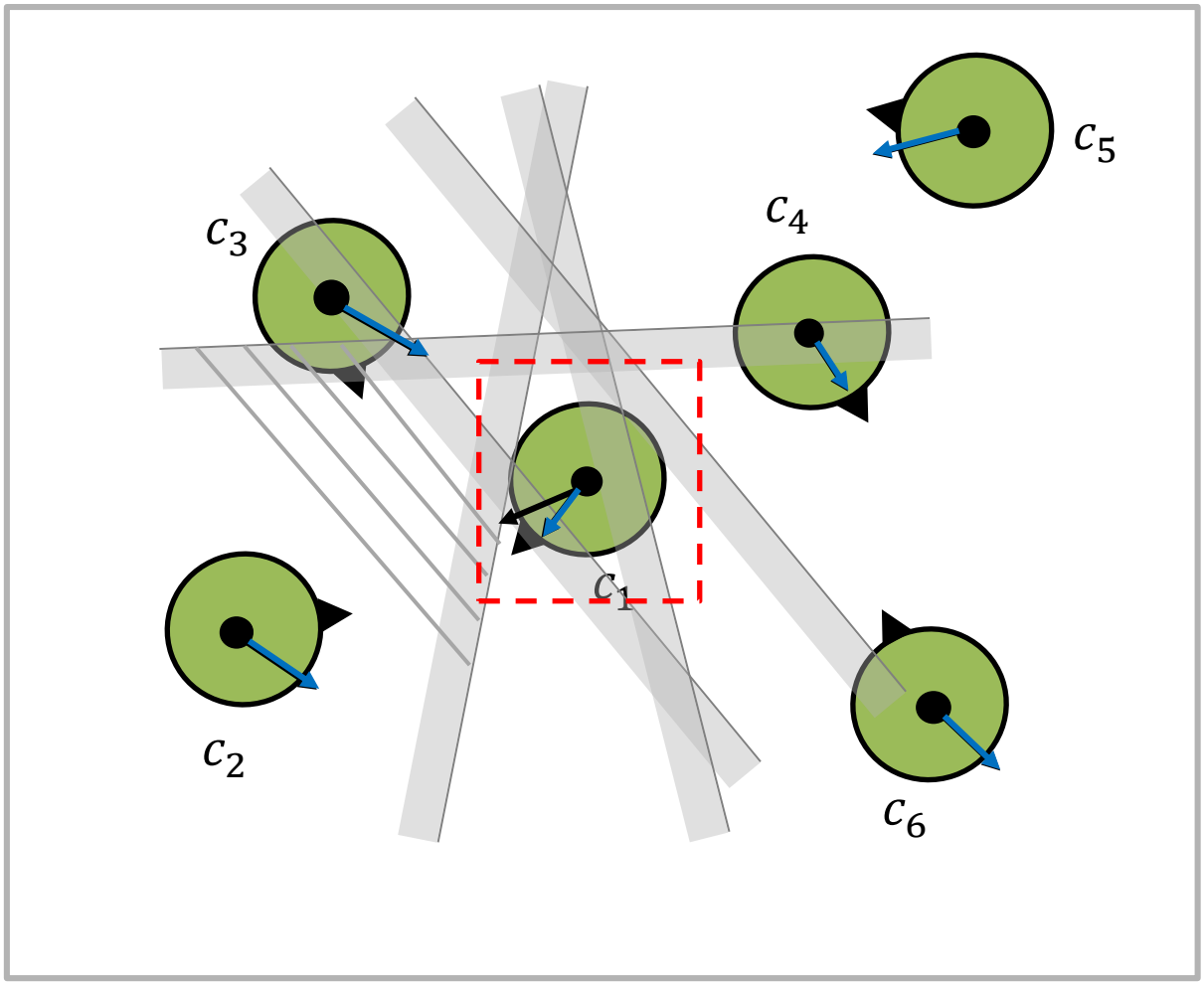
ORCA at one robot in one time step

sense positions and velocities of other robots

infer preferred velocities of other robots

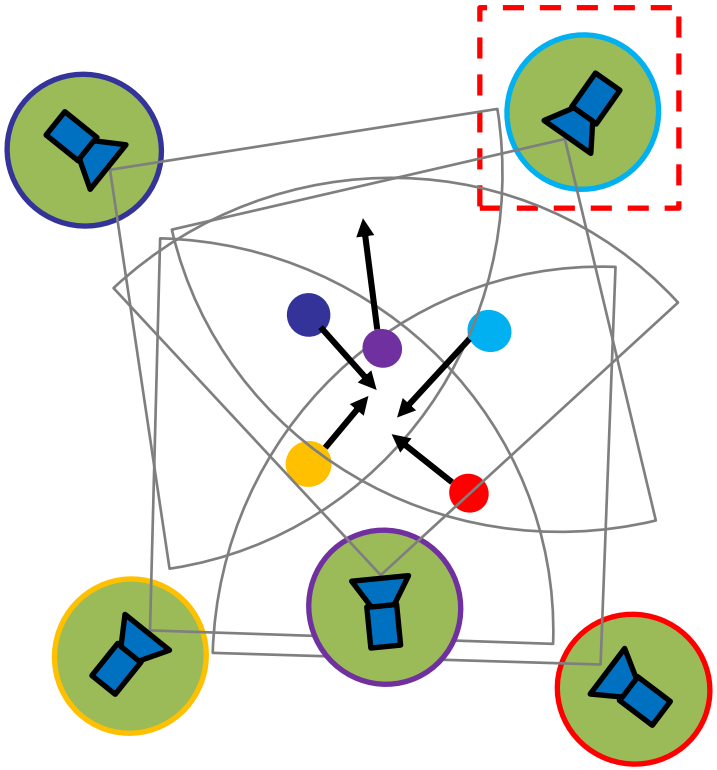
derive velocity constraint induced by each robot

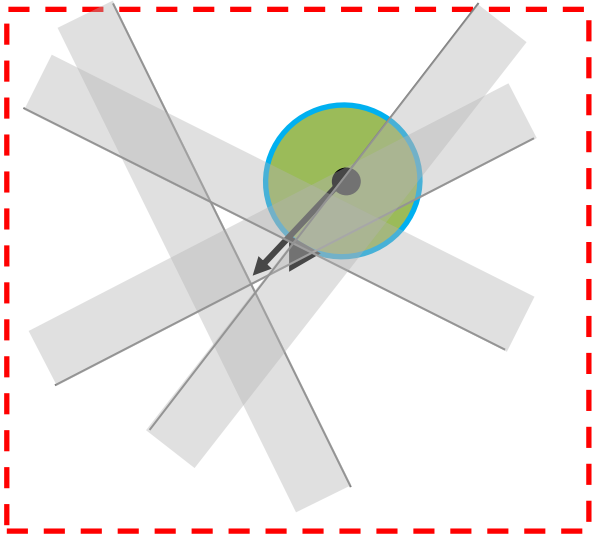
select a new collision-free velocity



We use ▶ to indicate the heading of a robot

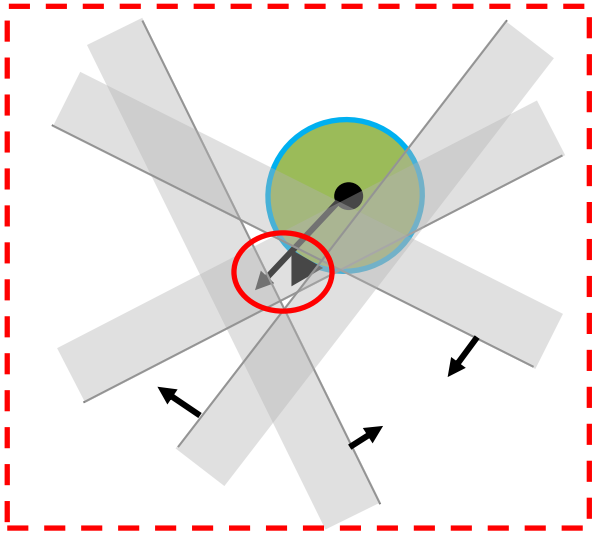
ORCA for active visual tracking





No accessible collision-free velocity (*empty-set* case)

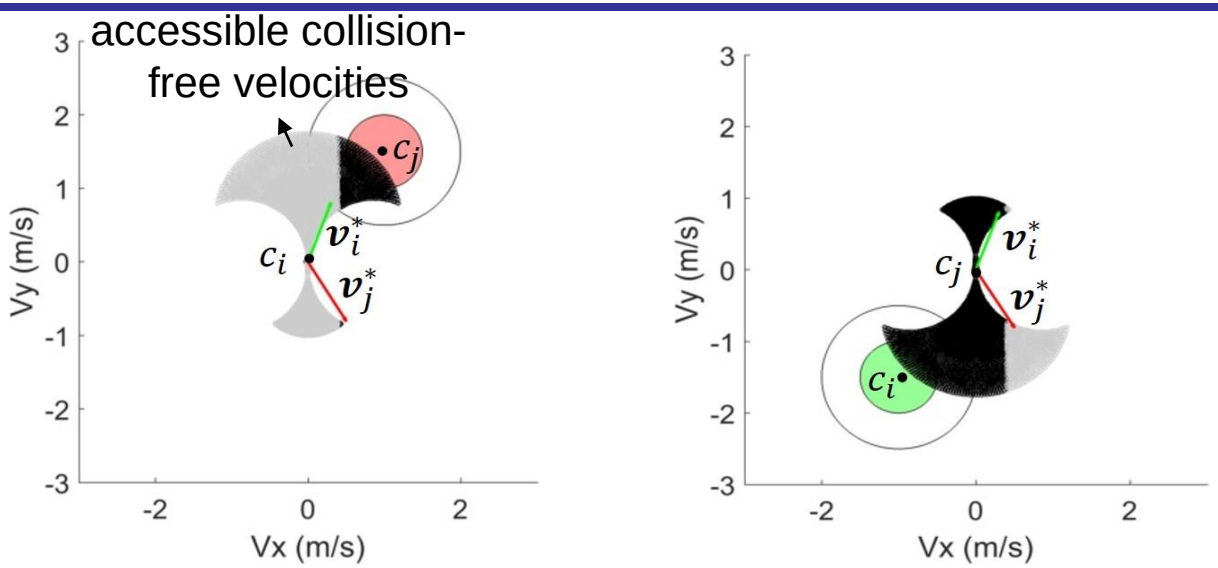
How to prevent?



Adapt the pair-wise responsibility

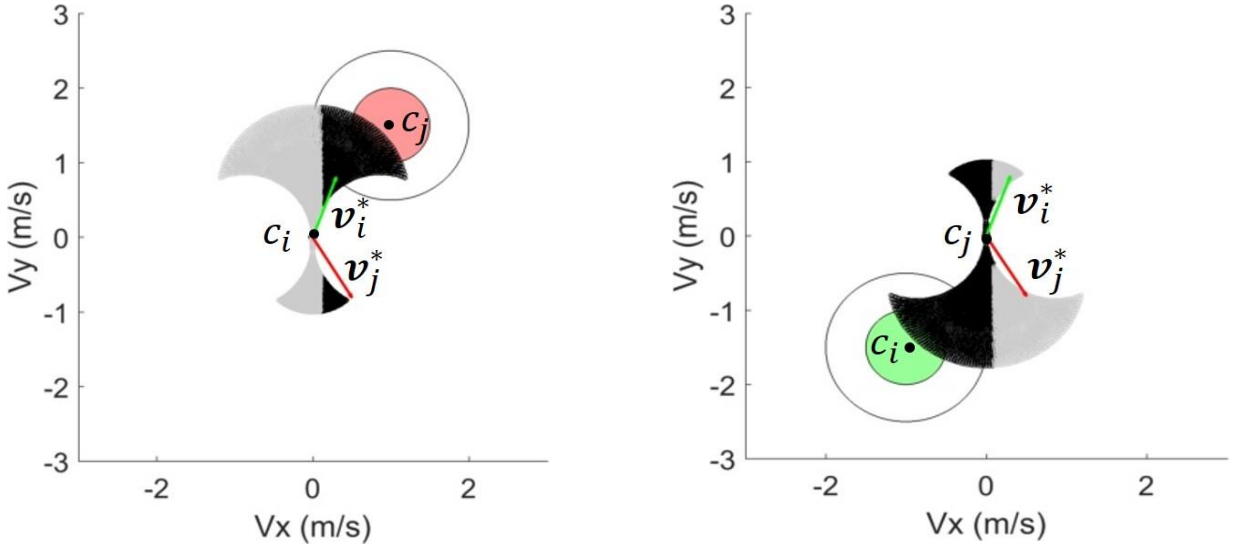
Adaptive pair-wise responsibility

Equal responsibility



Objective: increase the accessible collision-free velocities of a pair of robots in a **fair** way

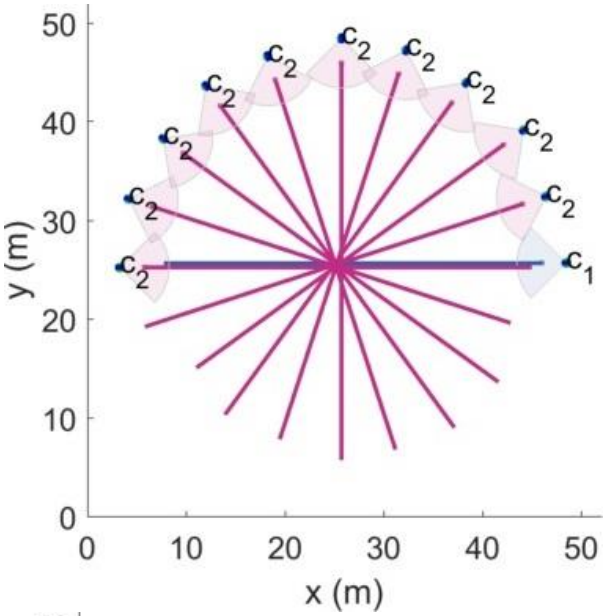
Adaptive responsibility



Tested scenarios

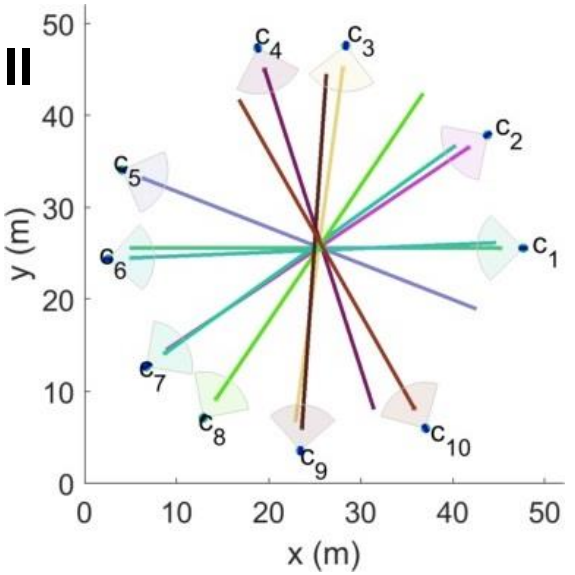
Scenario I

target-intersecting angle



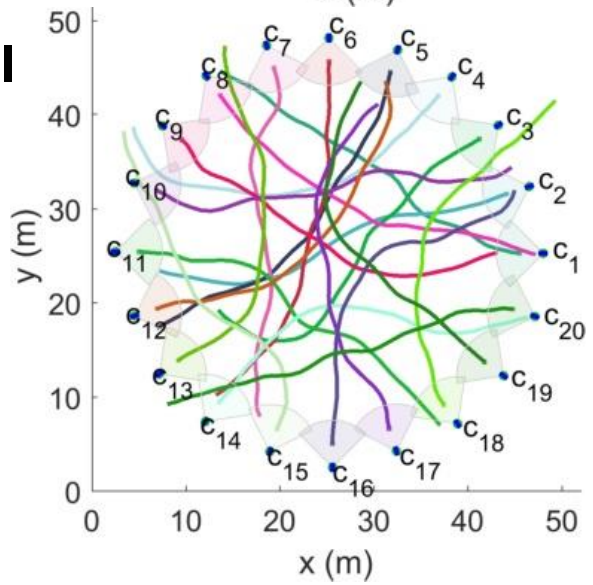
Scenario II

simultaneous intersection

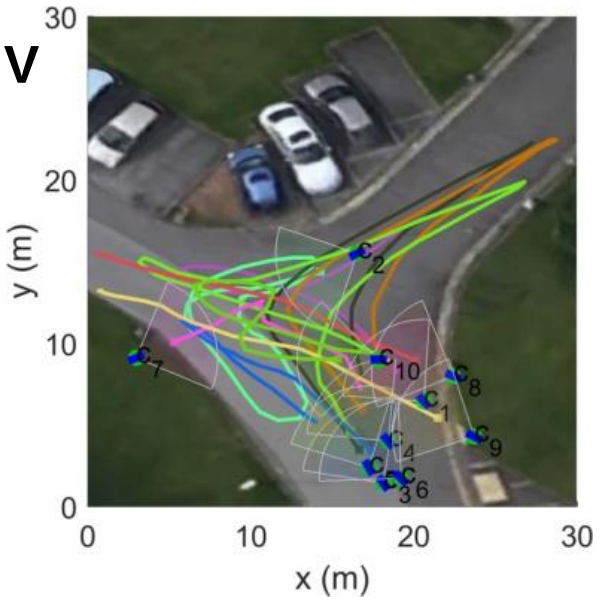


Scenario III

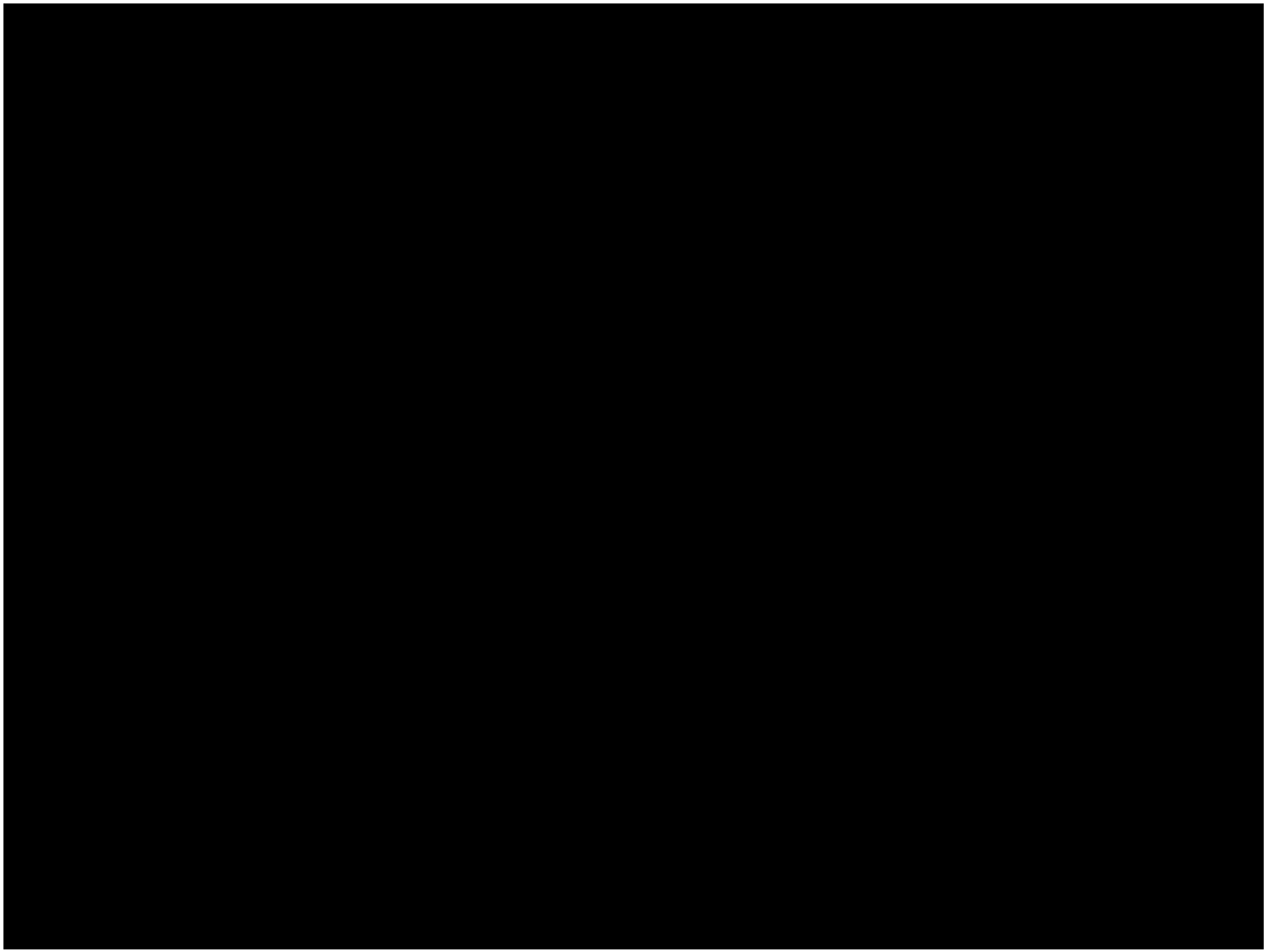
sparse intersection



Scenario IV



Result video



Thank you