

Dynamic Crowd Routing: RL-Driven Crowd Dynamics

Daniele Della Pietra¹ Nicola Garau^{1,2} Nicola Conci^{1,2} Fabrizio Granelli^{1,2}

¹University of Trento ²CNIT - Consorzio Nazionale Interuniversitario per le Telecomunicazioni

Method

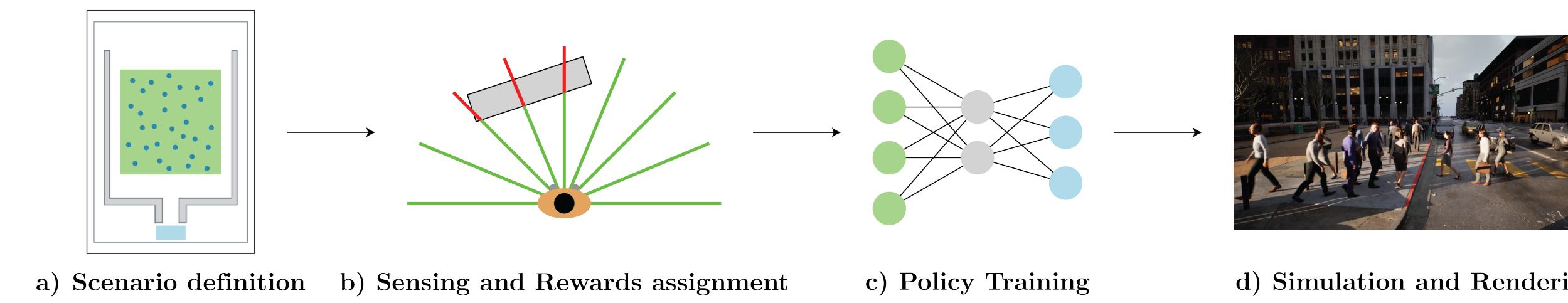


Figure 1: We present Dynamic Crowd Routing (DCR), a RL-based method for crowd dynamics. We (a) define a map for an arbitrarily large scenario. Each agent (b) is equipped with 180° sensing rays that capture observations from the nearby environment, including dynamic obstacles and pedestrians. *No goal information is given at any time to any of the agents*. We train (c) a very shallow neural network using the PPO algorithm. Finally, (d) we render a photorealistic simulation of the crowd during inference, in real-time.

Qualitative results

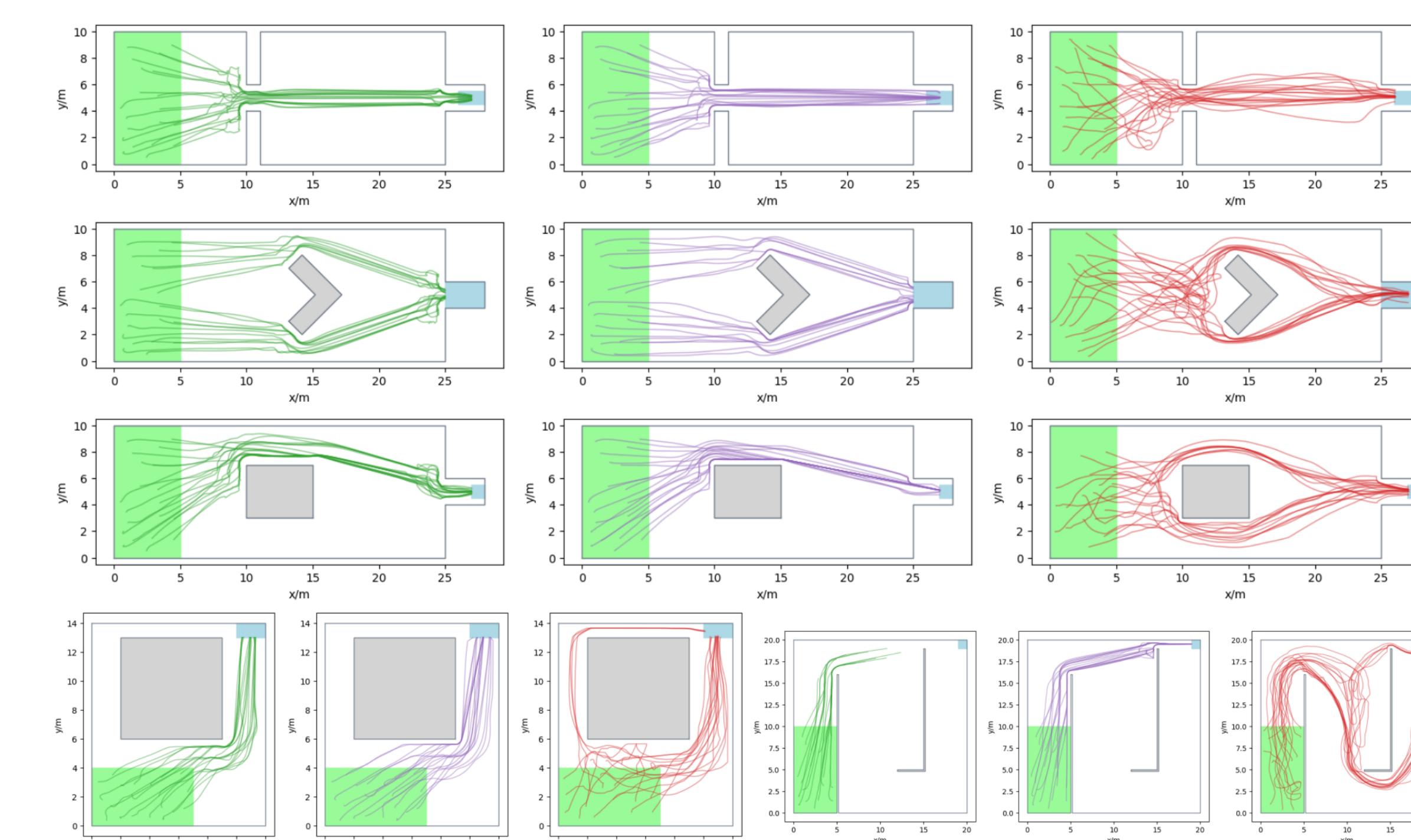


Figure 3: **Green:** R-SFM, **Purple:** CFSM, **Red:** Ours.

Motion definition and rewards

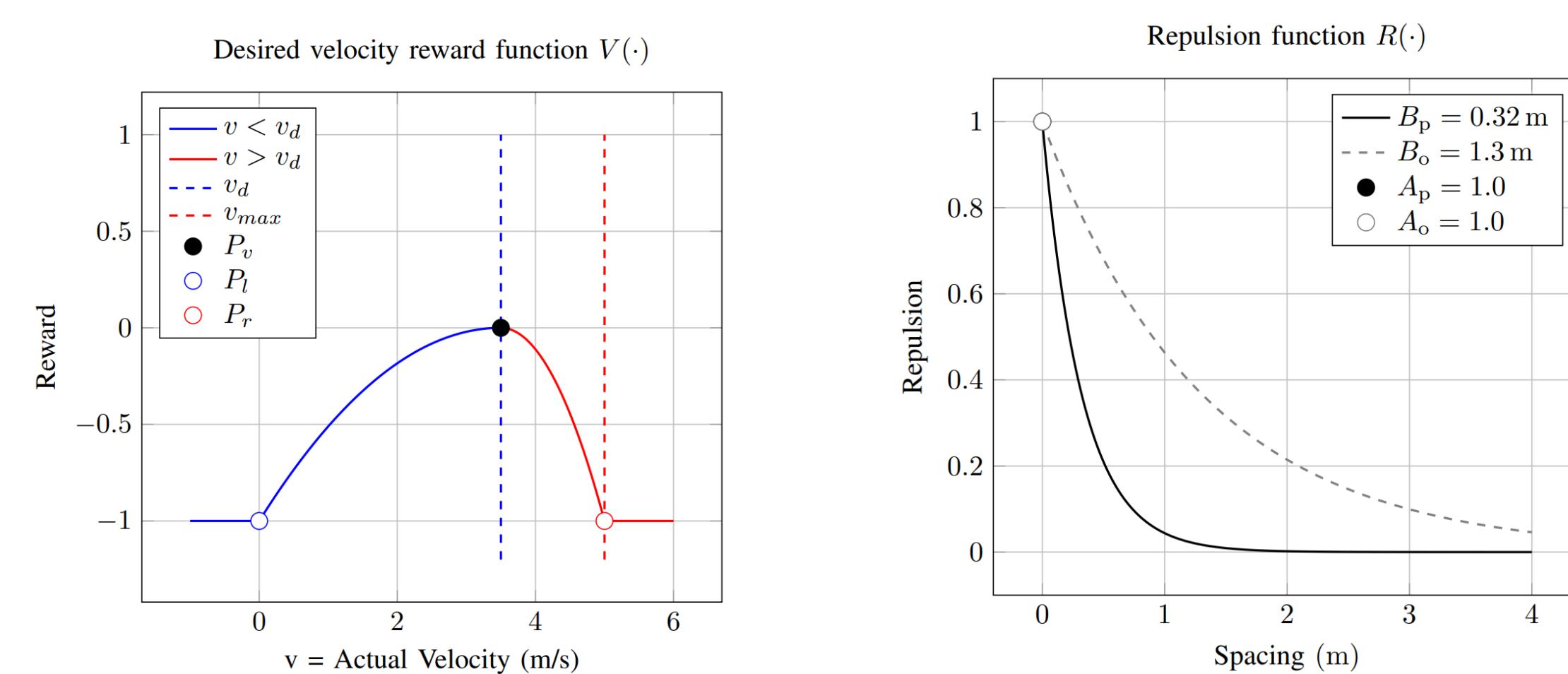


Figure 2: The overall reward for each agent at time t is given by:

$$r^t = \lambda_g r_g^t + \lambda_v r_v^t + \lambda_c r_c^t + \lambda_d r_d^t$$

Real-world results

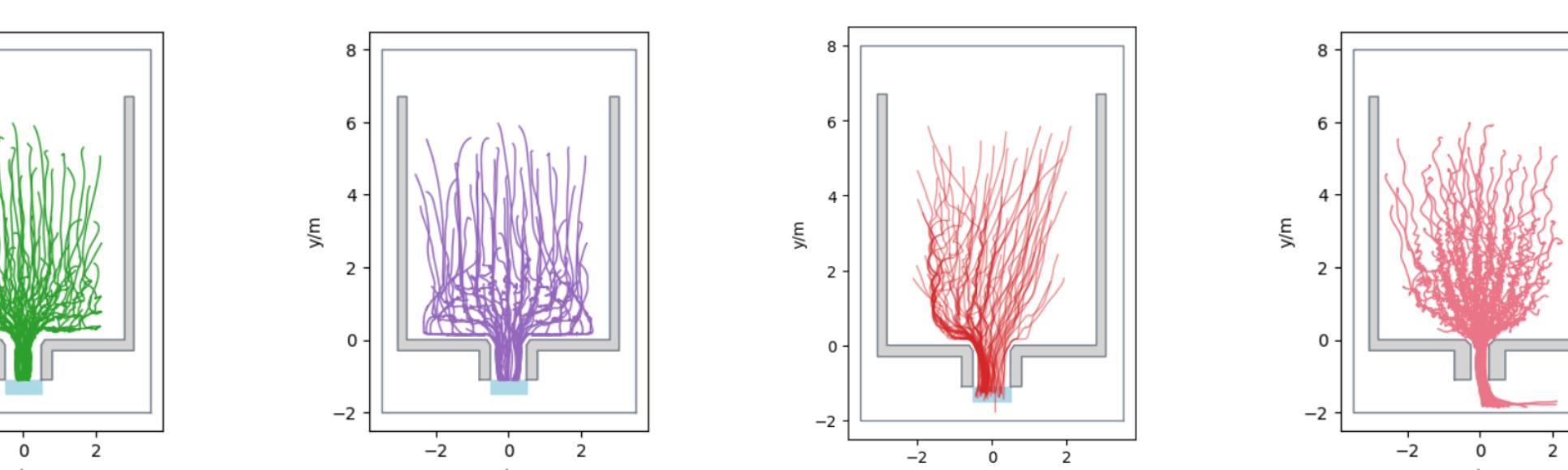


Figure 4: **Green:** R-SFM, **Purple:** CFSM, **Red:** Ours, **Pink:** Ground truth.

Trajectories distribution

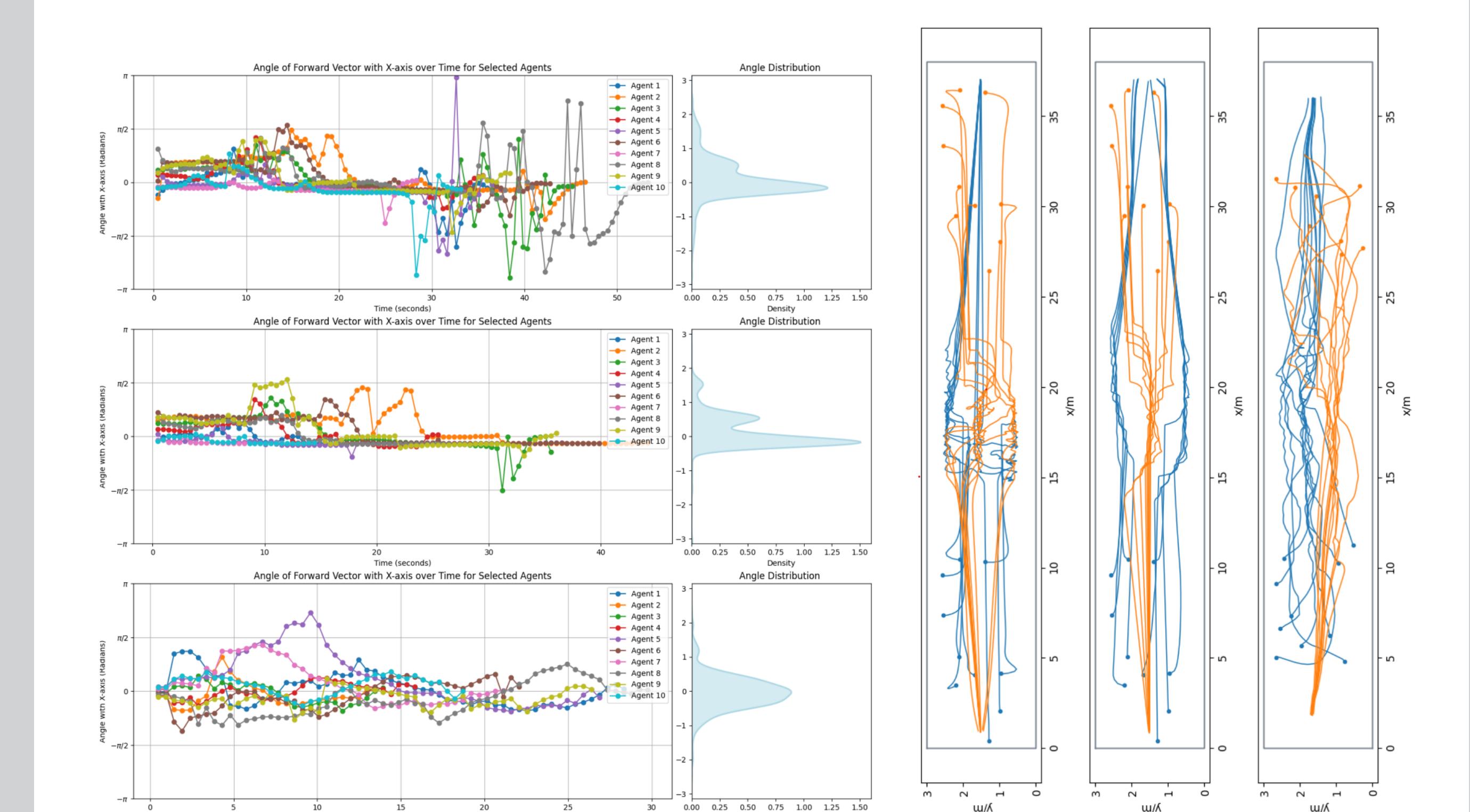


Figure 5: **Left**, top to bottom: R-SFM, CFSM, Ours. Changing of the forward vector direction over time and the corresponding distributions (right). **Right**, left to right: R-SFM, CFSM, Ours. Emergent lane formation.

Acknowledgements

Project funded under the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.4 - Call for tender No. 1031 of 17/06/2022 of Italian Ministry for University and Research funded by the European Union – NextGenerationEU (proj. nr. CN 00000013)

