

SocialDriveGen: Generating Diverse Traffic Scenarios with Controllable Social Interactions

Jiaguo TIAN, Zhengbang ZHU, Shenyu ZHANG, Li XU, Bo ZHENG,
Xu LIU, Weijie PENG, Shizeng YAO,
Weinan ZHANG

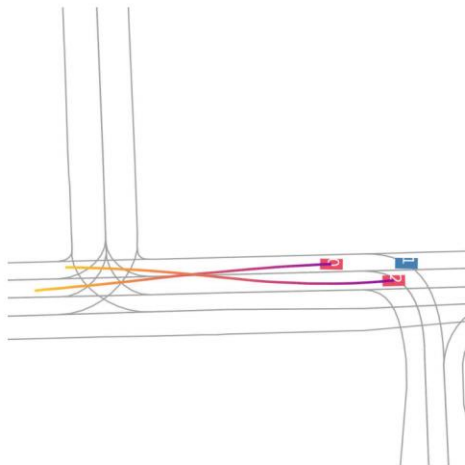
Frontiers of Computer Science, DOI: [10.1007/s11704-026-51974-4](https://doi.org/10.1007/s11704-026-51974-4)

Problems & Ideas

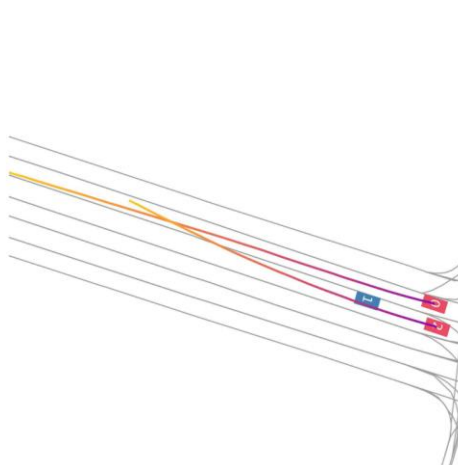
- Problems of conventional traffic scenario generation:
 - Behavioral realism and physical fidelity are often treated as disjointed objectives.
 - Existing simulation approaches tend to fail in complex, socially interactive "long-tail" scenarios.
- Ideas: A hierarchical framework integrating VLMs and multi-agent diffusion models to create socially realistic scenarios that account for both task-oriented extrinsic goals and social-aware intrinsic values.



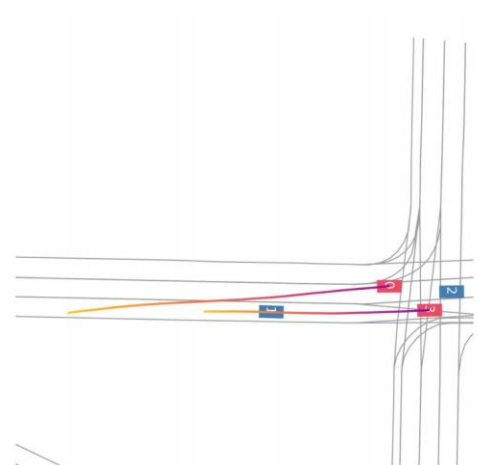
Car 0: Change to the left lane
Car 2: Change to the right lane



Car 0: Maintain current speed
Car 2: Change to the right lane



Car 0: Accelerate, Change to the left lane
Car 3: Yield to Car 0



Main Contributions

- Contributions:
 - A novel hierarchical framework integrating semantic reasoning and social psychology;
 - A social-aware reward decomposition scheme to disentangle task-oriented extrinsic goals from intrinsic social constraints, providing a principled method to model diverse driver personalities along the egoism-altruism spectrum;
 - A reward-guided multi-agent diffusion process featuring step-wise evolutionary guidance to ensure coordinated and socially coherent outcomes disparity maps.

Metric	Original nuScenes	SocialDriveGen (Ours)
Engagement Ratio (%) $\uparrow$	11.00	47.00 (+327.27%)
Max Accel (m/s^2) $\uparrow$	6.42	6.91 (+7.63%)
Max Rel. Velocity (m/s) $\uparrow$	3.12	3.22 (+3.21%)

Zero-shot performance on nuScenes dataset. Despite being trained exclusively on Argoverse 2, our framework significantly enhances scenario complexity, increasing the Engagement Ratio from 11.00% to 47.00%.