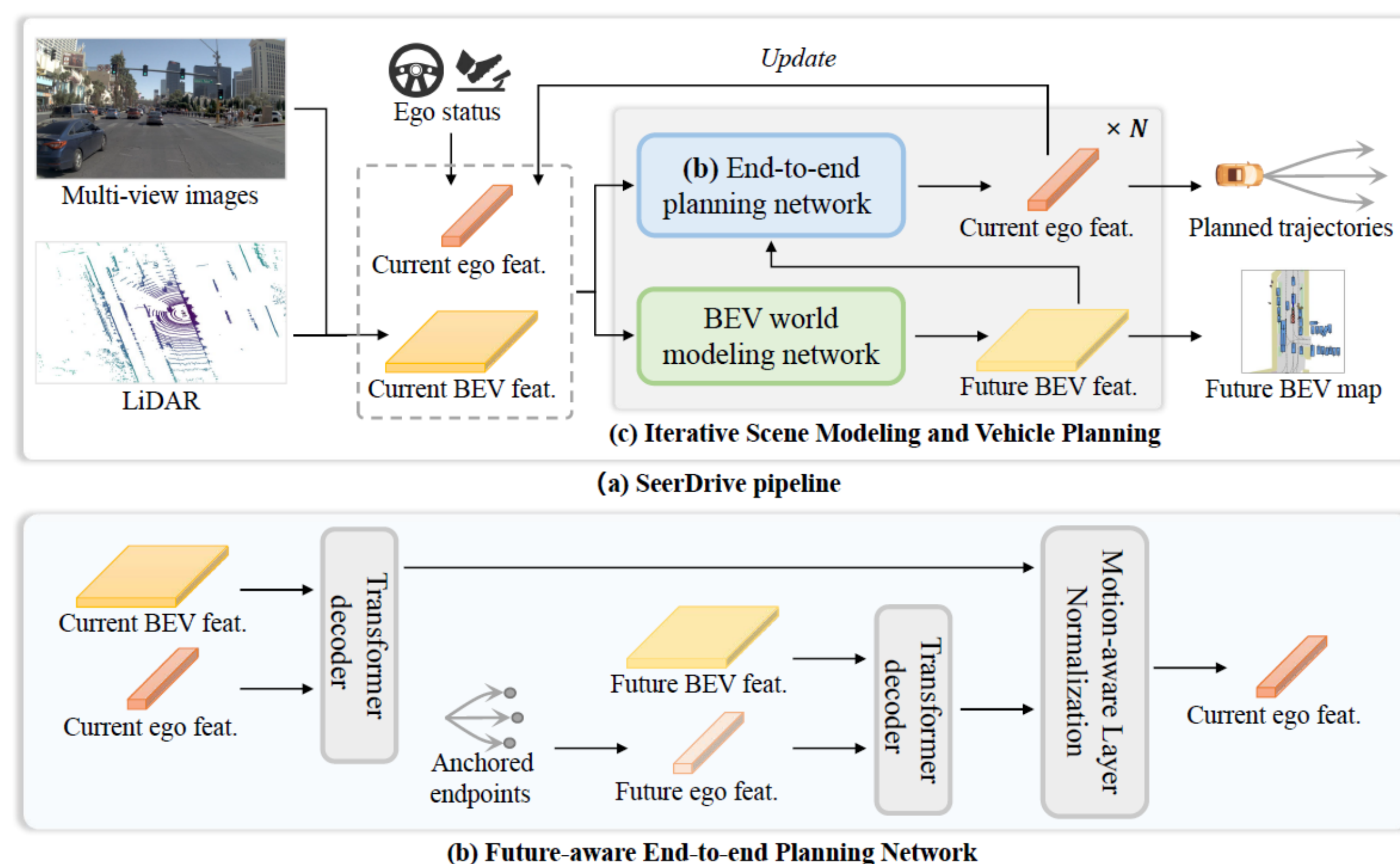


Motivation

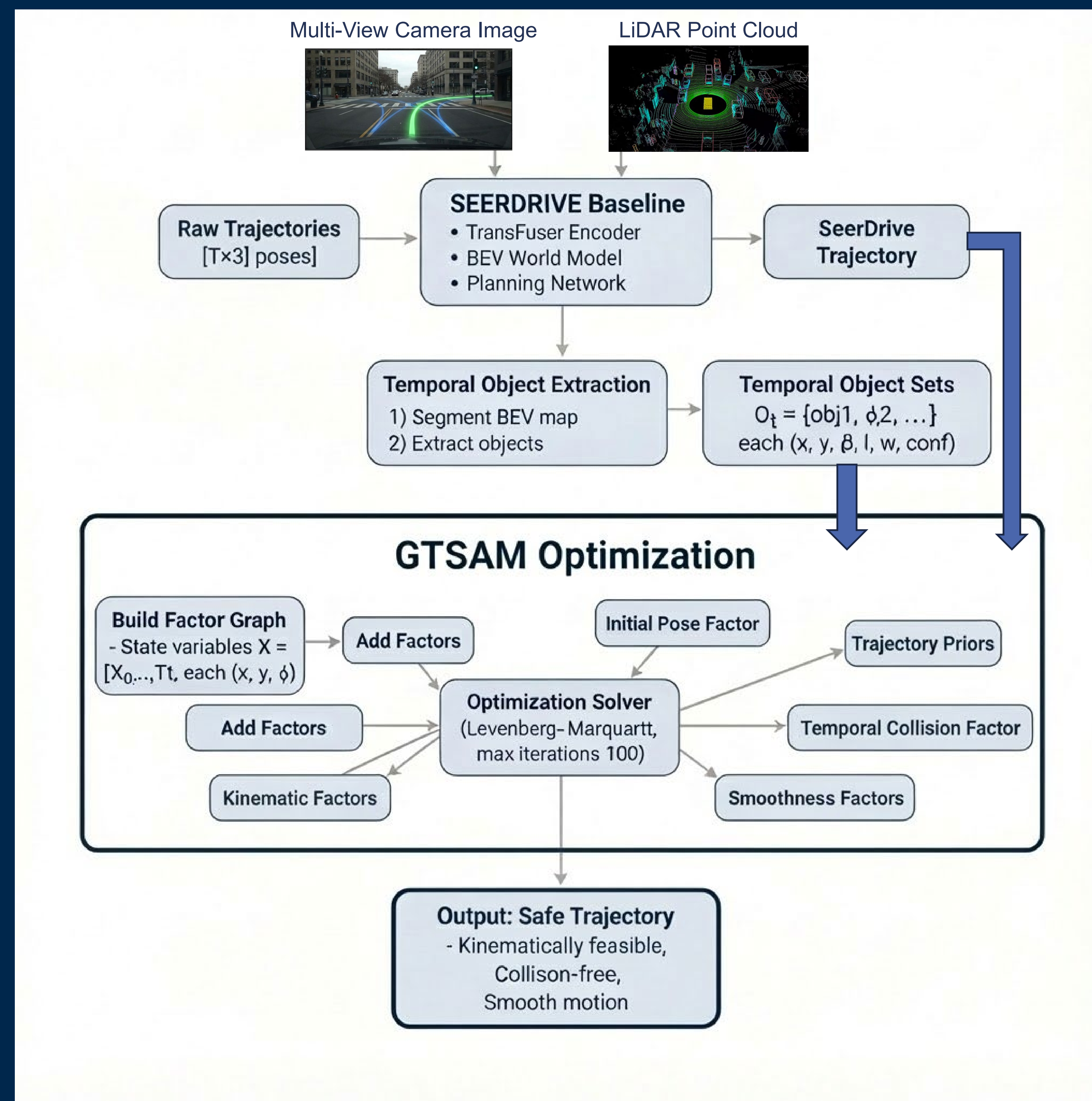
We aim to address neural planner safety violations in autonomous driving by combining SeerDrive's future BEV prediction with constrained optimization frameworks, which provide hard constraint enforcement for kinematic feasibility and temporal collision avoidance where pure learning approaches fall short.

SeerDrive

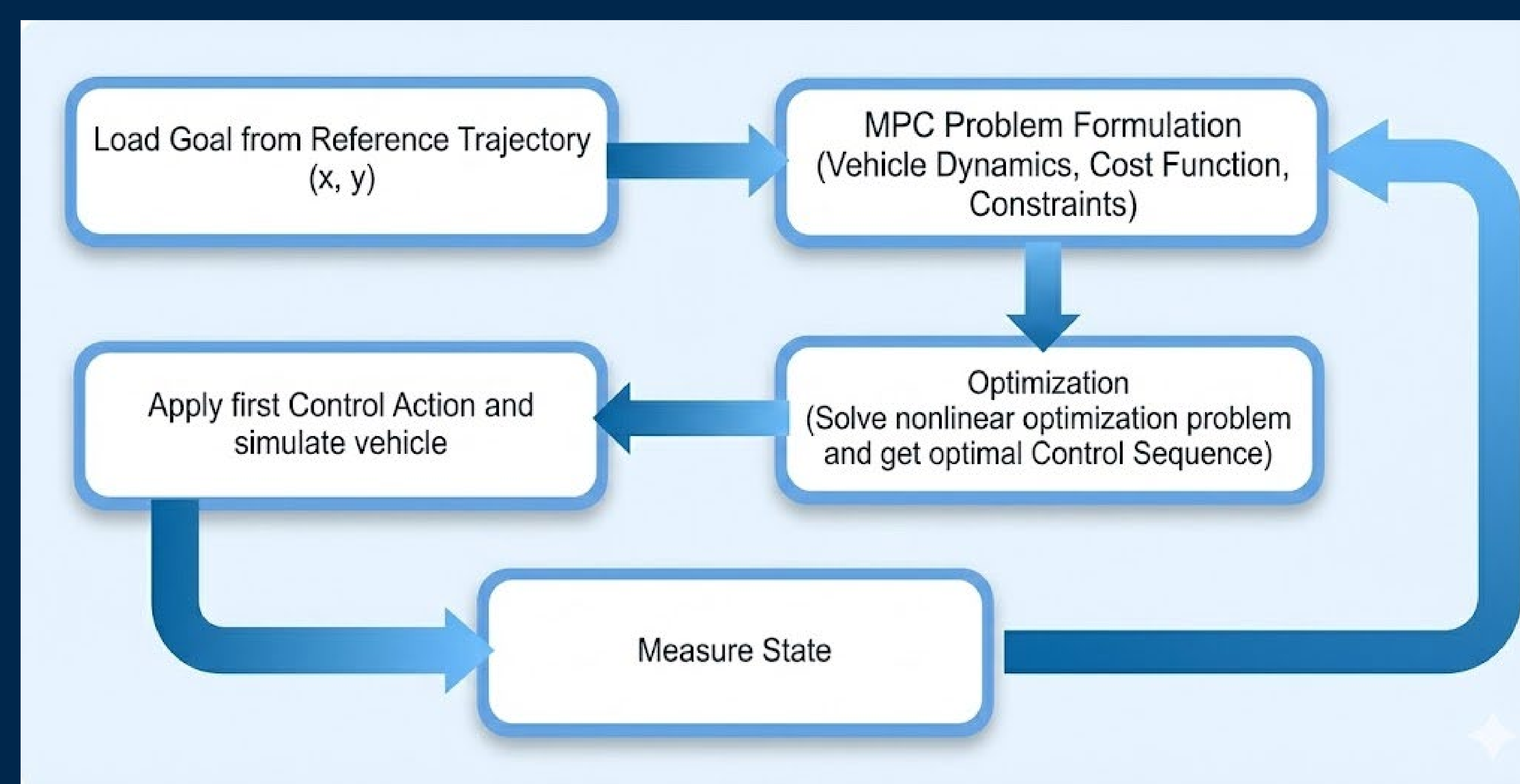
- Predicts future BEV semantic maps using Transformer-based world model across 8 timesteps.
- Generates multi-modal trajectories through bidirectional planning-prediction refinement.
- Achieves 88.9 PDMS on NAVSIM with real-time inference.



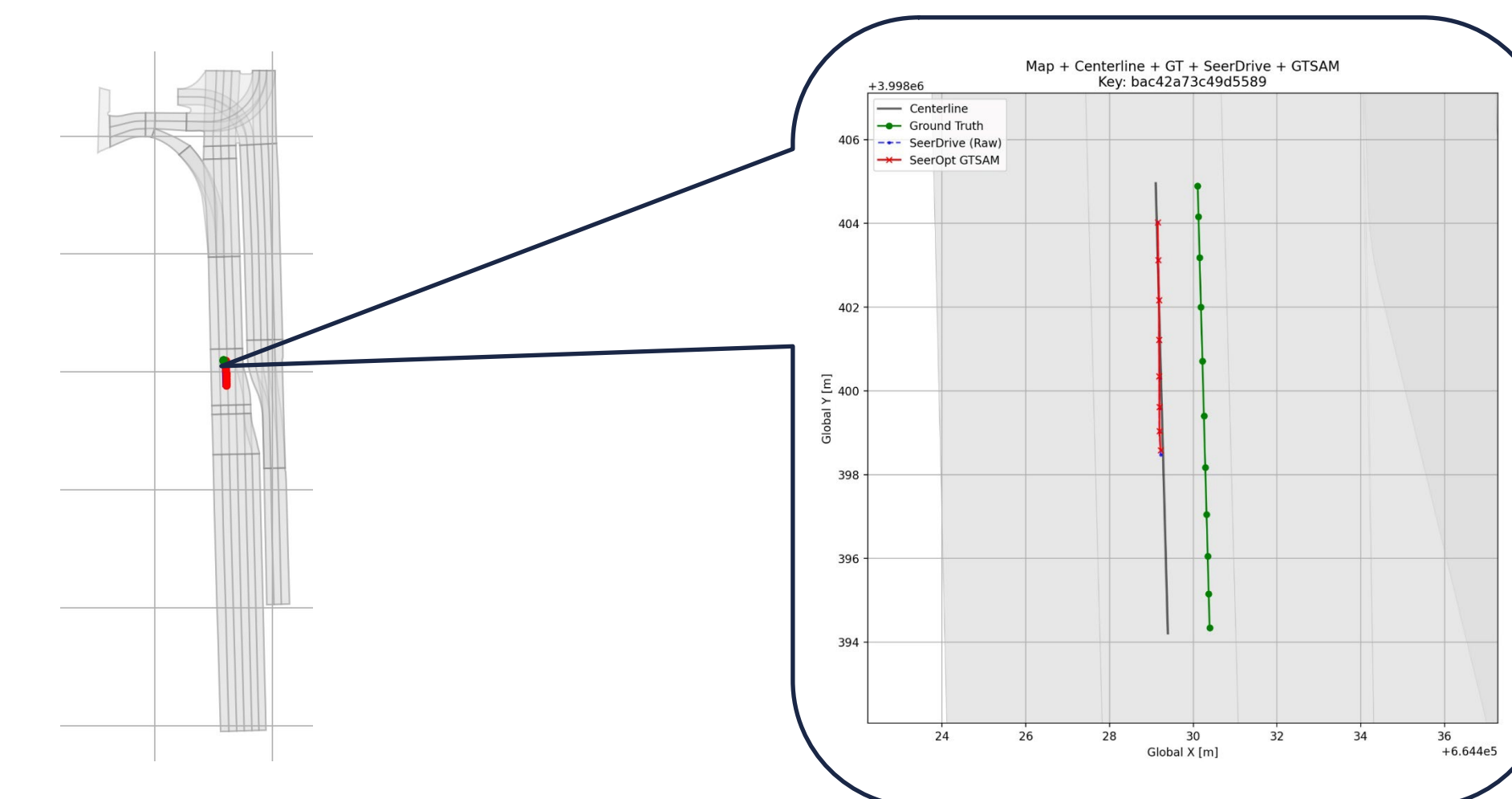
a) GTSAM-Enhanced Pipeline



b) MPC-Enhanced Pipeline



Results



TRAJECTORY PERFORMANCE METRICS

Method	Number of Collisions (NC)	Drivable Area Compliance (DAC)	Driving Direction Compliance	Ego Progress (EP)	Time-to-Collision (TTC)	Comfort (Conf.)	PDM Score (PDMS)
SeerDrive	0.909	0.653	1.000	0.411	0.823	1.000	0.494
SeerOpt (GTSAM)	0.911	0.685	1.000	0.411	0.841	1.000	0.517
SeerOpt (MPC)	0.908	0.760	1.000	0.319	0.827	0.758	0.485

Future Work

- Current Ego-state integration:** Add velocity, acceleration, and steering limits for more feasible trajectories.
- Obstacle-aware optimization:** Use predicted object motion for safer, obstacle-aware planning.
- Real-time closed-loop:** Combine GTSAM for global smoothing with MPC for local control.

References

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- Rawlings, J. B., & Mayne, D. Q. Model Predictive Control: Theory and Design. Nob Hill Publishing, 2009.
- Cao, W. et al. Pseudo-Simulation for Autonomous Driving. arXiv:2506.04218, 2025.