Plausible and Feasible Long-Term Human Trajectory Prediction via Motion Field-Regularized Flow Matching

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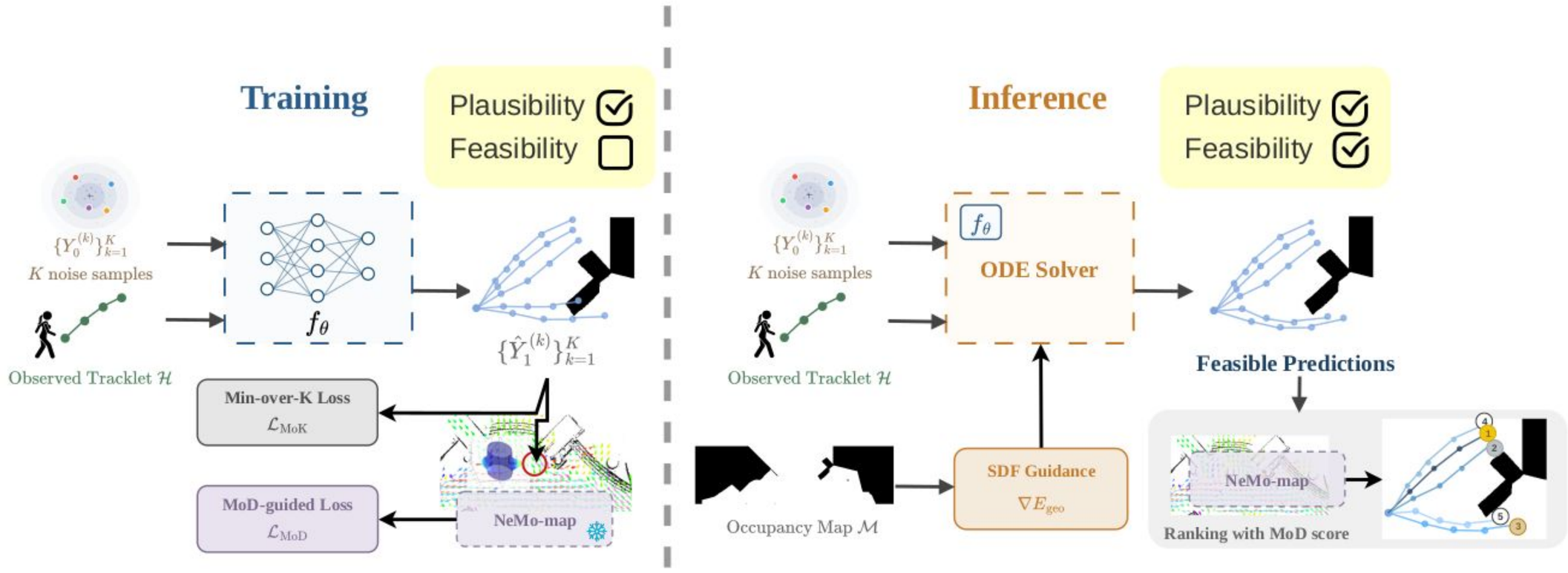
Introduction

- Propose NeuFM, a motion-field-regularized flow matching framework for long-term human trajectory prediction.
- NeuFM uses neural implicit motion fields to guide trajectory candidates toward environment-consistent human motion patterns, improving plausibility and mode-consistent diversity.
- With SDF-based inference-time guidance, NeuFM steers predictions away from static obstacles without retraining, improving accuracy, diversity, and physical feasibility on long-horizon ATC trajectory prediction.

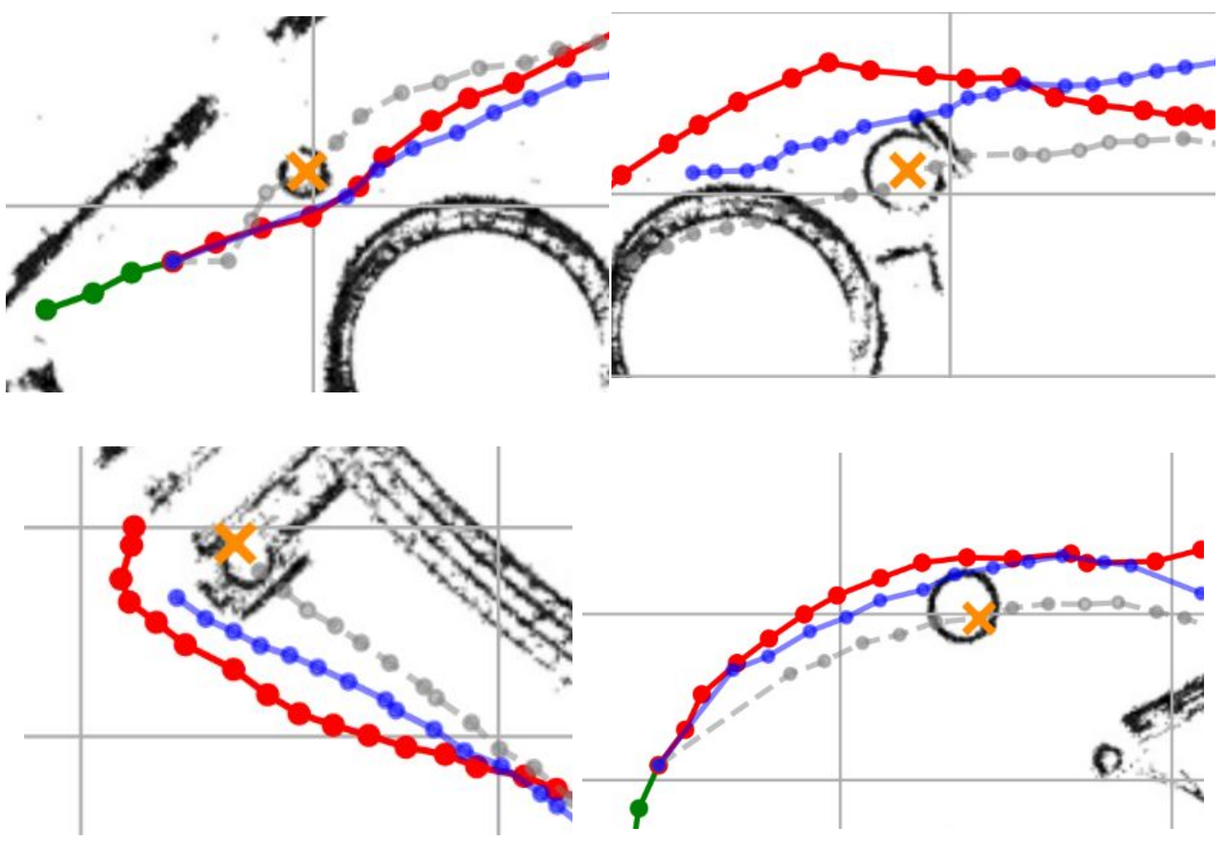
Improves **plausibility** by aligning predictions with learned human motion patterns.
Improves **feasibility** by steering trajectories away from obstacles during inference.

Method



During training, the generative model is regularized by a Map-of-Dynamics Loss to encourage plausible, mode-consistent predictions. During sampling, an SDF-based geometric guidance is introduced to steer trajectories away from obstacles, encouraging physical feasibility.

Evaluatioin



Orange crosses mark waypoints where the unguided trajectory collides with obstacles (SDF < 0).

The geometric guidance steers the predicted trajectory away from walls and pillars during ODE integration, encouraging collision-free paths without retraining.

Observed (past) | GT future | Without guidance | Collision point | With guidance