

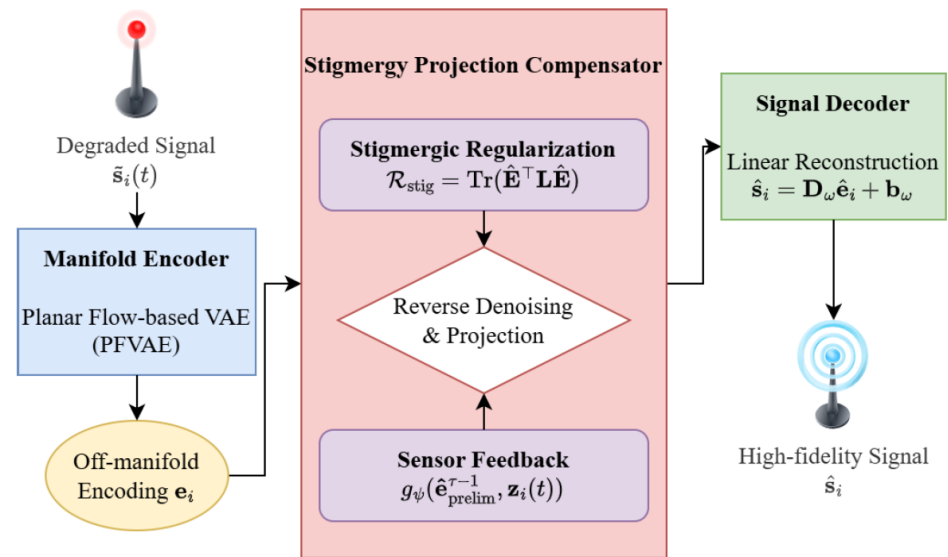
StigMAP: Stigmergy-Guided Manifold Projection using Diffusion Models for Multi-Agent Localization

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Problems & Ideas

- Problems:
 - Signal Degradation: Real-world multi-agent systems suffer from severe signal distortion and communication interruptions.
 - Limitations of Aggregation: Traditional methods (like GNNs) rely on aggregating neighbor information.
- Proposed Ideas (StigMAP):
 - This work treats signal recovery as projecting corrupted signals back onto a learned low-dimensional manifold.
 - It introduces "Stigmergic Regularization" (inspired by biological consensus) to guide agents toward mutual consistency without heavy communication overhead.

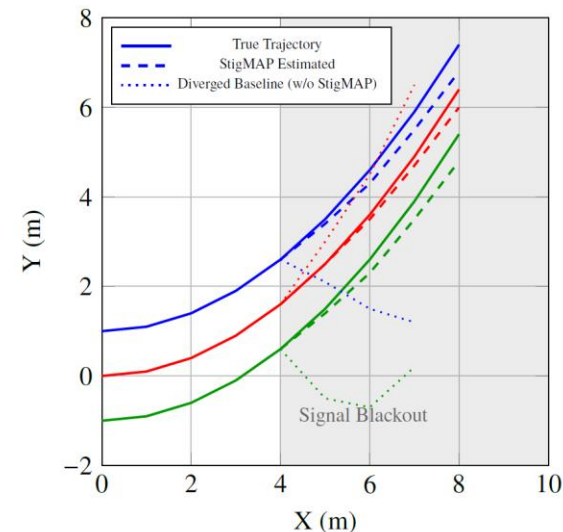


The StigMAP framework.

Results

- Experimental Results:
 - Superior Accuracy: StigMAP outperforms state-of-the-art methods (such as CORE and When2com). It reduces the Root Mean Square Error (RMSE) by approximately 10% compared to cooperative reconstruction baselines.
 - Robustness to Blackouts: The model maintains high agent coordination even during complete signal blackouts. By leveraging the learned manifold, agents can predict probable next-states, effectively bridging communication gaps that cause traditional methods to diverge.

Method	RMSE(m) on V2X-Sim	RMSE(m) on COMAP
STGDAN [1]	0.563	0.624
BAITC [7]	0.673	0.735
FTC-NN [8]	0.592	0.656
DiscoGraph [2]	0.515	0.583
When2com [3]	0.435	0.545
CORE [9]	0.488	0.523
EFTC [10]	0.502	0.561
w/o Stigmergy	0.551	0.613
w/o Feedback	0.525	0.582
CVAE-Gen	0.540	0.595
StigMAP (Full)	0.431	0.480



StigMAP achieves the lowest localization compared to aggregating methods like DiscoGraph and CORE.

Trajectory coordination during a complete signal blackout.