Grouptron: Dynamic Multi-Scale Graph Convolutional Networks for Group-Aware Dense Crowd Trajectory Forecasting

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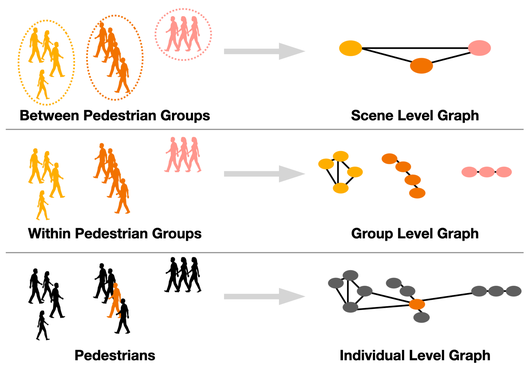
Motivation

- Human Trajectory Prediction is **extremely important** for intelligent and reliable autonomous systems
- State-of-the-art methods struggle with **densely populated and highly dynamic** scenarios
- Important insight from data: humans often **walk in groups** and there are different dynamics and interactions **at different scales**

Problem Formulation

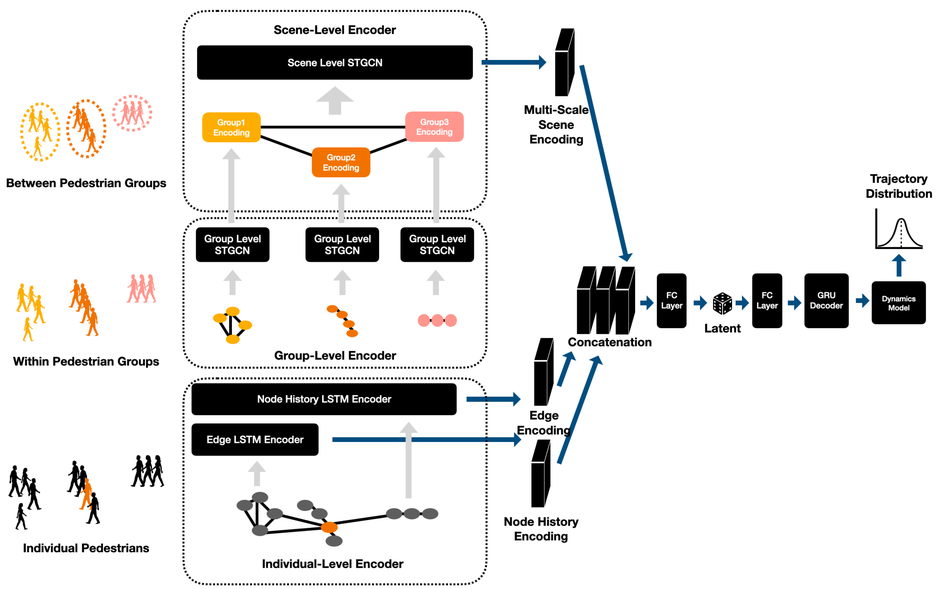


The Inidividual Level: Interactions between **individual** pedestrians

The Group Level: Dynamics **within** each pedestrian group

The Scene Level: Interactions **among** pedestrian groups

Grouptron Visualization



Quantitative Results

- **9.3%** decrease in FDE on benchmark dataset
- **16.1%** performance improvement in **densely populated** scenes
- **ADE** = Average Displacement Error
- **FDE** = Final Displacement Error

ADE/FDE Values for ETH/UCY Datasets

*Lower is better

Method	ETH	HOTEL	UNIV	ZARA1	ZARA2	AVG
Social-LSTM	2.35/1.09	1.76/0.79	1.40/0.67	1.00/0.47	1.17/0.56	1.54/0.72
Social-GAN	1.52/0.81	1.61/0.72	1.26/0.60	0.69/0.34	1.84/0.42	1.18/0.58
SoPhie	**1.43/0.70**	1.67/0.76	1.24/0.54	**0.63**/0.34	0.78/0.38	1.15/0.54
Trajectron++	1.68/0.71	**0.46**/0.22	1.07/0.41	0.77/**0.30**	0.59/0.23	0.91/0.37
Grouptron	1.56/**0.70**	**0.46/0.21**	**0.97/0.38**	0.76/**0.30**	**0.56/0.22**	**0.86/0.36**

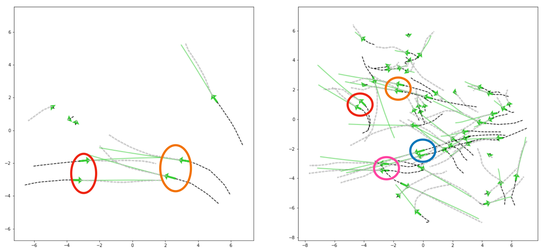
ADE/FDE Values for Densely Populated Scenes

*Lower is better

Method	UNIV	UNIV-40	UNIV-45	UNIV-50
Trajectron++	1.07/0.41	1.17/0.436	1.24/0.46	1.25/0.47
Grouptron	**0.97/0.38**	**1.00/0.39**	**1.04/0.40**	**1.07/0.42**

Qualitative Results

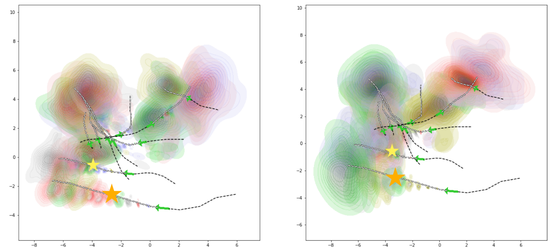
Grouptron accurately predicts complex situations



Left: Two pedestrian groups crossing paths, where Grouptron **accurately predicts when and where the two groups' trajectories intersect**

Right: Grouptron's performance in densely populated scenes with **more than 40 pedestrians**

Grouptron is more confident in densely populated scenes when compared with SOTA



Comparison: Grouptron's prediction distributions have **much smaller ranges**, indicating that it is much **more confident** with prediction outcomes.

*Stars indicate pedestrians of interest