Interactive Adjustment for Human Trajectory Prediction with Individual Feedback

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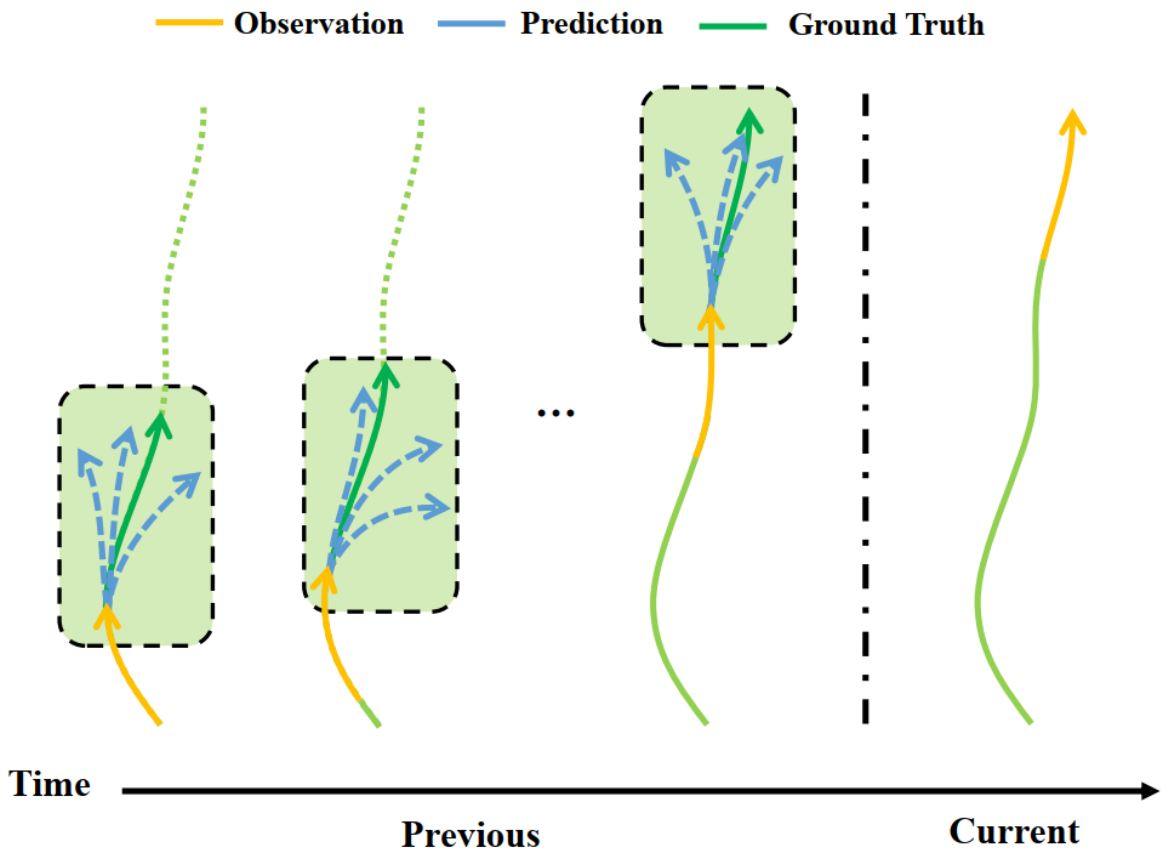
* and ** denote equal contribution

Background

- **Human Trajectory Prediction**
  - The problem of predicting the target's future movements given the observation.
  - Have been studied from numerous aspects while achieving remarkable progress.
    - Multi-modal prediction
    - Human social interaction
    - Scene context restrictions
    - …

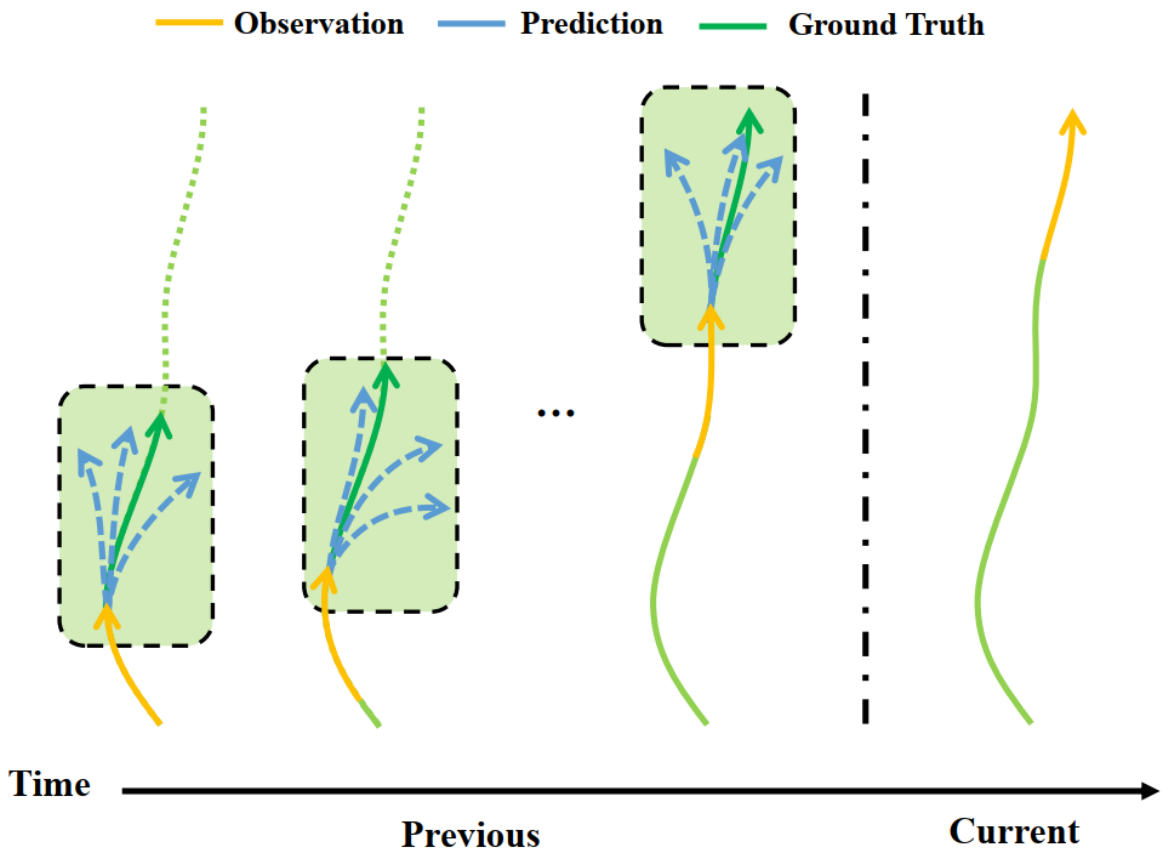
Motivation

- **Human Trajectory Prediction**
  - Given the sequential nature:
    - An agent's presence in a scene is typically a long sequence
    - A series of consecutive predictions is performed over time
  - Another essential information:
    - **Individual Feedback.**



Motivation

- **Human Trajectory Prediction**
  - Continuous predictions on the agent
  - Previous predictions can be verified by the agent's ground-truth trajectory
    - Available through the progression of time
  - **Individual Feedback** from verification



Individual Feedback

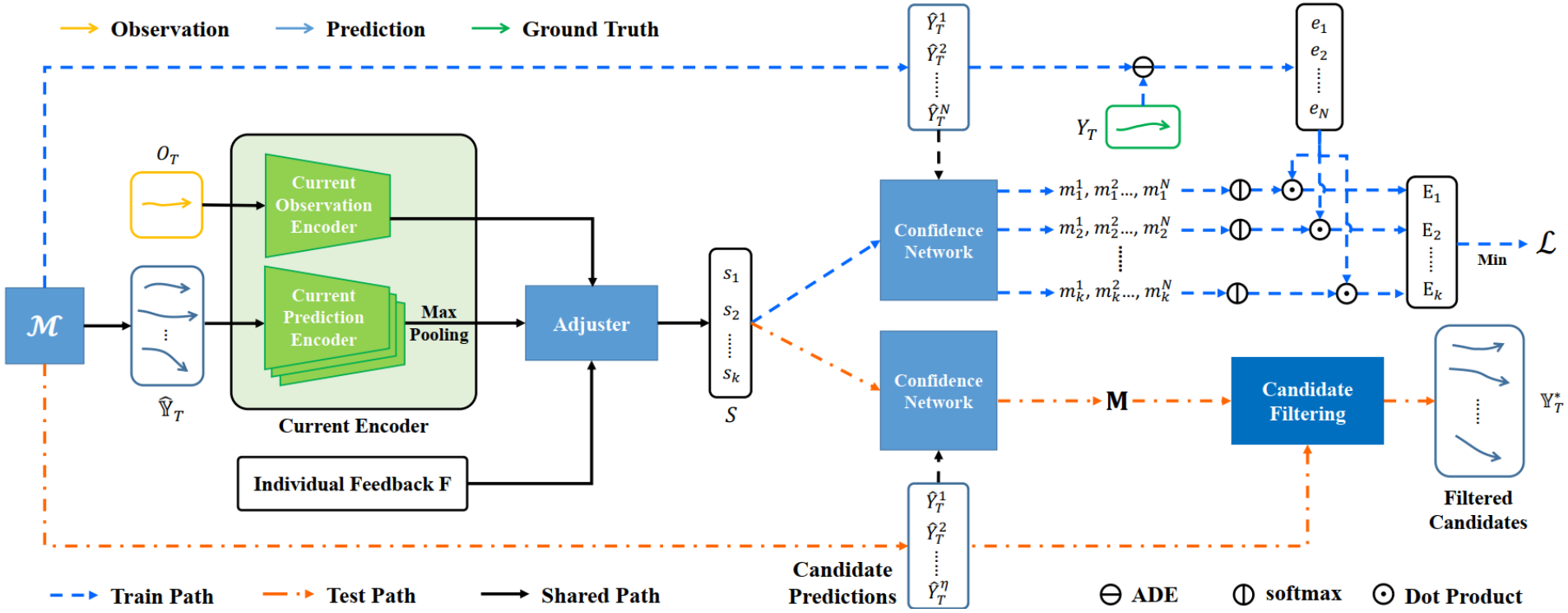
- In the conventional trajectory prediction setting, a prediction model $\mathcal{M}$ takes an observation sequence on an agent with length τ_{obs} as input, and outputs predicted trajectories with length τ_{pred}.
- When the agent has been present in the scene for more than τ_{obs} + τ_{pred} timesteps, there exists predictions whose qualities can be verified by the corresponding actual trajectories of the agent.

Interactive Adjustment Network (IAN)

- In order to effectively utilize the individual feedback, we design the Interactive Adjustment Network (IAN).
- Two major considerations during the design
  - The feedback information cannot be directly integrated into the prediction model and trained end-to-end. This means that the network should developed as an external module.
  - As an external module, the network cannot directly be aware of the restraints given by the prediction model when adjusting. This prevents the network from directly outputting trajectories adjusted via individual feedback.

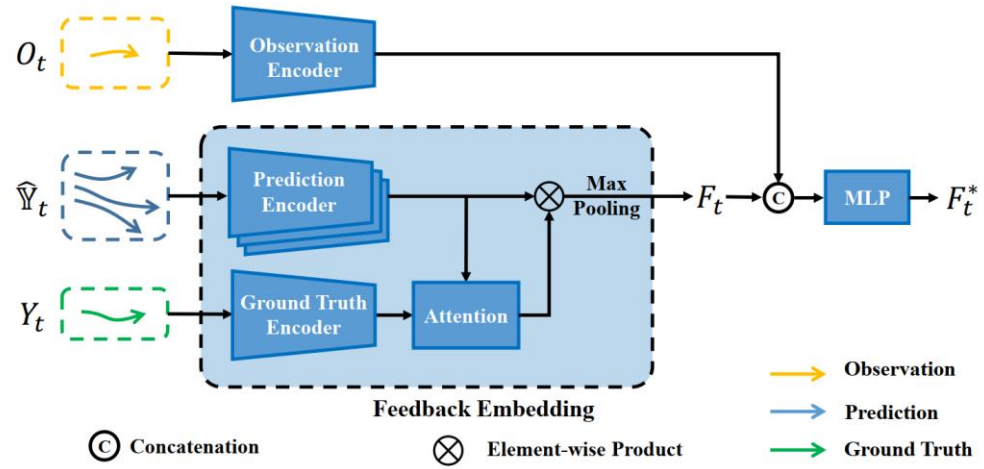
Interactive Adjustment Network (IAN)

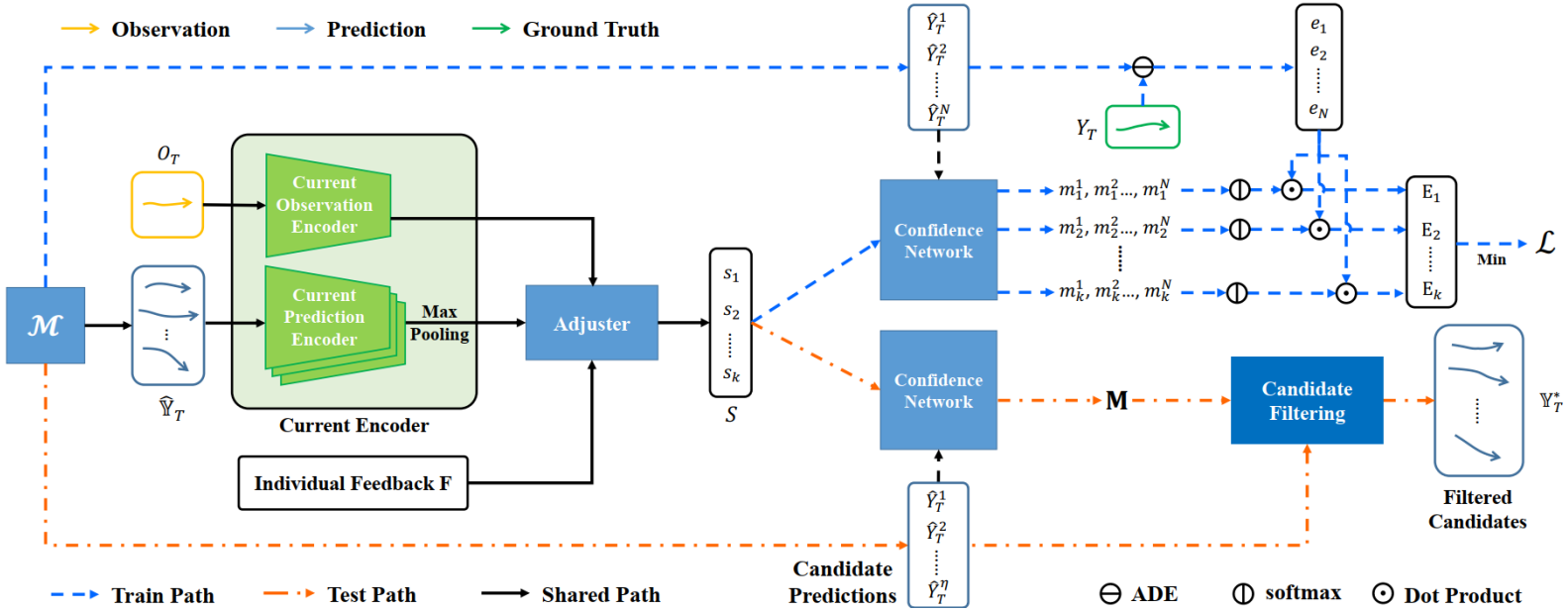
- Based on the two considerations, we design the network as an external module that
  - First embeds the individual feedback
  - Then use the feedback embeddings to produce proposals and adjust the predictions of the prediction model



Interactive Adjustment Network (IAN)

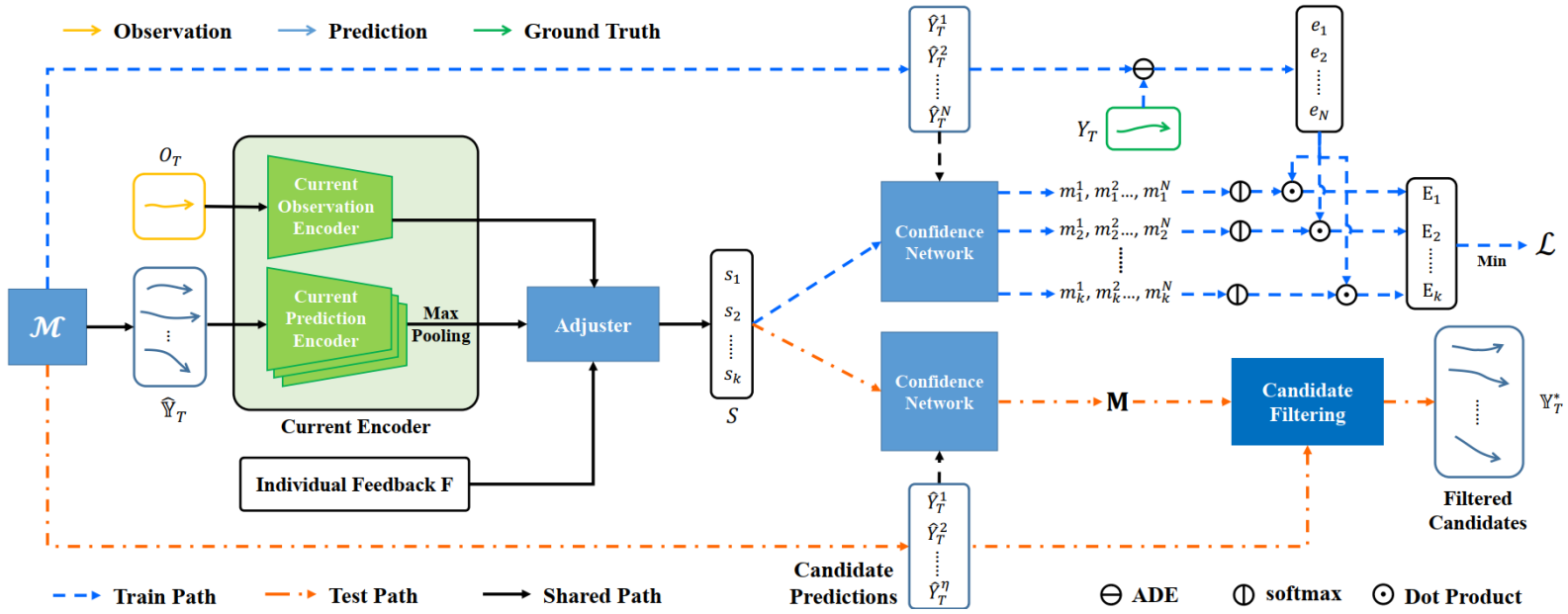
- In the pipeline
  - An illustration of the feedback embedding network is shown on the right.
  - The feedback embeddings for each agent are aggregated together as the individual feedback **F**





Interactive Adjustment Network (IAN)

- In the pipeline (cont'd)
  - The individual feedback **F** is sent through the adjuster along with the current observation and predictions.
  - The adjuster produces a series of proposals, which are used to filter the candidate predictions (generated by the prediction model) via a greedy algorithm

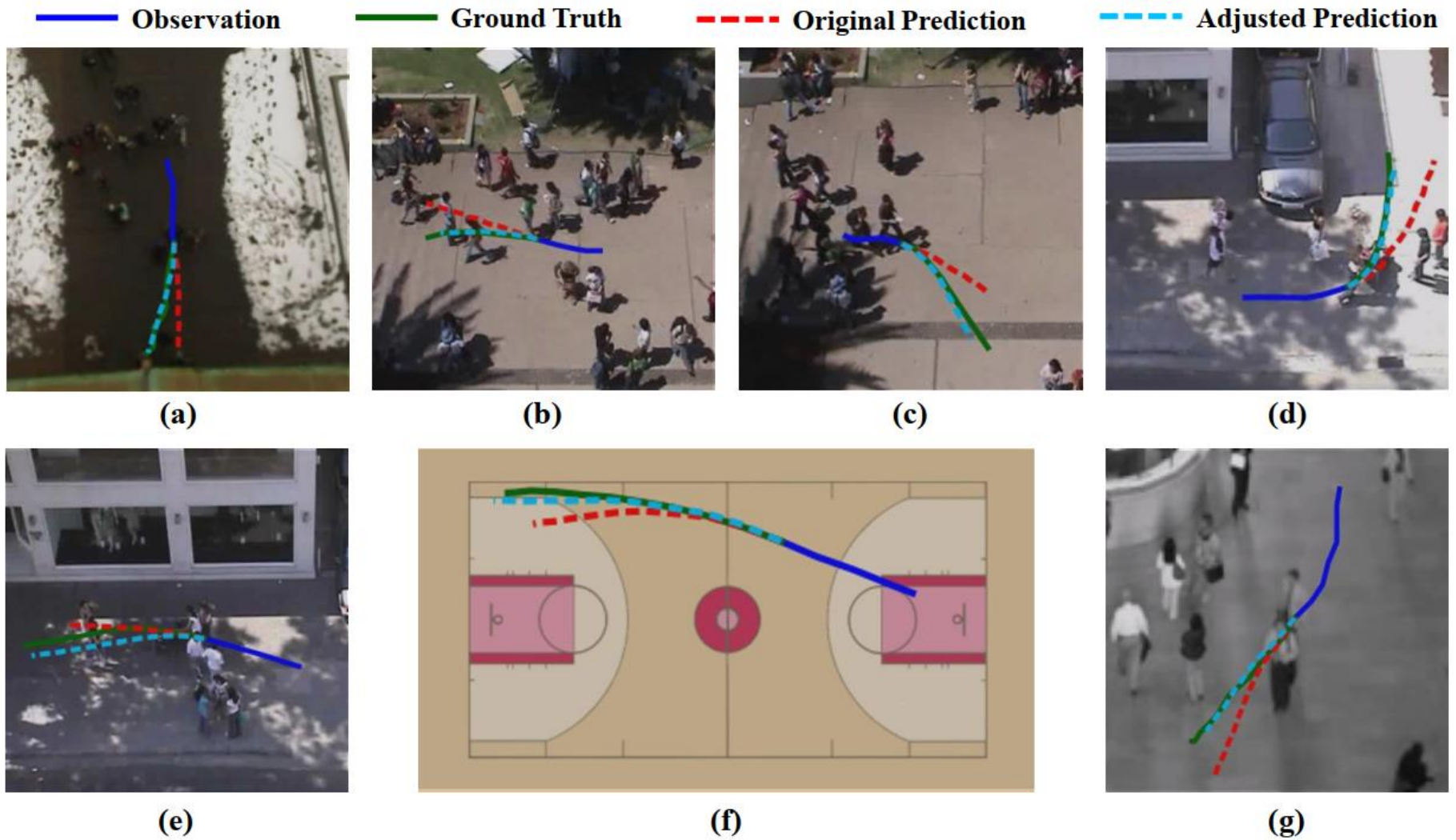


Experiments

- We conducted experiments by adopting IAN to six representative prediction models across three widely used benchmarks, and use ADE/FDE as metrics
- Substantial performance improvements are achieved for all the prediction models on three benchmarks after applying IAN to model the individual feedback information

ID	Method	SGAN	SGCN	LB-EBM	GroupNet	TUTR	ST
1	Baseline	0.22 / 0.39	0.28 / 0.48	0.20 / 0.36	0.21 / 0.35	0.23 / 0.39	0.20 / 0.30
	w/ IAN	**0.20 / 0.34**	**0.26 / 0.44**	**0.18 / 0.31**	**0.19 / 0.30**	**0.22 / 0.36**	**0.19 / 0.29**
	Impr.	9.1% / 12.8%	7.1% / 8.3%	10.0% / 13.9%	9.5% / 14.3%	4.3% / 7.7%	5.0% / 3.3%
2	Baseline	4.47 / 7.40	4.10 / 6.51	3.19 / 5.24	2.65 / 4.05	2.81 / 4.40	3.05 / 4.60
	w/ IAN	**4.28 / 7.04**	**3.79 / 5.94**	**2.98 / 4.72**	**2.56 / 3.83**	**2.72 / 4.25**	**2.96 / 4.45**
	Impr.	4.3% / 4.9%	7.6% / 8.8%	6.6% / 9.9%	3.4% / 5.4%	3.2% / 3.4%	3.0% / 3.3%
3	Baseline	1.53 / 2.24	1.56 / 2.46	1.40 / 2.08	1.17 / 1.64	1.23 / 1.93	1.24 / 1.60
	w/ IAN	**1.47 / 2.11**	**1.44 / 2.19**	**1.34 / 1.94**	**1.13 / 1.56**	**1.19 / 1.84**	**1.20 / 1.55**
	Impr.	3.9% / 5.8%	7.7% / 11.0%	4.3% / 6.7%	3.4% / 4.9%	3.3% / 4.7%	3.2% / 3.1%

Qualitative Analysis



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Thank you for watching!

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