DAIT Project

Trajectory Preduiction for Human-Human Interaction

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EPFL

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Introduction

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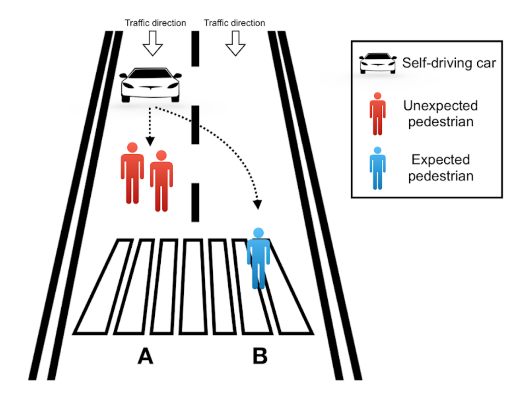
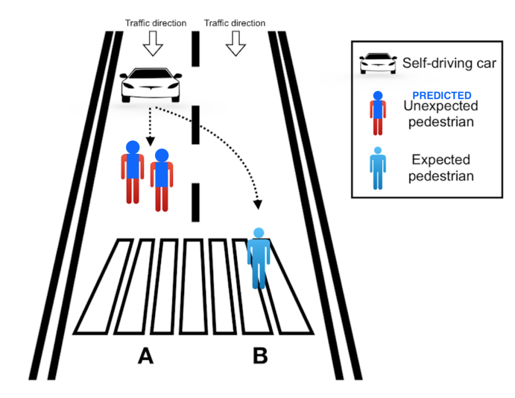
- Trajectory prediction is crucial for improving autonomous vehicles behaviour



Introduction

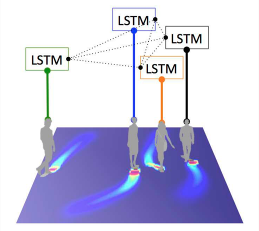
- Trajectory prediction is crucial for improving autonomous vehicles behaviour
- Could avoid situations seen in the ethical lectures



Previous work Social LSTM : Human Trajectory Prediction in Crowded Spaces

In their project, they used different components to make the structure:

- One LSTM per pedestrian
- Social Pooling
- Prediction per frame



Images from Social LSTM:Human Trajectory Prediction in Crowded Spaces and courses lecture

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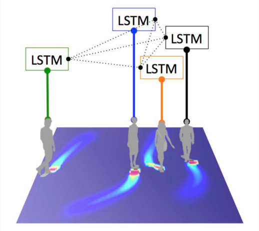
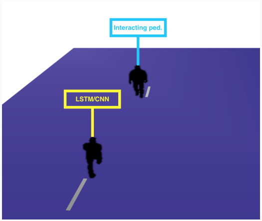


In our project we only use:

- One CNN, or one LSTM
- Prediction per pedestrian



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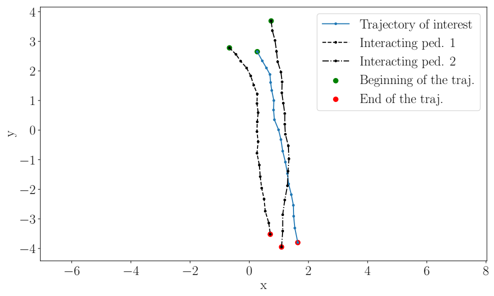
Data

Pre-processing

The preprocessing is divided in 4 steps:

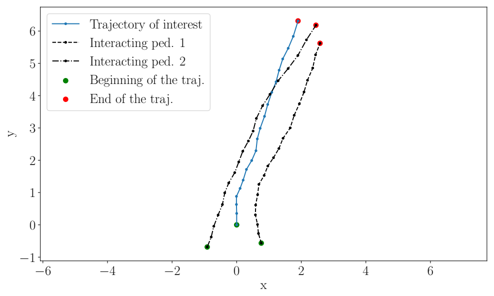
1. We isolate each trajectory along with his interaction, that is the other trajectories that are around within the same frames



Pre-processing

The preprocessing is divided in 4 steps:

1. We isolate each trajectory along with his interaction, that is the other trajectories that are around within the same frames
2. We normalize the trajectories such that the first point is at $(0, 0)$ and the second is at $(0, y_1)$



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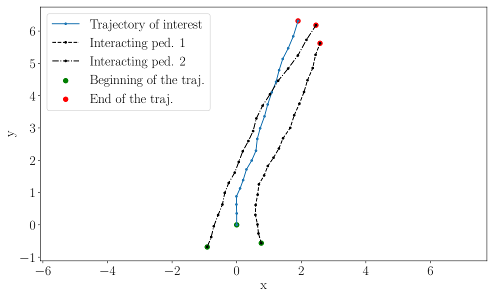

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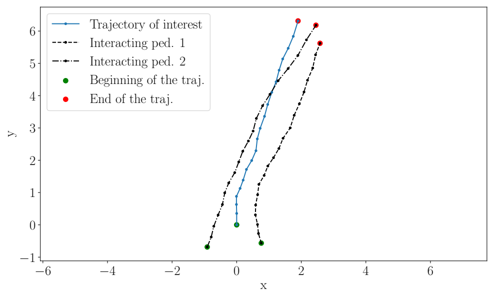
3. We calculate axis velocities V_x and V_y
4. For each frame, if there is a interacting pedestrian we add its coordinates and speed otherwise zeros are added



Data

We have a file with:

- Pedestrians ID
- Frame number
- Twenty sets of x and y coordinates per pedestrian

Frame Number	ID	x	y	V_x	V_y
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

Data

We have a file with:

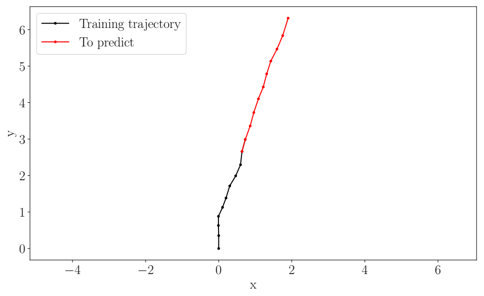
- Pedestrians ID
- Frame number
- Twenty sets of x and y coordinates per pedestrian

We want :

- Train on the 10 first coordinates
- Predict the next 10

Frame Number	ID	x	y	V_x	V_y
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$

Example of trajectory to predict



Outputs structure

Finally our inputs have the following shape: $[10, N, 4 * N_{inter}]$, with

- 10: sequence length
- N: The number of data
- $4 * N_{inter}$: 4 (being the x and y coordinates and V_x and V_y velocities) times the number of pedestrians interacting with the one of interest.

- The models can predict either coordinate or speed or both
- We test our two models for 4 different cases

The four different cases are:

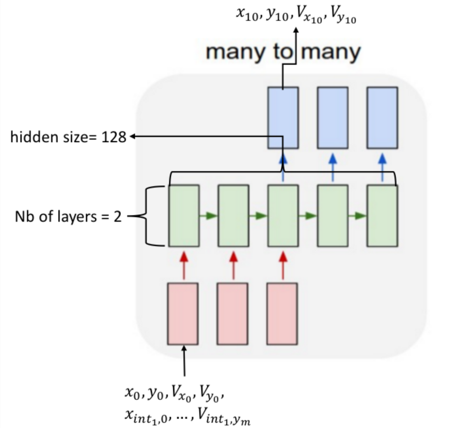
1. Predict coordinates with loss defines as $L_1 = (X - X_{pred})^2$ with $X = [x, y]$
2. Predict speeds with loss defines as $L_2 = (V - V_{pred})^2$ with $V = [V_x, V_y]$
3. Predict both coordinates and speeds with loss defines as $L = L_1 + L_2$
4. Predict both coordinates and speeds with loss defines as $L = L_1 + L_2 + L_3$, with $L_3 = (X - X_{t-1} + V_t * 0.4)^2$

Models

CNN

Define CNN

LSTM



Inputs: sequence of coordinates and velocities of the trajectory of interest and of the interacting trajectories
Outputs: sequence of predicted coordinates and velocities for the trajectory of interest

Results

Results: Introduction

To calculate the correctness of the prediction two indicators are used:

1. The final displacement error: $e_{fin} = \sqrt{(X_n - X_{pred,n})^2}$
2. The mean displacement error: $e_{fin} = \sqrt{\frac{\sum_{i=0}^{n}(X_{gt,i} - X_{pred,i})^2}{(n)}}$

Depending on the inputs two ways are possible to find the predicted coordinates:

1. If the coordinates are predicted: directly use them
2. If the velocities are predicted: $X_t = X_{t-1} + V_t \cdot 0.4$, with 0.4 the time between two frames in seconds

Results: LSTM

	Model 3			Model 4		
	Traj type			Traj type		
	1	2	3	1	2	3
Mean disp. L2	0.519	0.484	0.568	0.537	0.473	0.576
Final disp. L2	0.979	0.871	1.093	0.992	0.86	1.125

Representation