Player Trajectory Prediction in Soccer

Jagjeet Singh, Rajat Kulshreshtha
Carnegie Mellon University

ABSTRACT

Traditional statistical methods of predicting the outcomes of sports like soccer relies upon long term, averaged statistics like expected goal value, player ratings and historical results. While these methods are sufficient to describe the general trend in a sports season, they are not sufficient to capture the intricacies of the gameplay at a real-time level. We propose a new model to predict the behavior of each player in soccer matches by learning to predict their motion. We also build upon a state-of-the-art LSTM based pedestrian trajectory prediction model and extend it to sports domain.

PROBLEM DESCRIPTION

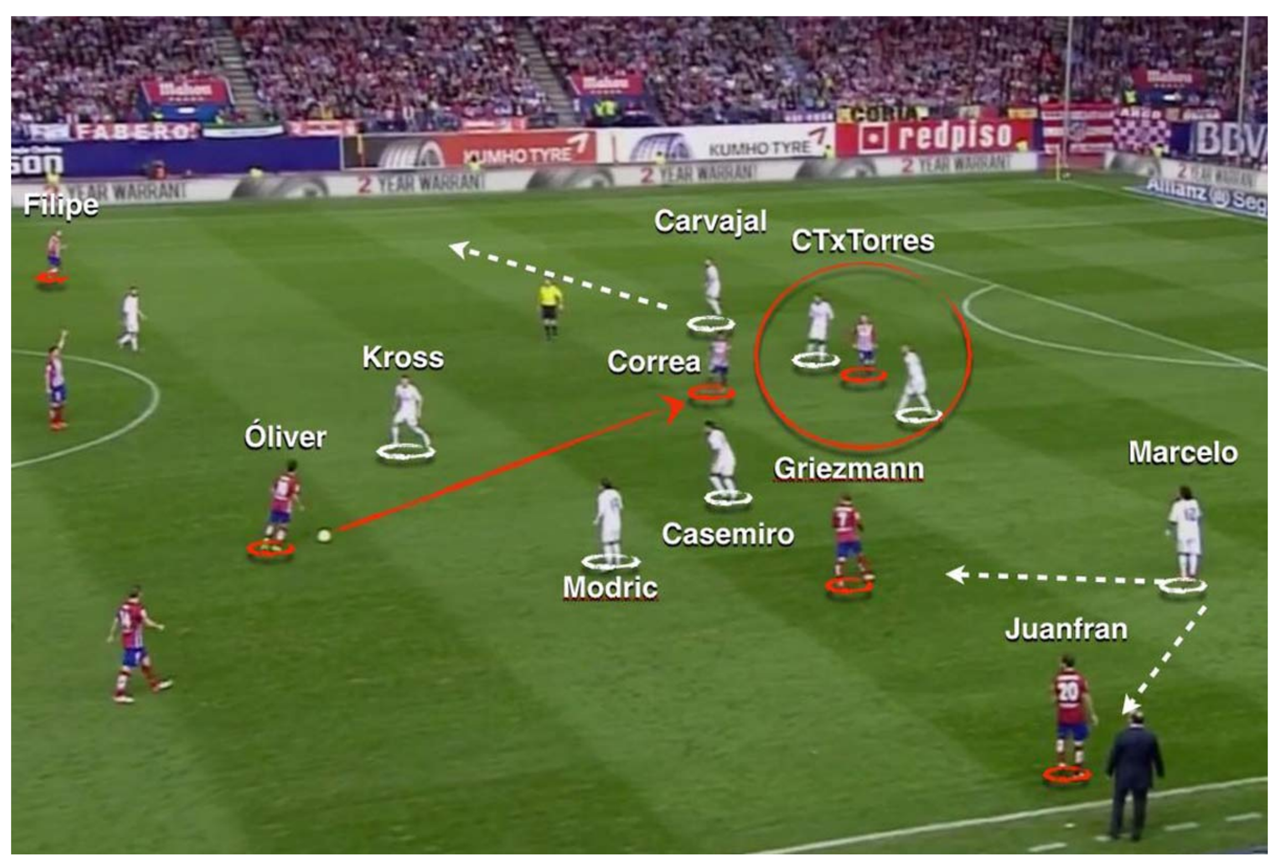

Fig1 Sample Scenario

Soccer is a very dynamic game. There are different ways in which each player responds to other players and the ball in the neighborhood. In Fig 1, the two central defenders maintain a proper cover over opposition attacker Torres, to increase the chances of intercepting the pass. Attacker Correa is trying to shift to an empty space in the field to receive the pass. Such strategies are implicit during a game and are frequently observed. We plan to adopt a data driven method to analyze such strategies and predict the trajectories of players.

PROPOSED METHODS

The problem of predicting trajectories can be considered as a case of sequence generation. There are two ways in which we approached the problem:

1. Vanilla RNN: Trajectories of all the players is taken as the input and we try to predict the next position of each player and the ball.
2. Social LSTM: In addition to conventional sequence prediction, this model can automatically learn typical interactions among trajectories that coincide in time.

1. VANILLA RNN

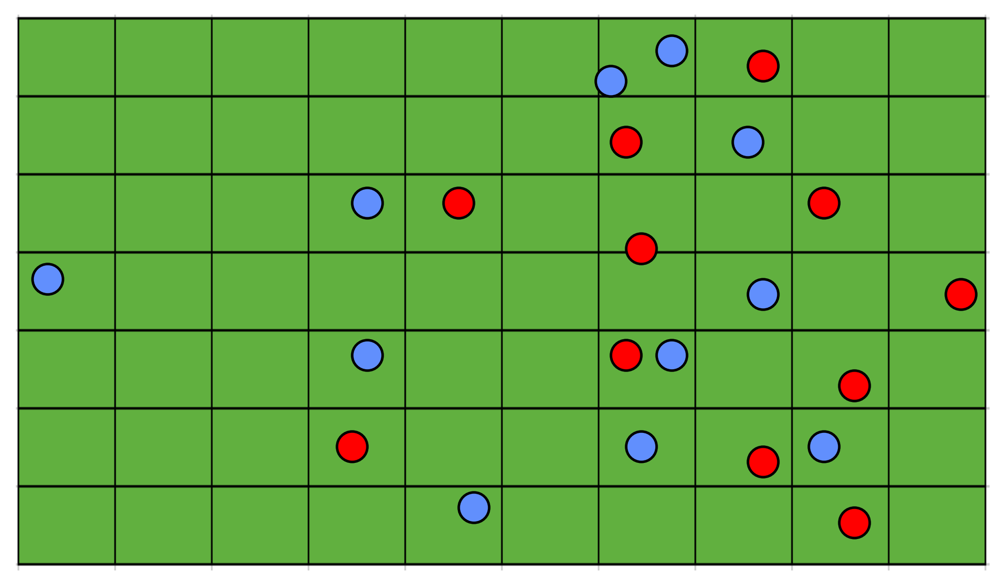

Fig 2: Game State Representation

In this setup, we model the game state prediction problem as a time series. The playing field was divided into grids, and each player position was thus represented as an index. Further, we choose to combine the representations of players on the same team. An LSTM model was trained on this sequence. We evaluate our model by presenting the first hundred steps and generating the next ten steps, but this model proved insufficient. We note the difficulty in training this model because of the inherent tradeoff between high-resolution and hard to train representations vs coarser representations which are unable to capture the fine details of player interactions.

2. SOCIAL-LSTM

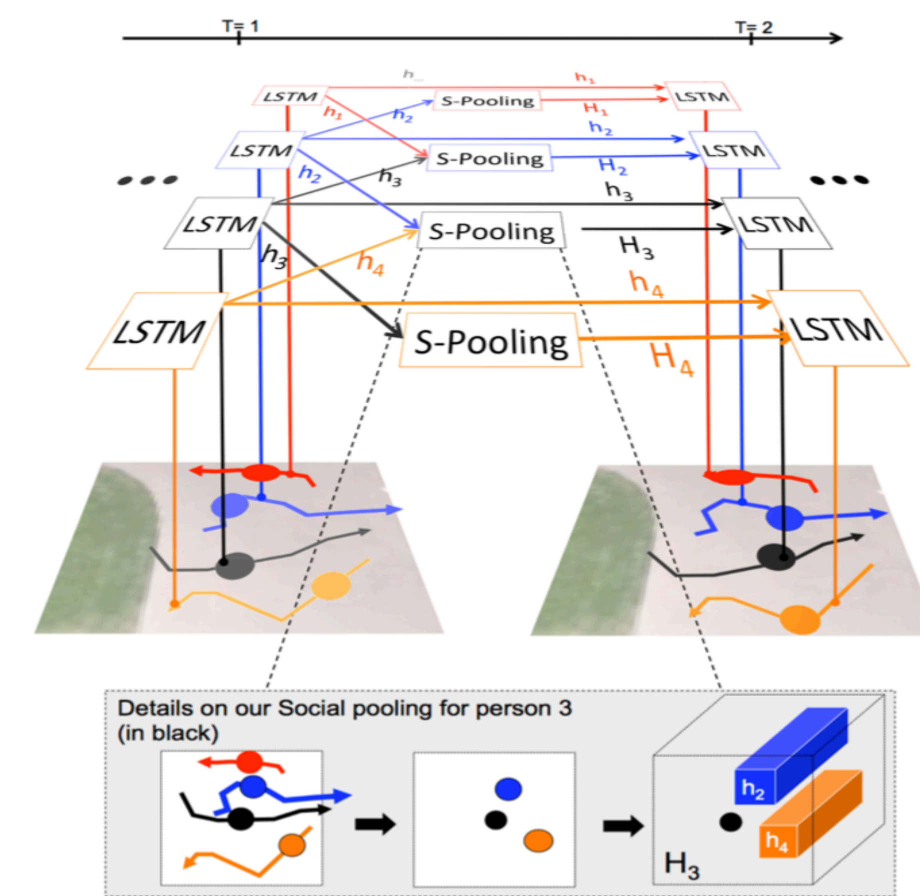

Fig 3: Overview of Social-LSTM method

LSTMs are a popular choice for sequence prediction because of their ability to store memory. However, when there are multiple sequences interacting in the same time frame, vanilla LSTM fails to learn these interactions. [1] proposed Social-LSTM model for learning behavior of pedestrians in crowded environment and eventually predicted their trajectories. Fig 2 shows the social pool layer proposed in [1].
We used this model in sports domain where the behavior might vary from player to player, unlike pedestrians. The model worked well for small sequences (15 time steps) but failed for larger sequences (100 time steps).

RESULTS

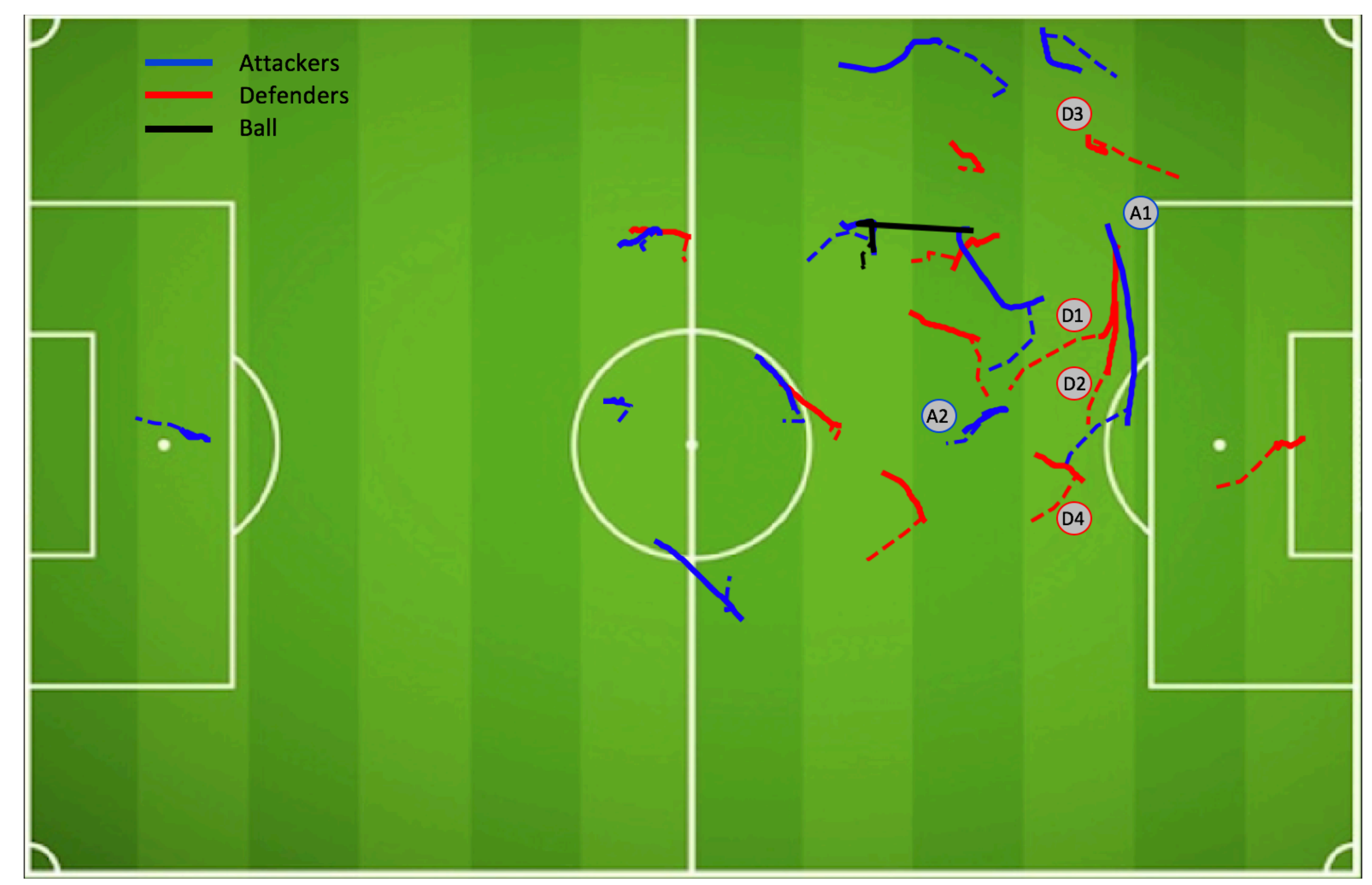

Fig 4: True and Predicted trajectories on a sample sequence

Fig 3 shows the results for a sample sequence. Solid lines represent the true trajectory and dashed lines represent predicted trajectory. As can be seen in the predicted trajectories, Attacker **A1** is trying to occupy the empty space between defenders **D2** and **D4.** Defender **D2** however follows the attacker **A1**. Also, as defender **D2** is already covering **A1**, defender **D1** moves to a different attacker **A2.**

[1] Alahi, Alexandre, et al. "Social LSTM: Human trajectory prediction in crowded spaces." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition.* 2016.
[2] Anirudh Vemula, Katharina Muelling and Jean Oh. Social Attention : Modeling Attention in Human Crowds. *Submitted to the International Conference on Robotics and Automation (ICRA) 2018.*