Predicting Player Trajectories in Shot Situations in Soccer

Per Lindström, Ludwig Jacobsson, Niklas Carlsson and Patrick Lambrix
Outline

• Motivation
• Method
• Results
• Conclusion
Motivation

• How would player X behave in a particular situation?
• What happens if we replace player Y?
• Find a player that behaves similarly to player Z
Motivation

• Is player behaviour latent information in their movement data?

• Given a tracking data set, is it possible to learn individual player movement patterns?
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Data

- Swedish top-tier league (Allsvenskan)
- First half of the 2019 season, which spans March-November
- 79 games
- 276 players
- 1,668 shots (193 goals, 1,475 non-goals)
- Tracking data for all players and the ball
- Data provided by Signality
Data

- Extracted 20 second sequences around shots
- 150 players with most played games
- 21,284 training sequences
- 5,188 validation sequences
Model

• Policy $\pi$

• State $x \equiv (s, c)$

• Action $a$

• Expert $\pi^*$
Model

- Behavioural Cloning

\[ \pi : s, c \rightarrow a \]

- General Imitation learning

\[ \pi : s_o, c \rightarrow \tau = \{ a_0, s_1, \ldots, a_{T-s}, s_T \} \]
Model

• Behavioural Cloning

Distribution of states given by $\pi^* : P^* = P(x | \pi^*)$

$$\hat{\pi}_\theta = \operatorname{argmin}_\theta \mathbb{E}_{x \sim P^*} \mathcal{L}(\pi^*(x), \pi_\theta(x))$$

• General Imitation learning

Distribution of states given by $\pi_\theta : P(x | \theta)$

$$\hat{\pi}_\theta = \operatorname{argmin}_\theta \mathbb{E}_{x \sim P(s|\theta)} \mathcal{L}(\pi^*(x), \pi_\theta(x))$$
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Action comparison

Absolute actions

Error=9.01, $\sigma=7.22$ m

Relative actions

Error=6.89, $\sigma=5.84$ m
# Window size

<table>
<thead>
<tr>
<th>Window</th>
<th>Mean</th>
<th>Stddev</th>
<th>Conf interval</th>
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<td>6.23</td>
<td>[7.47, 7.73]</td>
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<td>20</td>
<td>7.14</td>
<td>5.70</td>
<td>[7.02, 7.26]</td>
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<td>7.42</td>
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<td>7.72</td>
<td>6.04</td>
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<td>50</td>
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<td>[7.10, 7.36]</td>
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CDF over time

![CDF graph over time](image-url)
## Cross-evaluation

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<tr>
<th>Observed expert player</th>
<th>G1</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>O1</th>
<th>O2</th>
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<tr>
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Conclusion

• It is possible to learn the behaviour of individual players given their movement data

• Future research
  • Extend to more types of situations
  • Multi-agent modelling
  • Extrinsic measurement such as expected goals
Thank you

Questions?

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