Collective movement analysis reveals coordination tactics of team players in football matches

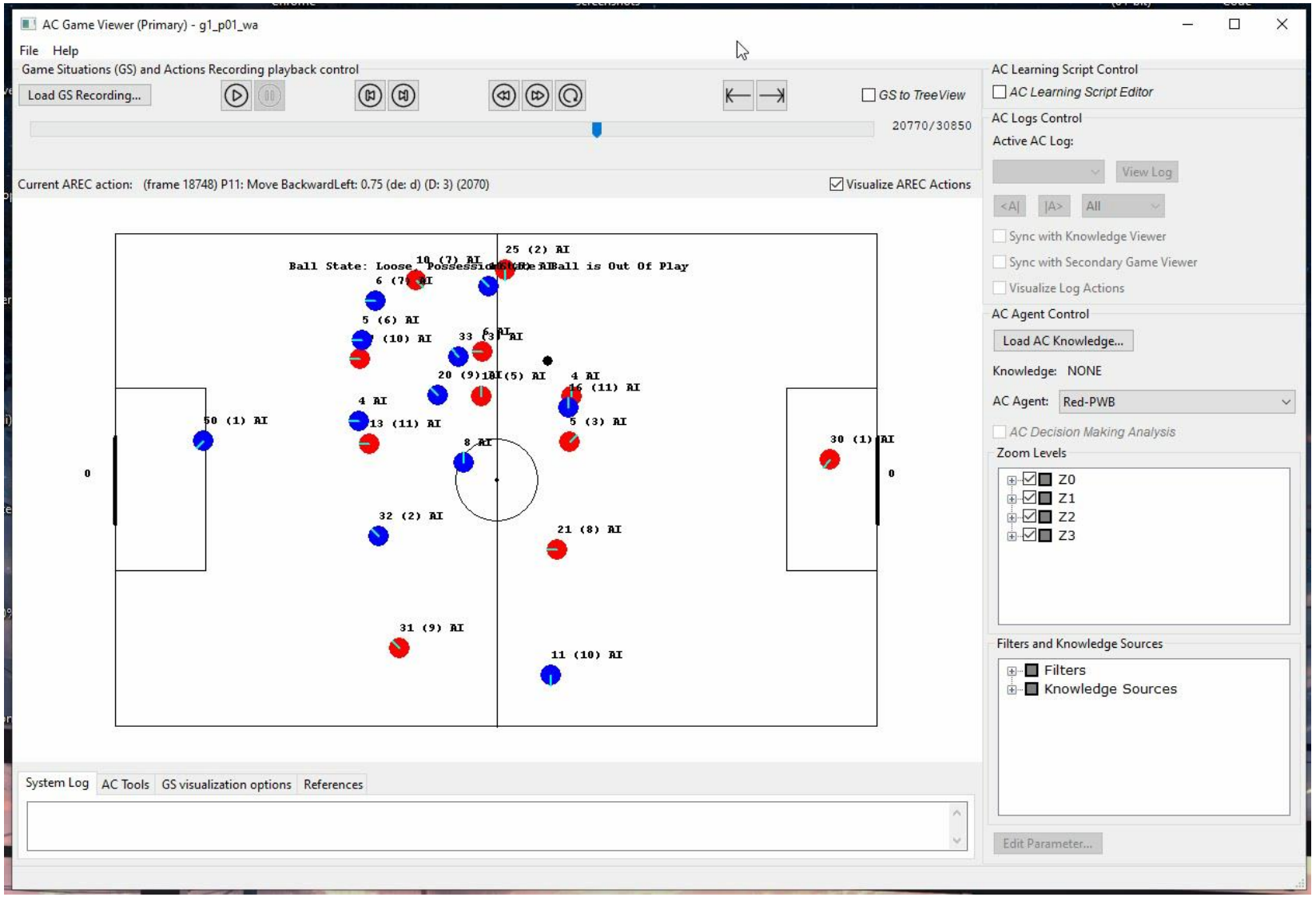
CHAOS, SOLITONS AND FRACTALS

NONLINEAR SCIENCE, AND NONEQUILIBRIUM AND COMPLEX PHENOMENA [2020]

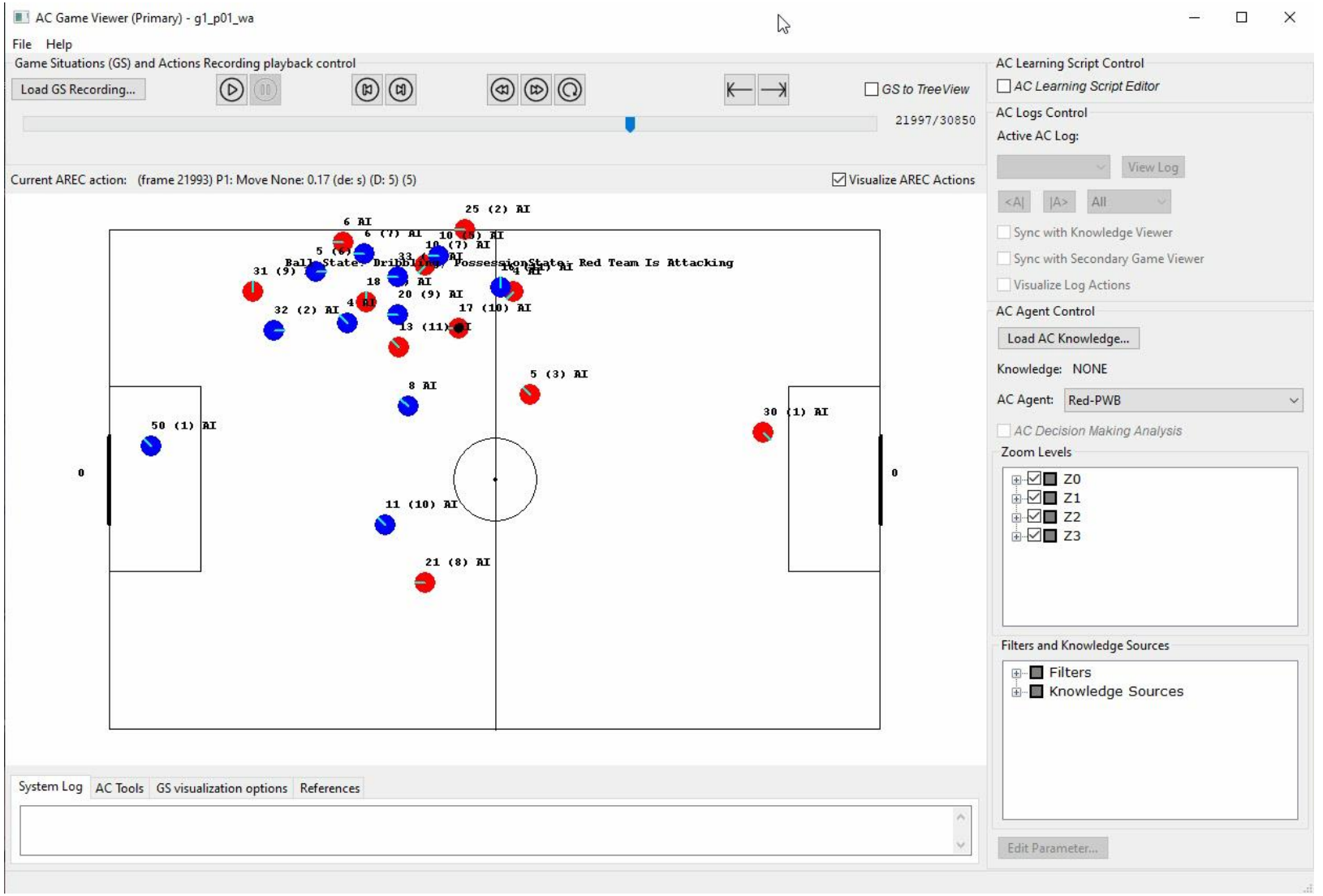
By Rui Marcelino, Jaime Sampaio, Guy Amichay, Bruno Gonçalves, Iain D. Couzin, Máté Nagy

Foreword

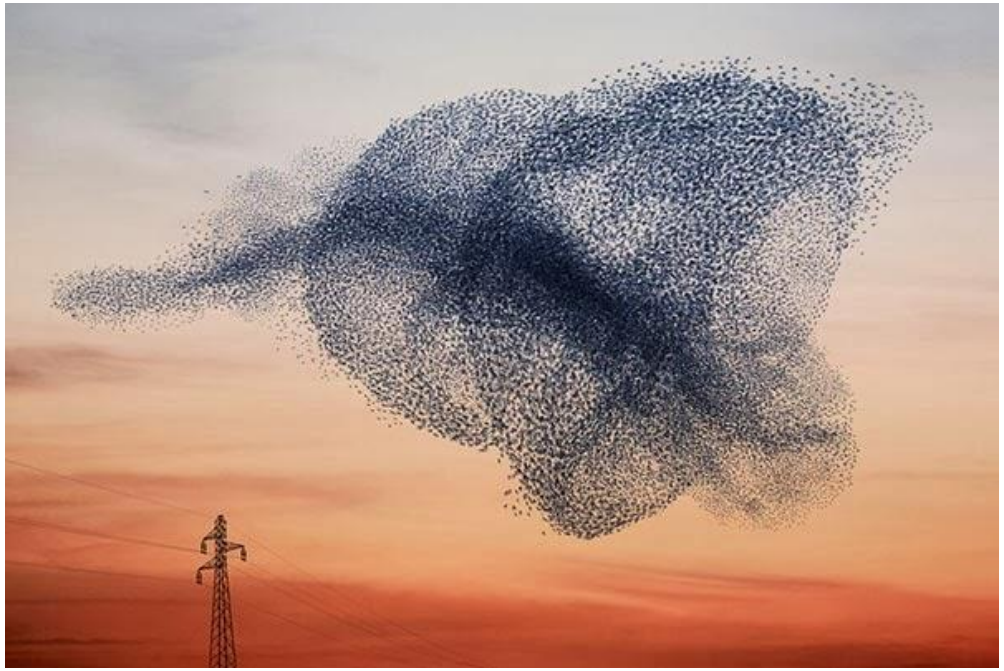
Behavior pattern 1. Cohesion



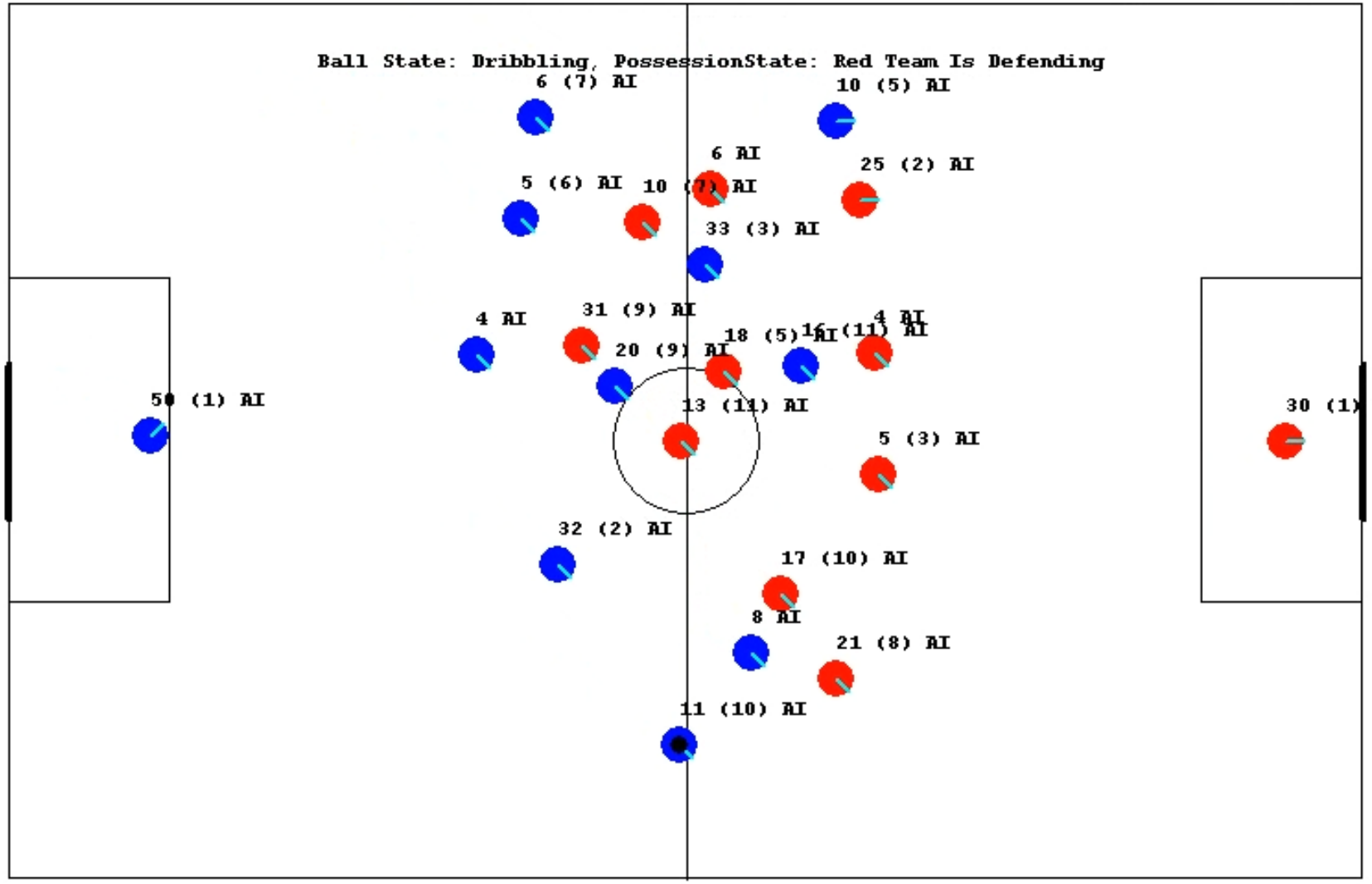
Behavior pattern 2



Example of complex collective behavior



Alignment.


Ball State: Dribbling, PossessionState: Red Team Is Defending
6 (7) AI
10 (5) AI
6 AI
25 (2) AI
5 (6) AI
10 (7) AI
33 (3) AI
4 AI
31 (9) AI
4 AI
18 (5) AI
16 (11) AI
20 (9) AI
50 (1) AI
13 (11) AI
30 (1)
5 (3) AI
32 (2) AI
17 (10) AI
8 AI
21 (8) AI
11 (10) AI

Article.

- Any living system has a collective behavior
- Soccer is a living system
- Methods from statistical physics may reveal collective motion patterns

Method.

For each player from his high-resolution trajectory, spatio-temporal correlation-based metrics were calculated with the other players (teammates and opponents) and the ball, in order to identify the highly correlated segments (HCS) .

Highly correlated segments (HCS)

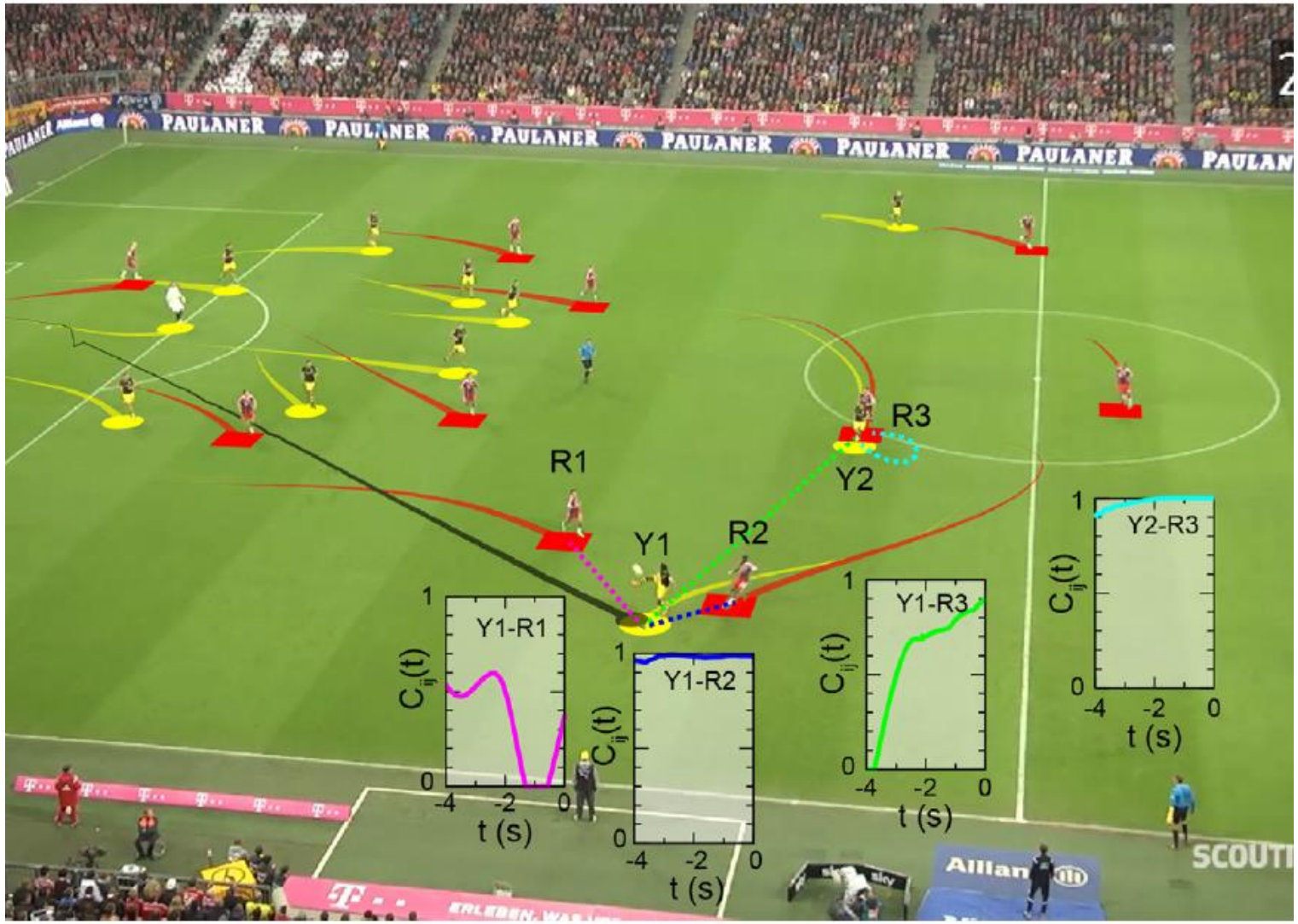
Legend:

Yellow/Red: Teams

Dotted lines: Pairs

Squares/Circles: End of segment

Plots: Correlation during time range



Filtering HCS

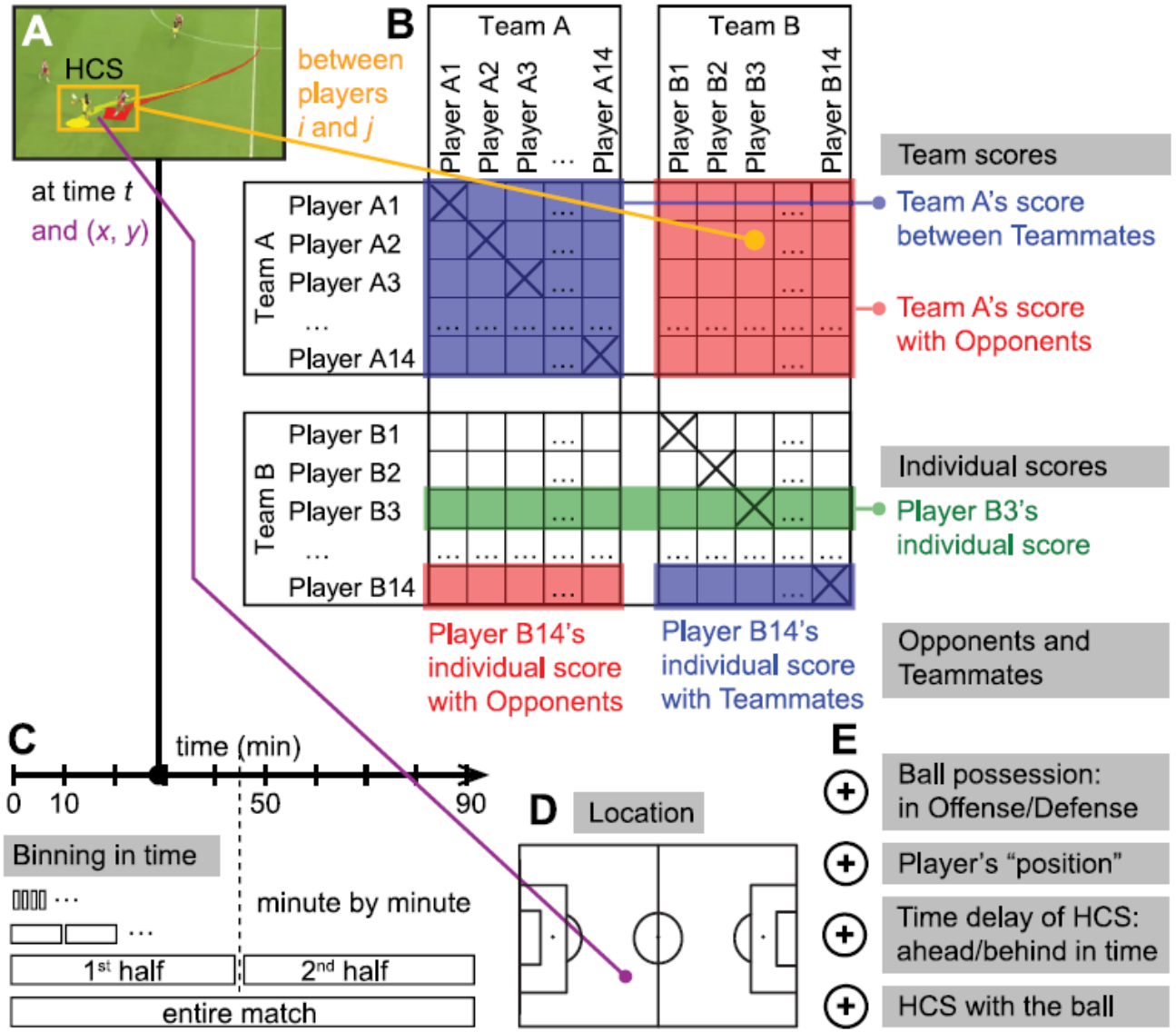
By time

By location

By game state:
Defense/Offense

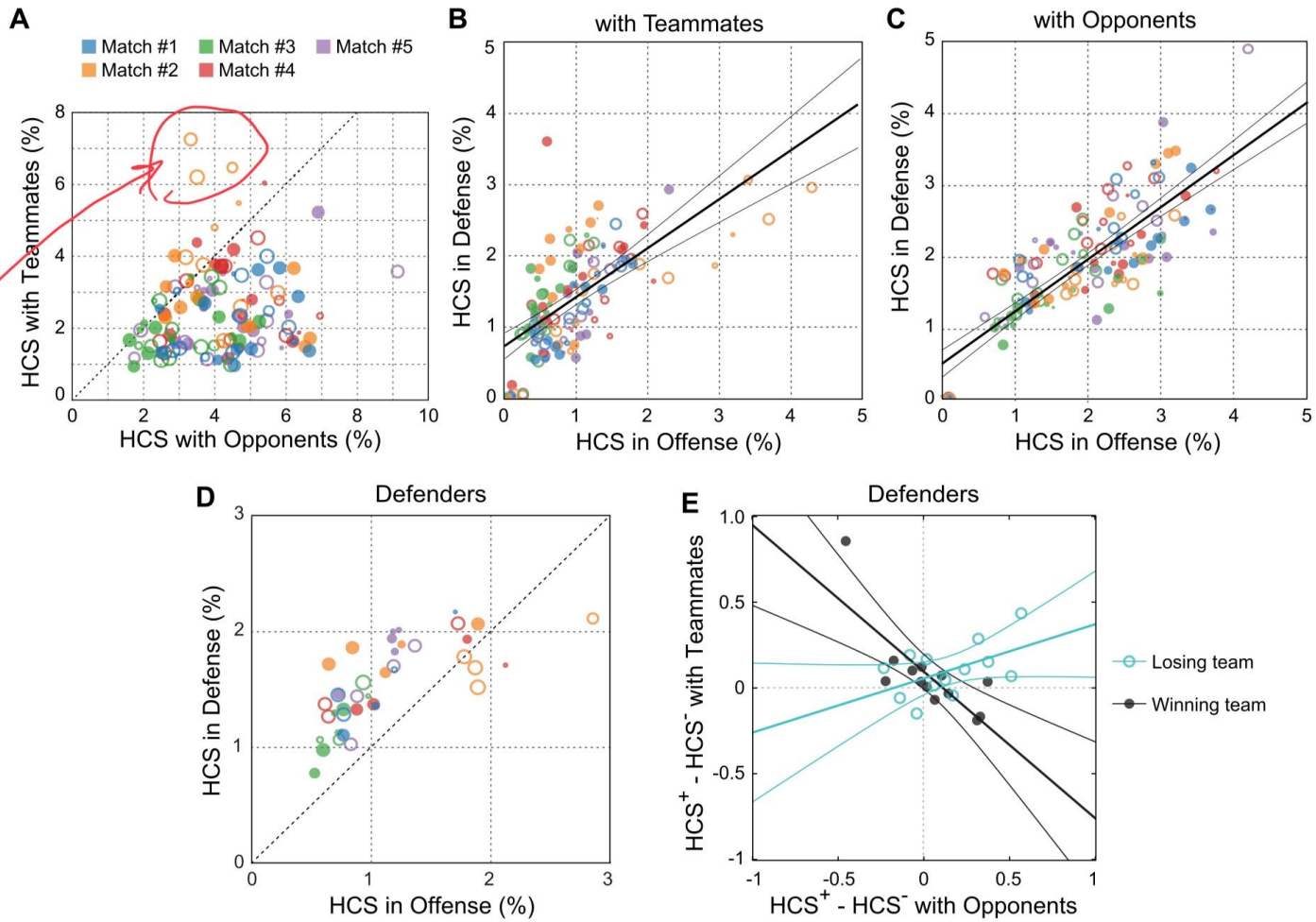
Fixed pairs

Own team/Opposite team



Average proportion of HCS

during the week the matches were played. The Final Rank shows the results at the end of the season but to ensure the anonymity of the teams only a range is given. In case of unbalanced matches, the winner team is shown highlighted by bold font type. Team tA played twice in matches #1 and #4.



Thank you for your attention!