



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

The screenshot displays the AC Game Viewer interface. The main window shows a soccer field with player positions and ball state. The interface includes a menu bar (File, Help), a playback control bar with buttons for Load GS Recording, play/pause, stop, and navigation, and a progress bar showing 20770/30850. The current AREC action is (frame 18748) P11: Move BackwardLeft: 0.75 (de: d) (D: 3) (2070). The right sidebar contains controls for AC Learning Script Control, AC Logs Control, AC Agent Control, and Zoom Levels. The bottom panel shows tabs for System Log, AC Tools, GS visualization options, and References.

Ball State: Loose Possession: 10 (7) RI
Ball is Out Of Play

Player positions and states (RI):

- 50 (1) RI
- 5 (6) RI
- 6 (7) RI
- 10 (7) RI
- 33 (3) RI
- 20 (9) RI
- 18 (5) RI
- 4 RI
- 16 (11) RI
- 5 (3) RI
- 30 (1) RI
- 21 (8) RI
- 11 (10) RI
- 31 (9) RI
- 32 (2) RI
- 8 RI
- 4 RI
- 13 (11) RI
- 25 (2) RI

AC Learning Script Control

- AC Learning Script Editor

AC Logs Control

Active AC Log:

<A| JA> All View Log

Sync with Knowledge Viewer

Sync with Secondary Game Viewer

Visualize Log Actions

AC Agent Control

Load AC Knowledge...

Knowledge: NONE

AC Agent: Red-PWB

AC Decision Making Analysis

Zoom Levels

- Z0
- Z1
- Z2
- Z3

Filters and Knowledge Sources

- Filters
- Knowledge Sources

Edit Parameter...

Behavior pattern 2

AC Game Viewer (Primary) - g1_p01_wa

File Help
Game Situations (GS) and Actions Recording playback control

Load GS Recording... [Play] [Pause] [Home] [End] [Previous] [Next] [Full Screen] [Refresh] [Close] GS to TreeView 21997/30850

Current AREC action: (frame 21993) P1: Move None: 0.17 (de: s) (D: 5) (5) Visualize AREC Actions

6 RI, 25 (2) RI, 5 (6) RI, 33 (7) RI, 10 (7) RI, 31 (9) RI, 18 RI, 20 (9) RI, 17 (10) RI, 32 (2) RI, 4 RI, 13 (11) RI, 8 RI, 5 (3) RI, 50 (1) RI, 30 (1) RI, 11 (10) RI, 21 (8) RI

Ball State: Dribbling
Possession State: Red Team Is Attacking
Red Team Is Attacking

0 0

System Log AC Tools GS visualization options References

AC Learning Script Control
 AC Learning Script Editor

AC Logs Control
Active AC Log: [Dropdown] View Log
<A| |A> All [Dropdown]
 Sync with Knowledge Viewer
 Sync with Secondary Game Viewer
 Visualize Log Actions

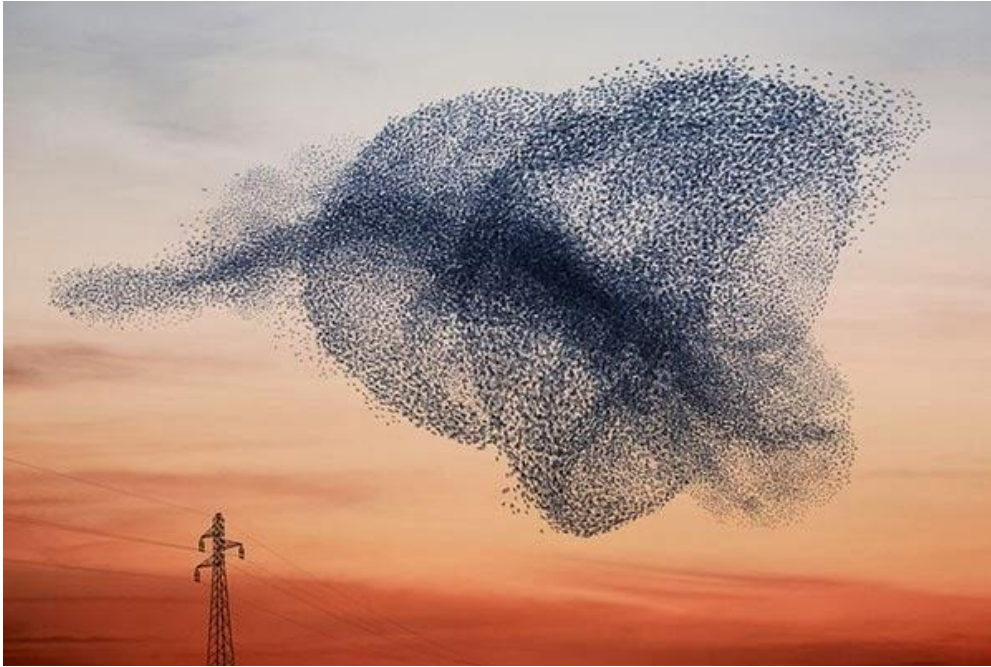
AC Agent Control
Load AC Knowledge...
Knowledge: NONE
AC Agent: Red-PWB [Dropdown]
 AC Decision Making Analysis

Zoom Levels
 Z0
 Z1
 Z2
 Z3

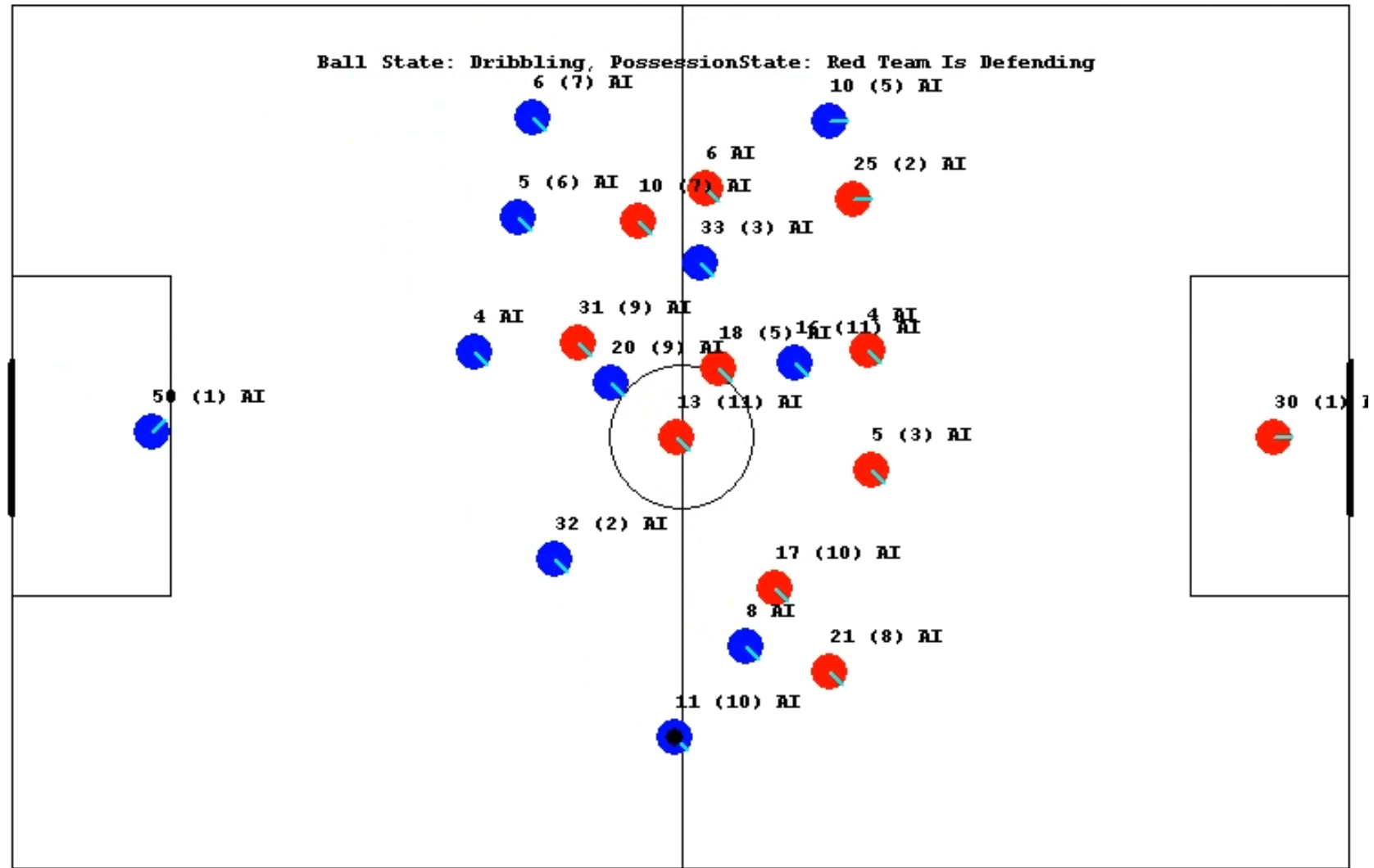
Filters and Knowledge Sources
 Filters
 Knowledge Sources

Edit Parameter...

Example of complex collective behavior



Alignment.



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)

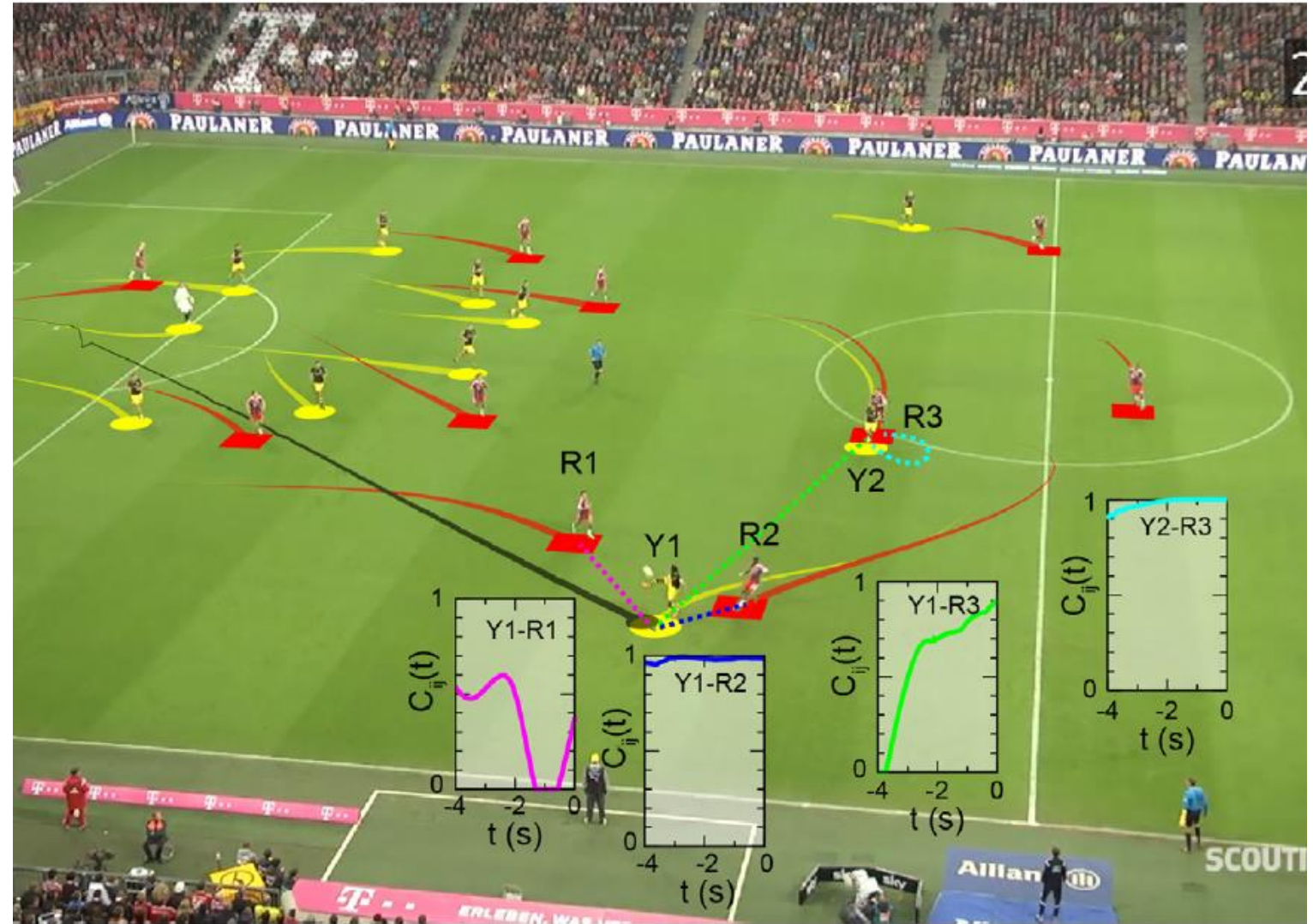
Legend:

Yellow/Red: Teams

Dotted lines: Pairs

Squares/Circles: End of segment

Plots: Correlation during time range



Filtering HCS

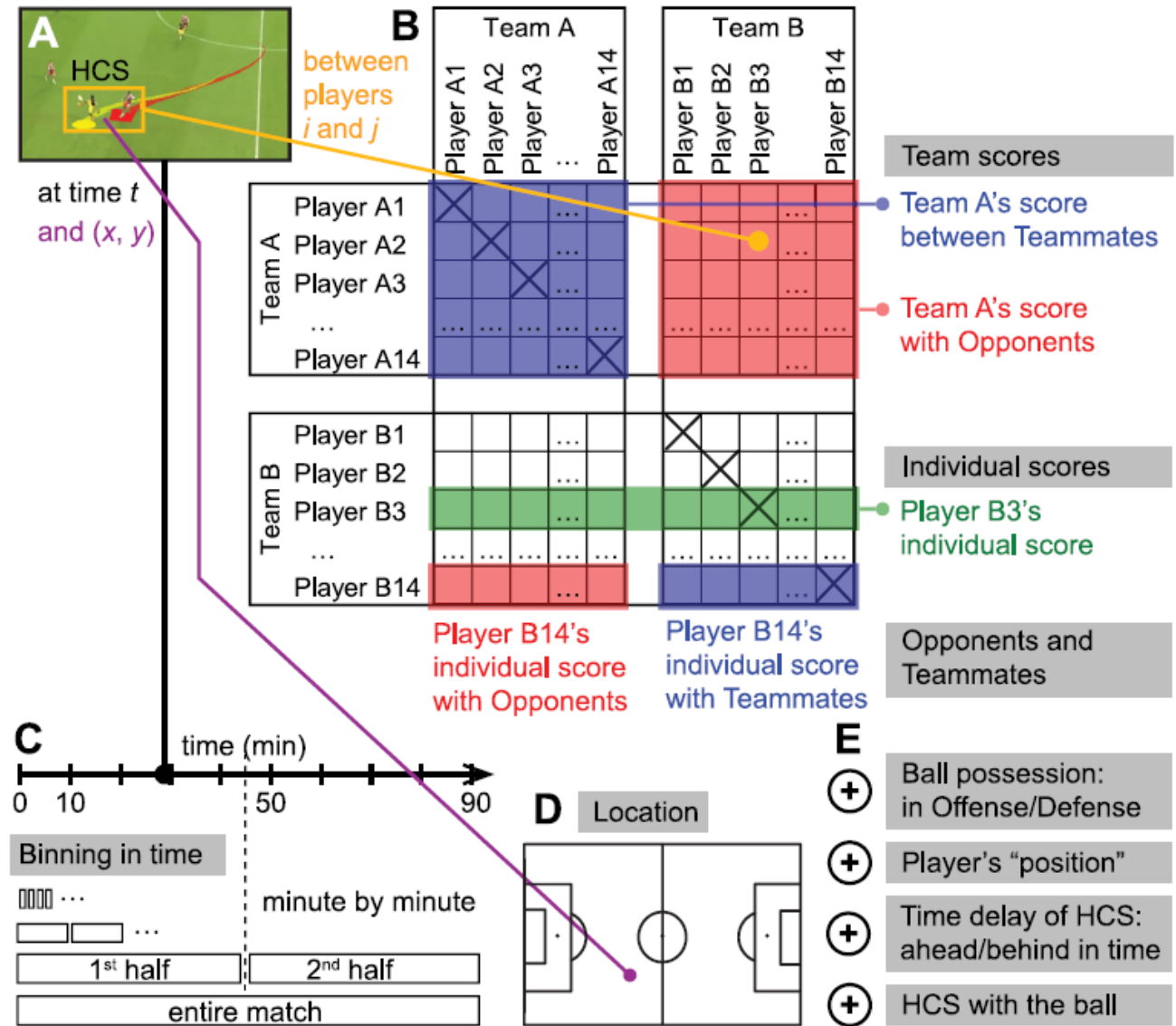
By time

By location

By game state:
Defense/Offense

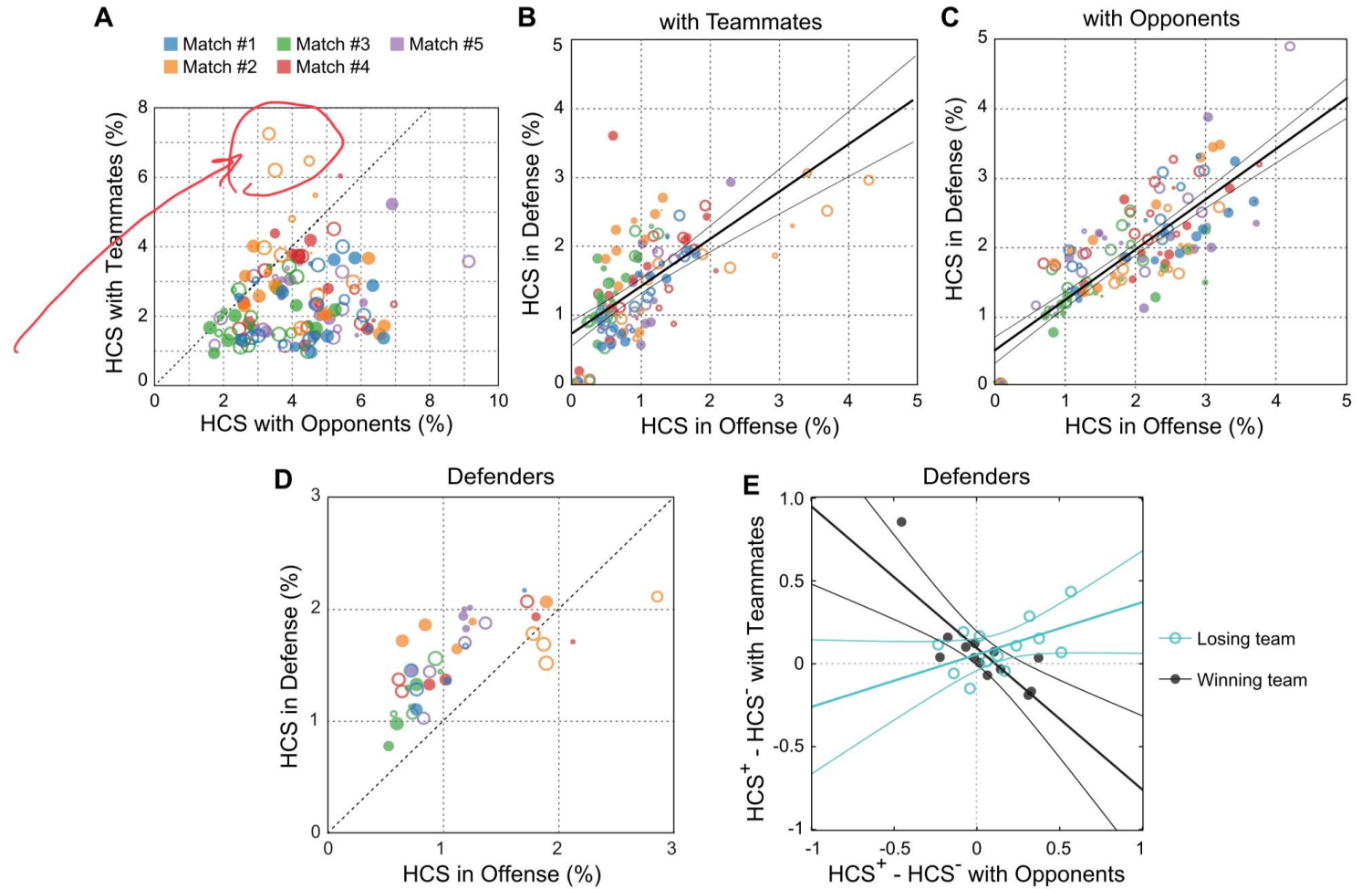
Fixed pairs

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!
