

# 28th ECSS Anniversary Congress, Paris/France, 4-7 July 2023

## A Passing Network Analysis to Identify Sport Teams' Signature: How the Defensive Imbalance Constraints Patterns of Interactions Between Players in Basketball and in Rugby

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### INTRODUCTION:

Classical analysis of team sport hardly considers performance context and ongoing interactions between performers, analyzing sport teams as complex systems where team behavior results from player interactions can lead to valuable insights [1]. Such systems have several ways of (re-)organizing themselves to produce a behavior adapted to the evolving constraints, and as each team is doing it in its own way we can refer to the existence of team signature [2]. Graph (vertices and edges) provides a useful tool to analyze the interactions network of a complex system. By focusing on motifs (significant patterns of edges in the network [3]) and more precisely on flow motifs (which also consider the edges sequential order, as the temporal dimension is crucial for a more detailed profile able to identify team's signature [4]) we can build a motif profile and thus identify playing styles [5]. Here, objective is twofold: with a controlled small-sided game (SSG) in basketball and rugby we aim at identifying 1) how a given constraint (defensive imbalance) shapes the emergence of team's behavior and 2) different teams' signatures.

### METHODS:

24 rugby and 18 basketball teams of 3 young elite players repeated 24 times a SSG in 2 situations (12 times each) with 2 levels of imbalance (high/low) representing 1008 possessions (576 in rugby, 432 in basketball). We design a profile as the proportion of each passing network structure performed among all possible ones along the 12 trials in a given situation. First, we compare the average profiles of both situations to evaluate the effect of this particular constraint. Then, we cluster profiles within each sport to identify teams' signature with a neighborhood-based algorithm: we characterize team playing style with the average profile of their assigned cluster, and the effect of the defensive imbalance on their behavior with a path between the two clusters they are assigned to in both situations.

### RESULTS:

First, results shows that players do not interact in the same way to achieve the 2 situations: the  $\chi^2$  independence test indicates that the profile is related to the imbalance level in basketball ( $\chi^2=21.4$ ,  $p=.006$ ) as in rugby ( $\chi^2=28.4$ ,  $p<.001$ ) with the reinforcement of the prevailing pattern of interaction while increasing the defensive imbalance. Second, we observe that all teams don't share the same profile: we differentiate 3 clusters of profiles in basketball and 5 in rugby. More, we observe that the level of defensive imbalance does not have the same effect on each team: teams show various paths, particularly in rugby.

### CONCLUSION:

We argue that we can investigate the effect of a given constraint on team's behavior and team's signature by designing a profile of the passing network structures performed. It allows a team sport performance analysis with more reference to performance context and interactions between players.

[1] Travassos et al. 2013 [2] Hughes & Frank 2005 [3] Battiston et al. 2020 [4] Buldú et al. 2019 [5] Gyarmati & Rodriguez 2014

Topic: Statistics and Analyses

Presentation E-poster

European Database of Sport Science (EDSS)

Supported by SporTools GmbH



34356