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COMPLEX SYSTEMS IN SPORTS: INTRODUCTION TO THE SPECIAL ISSUE*

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1 Complex Systems in Sports

Sport is one of the most important activities of Humanity. Its relevance goes beyond the physical/psychological benefits that their practicing provides (an aspect that justifies in itself its importance in our current society). In fact, be it as actually playing some sport or just watching some games, it provides a huge means for socialization and education. Needless to say, the economical viewpoint is also enormously relevant: events such as the Olympic Games, the FIFA World Cup, as well as continental and national football or basketball leagues attract the interest of millions of people and the intervening parties/clubs handle budgets in the several-hundred million euro range. For these reasons, sport is an activity deservedly studied from multiple point of views. In this sense, complex systems provide a perspective of the foremost interest when it comes to analyze sports. Consider for example that team sports have a strong network component, since they are essentially a network developed along time and space, with nodes being players and links being passes or other interactions. The network paradigm allows for a strong quantitative description of a whole match, while at the same time offers some insight on how performance is achieved. This could result, eventually, in a prediction of game outcome according to network characteristics. Complex networks, and thus emergent behavior, appear also in other aspects. Indeed, there are many aspects in the dynamics of sports (related to scoring, performance, etc.) that can be analyzed from this general perspective in order to model the game, find hidden patterns and phase transitions, etc. From an even more general viewpoint, the analysis can be extended beyond the actual game dynamics and tackle other sport-related issues: transfer networks, sport fans networks and their dynamics, etc.

The importance of the topic has justified the existence of several events devoted to it, e.g. [4]. This special issue is an extension of the workshop on Complex Systems in Sports [8] which was chaired by the editors, and held in Paris in August 2011 along within the European Conference on Artificial Life. There were five papers accepted in that workshop, and they were all invited to submit an extended version to this special issue; the call was publicly extended to all researchers working on the topic.

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Finally, after the review process and resubmission of those in need of changes, ten papers were accepted to this special issue.

2 An Overview of this Special Issue

The interested reader should start by the overview provided by Balagué and coauthors in [2], which shows how a complex systems perspective changes the traditional mechanistic view of sports, and is an excellent introduction to the field as well as the topic of this issue.

There is a block of papers all dealing with the same sport: football, considered by many the king of sports. Every one of them offers a different perspective, from the article by Siegle [11], which applies statistical mechanic techniques to the analysis of the France-Italy 2006 FIFA World Cup final, to the article by Cotta et al. [3], which uses social network analysis to analyze several matches of the FIFA 2010 World Cup that culminated with the final between the Netherlands and Spain. These matches are also analyzed by Menéndez et al. [9], but they look at the static match information and try to extract behavioral models from them. On the other hand, Duarte et al. [5] analyze the performance of teams looking at their positional data, using of course the perspective of complex systems; positional information (using the areas occupied and the allocation of players by each team) is used by Vilar et al. [12] to analyze football as a social complex system. Special versions of football with less players and custom field sizes are analyzed by Frencken et al. [6] to show how interactive team behavior emerges under these size constraints, specially from the point of view of inter- and intra-team distances.

There is another paper that studies team sports: de Saá et al. [7] analyze five regular NBA seasons looking at scoring differences and analyze its behavior, trying to find which distribution fits better and whether there are phase transitions where scoring changes significantly.

Finally, sports are analyzed from a medical angle by Sarmiento et al. [10], looking at heart rate variability due to exercise, and from a sociological angle by Aranda et al. [1], who try to apply complex systems analysis to the modeling of predicting behavior in sports.

3 Conclusion

The ten papers in this issue constitute an excellent review of the state of the art of complex systems applied not just to football but also to other team sports (which were, after all, the main emphasis of the workshop), and also include an overview of the issues present in the field. Prediction, an emerging field in complex systems as it relates to the high-stakes field of betting and sports medicine are also featured, so, even as the field is not completely covered, we expect it will be interesting enough to the researchers in this area.

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