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TUS Research

> “Analytics can be used to predict fatigue and improve athletes’ performance in various sports.

Sport analytics techniques and their approaches to predict athletes’ fatigue

Presenter
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Indroduction

In sports analytics, statistics are plugged into a mathematical model to predict the outcome of a given play or game.

Coaches use it to optimize plays during games, while front offices can use it to decide which players need development.

The prediction of key variables have been explored through the use of artificial intelligence[1]. For this to happen, predictive models can provide insight into an athlete's condition by acting as an “automated data analyst”[2].

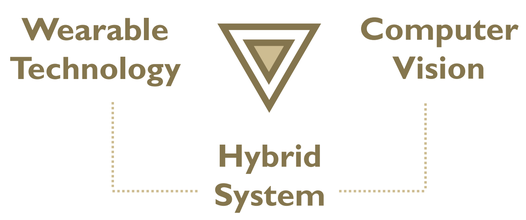
Fatigue is usually defined when a person feels tired, sluggish, weary, or exhausted. There are many types of fatigue described in sport science literature, including cardiovascular fatigue, biomechanical fatigue, respiratory fatigue, and mental fatigue[3]. Our results do not focus on a specific type, it is a general approach.

Thus, **this work investigates the use of data analytics in sport performance through athletes’ fatigue prediction.**

Research Question

What are the current state-of-the-art techniques of sport analytics that use wearable technology or computer vision to improve athletes’ performance?

The Magic Triangle



Methods

Process and search strategy

A representation of the review process and methodology is shown in Fig. 1.

First, the base of the review is a search for techniques of sport analytics using wearable technology or computer vision to improve athletes’ performance.

Second, it is very important to find actual literature of fatigue parameters measurement to understand some of the challenges that are faced in this field of research.

Third, machine learning and artificial intelligence approaches are investigated to understand their role in sport performance assessment through fatigue prediction.

Fig. 2 describes the search strategy of the methodology.

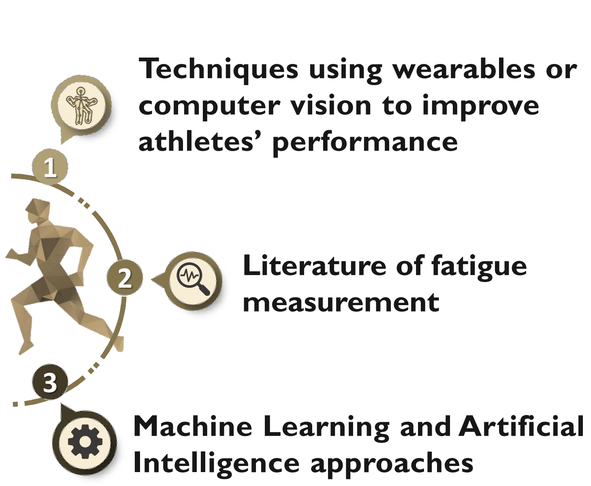


Fig. 1. Process strategy of the methodology.

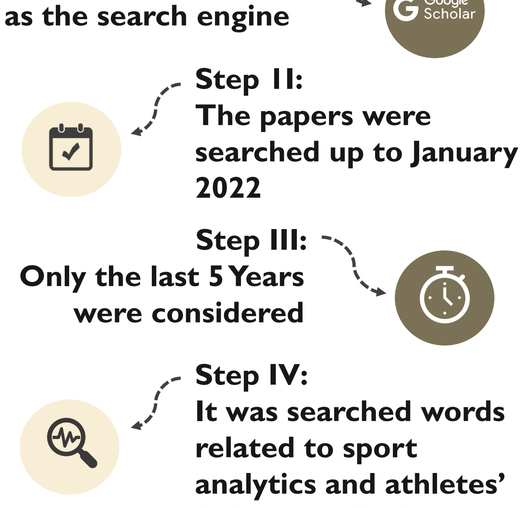


Fig. 2. Search strategy of the methodology.

Results and Discussion

The Magic Triangle indicates types of technology used by researchers and companies to solve sports medicine problems. Wearable technology and computer vision have been used more as the potential tools to solve some of them. In spite of few studies of this type of solution, the **Table I** aggregates this investigation of athletes’ fatigue prediction. It shows analytics techniques and applications have been used. As these techniques are read, different technologies are observed.

The **Table 2** goes in depth on wearable sensors. The reason of presenting this data is that fatigue-related parameters can be tracked through these sensors for different applications. It is important to search their capabilities and extract as much of them as possible for sport analytics projects.

Table. I.Prediction of athletes’ fatigue studies and approaches currently utilized.

Technology	Technique description	Application
Wearable	It was used 4 IMU sensors during the tests which their data was relevant for a supervised machine learning model called Gradient Boosted Regression Trees (GBRT)[4].	Predict runners fatigue based on his running style, through a subjective fatigue measure.
Computer Vision	The data features were analyzed via three methods to identify a fatigued pitcher: Extract the elbow valgus angle, the trunk flexion angle, and the time between pitches. OpenPose software was used to extract these first two types of data[5].	The coach uses this auxiliary information to avoid baseball injuries during baseball learning.
Wearable	Support Vector Machine (SVM) was used to predict injury. The framework was collected from different sources including internal load data (such as heart rate), external load data (such as the duration of workout and number of jumps), as well as questionnaire data[6].	Prediction of Soccer athletes’ injuries.

Table. 2.Wearable sensors data and its applications[7].

Application	Clinical ailment	Data from sensors	Wearable sensors
Workload management	Soft-tissue injury caused by overuse.	Distance Velocity Tri-axial acceleration MOS*	Catapult OptimEye S5[8] Zebra RFID[9] Moxy Monitor[10] Playermaker – Soccer[11] Catapult Playertek[12]
Dehydration and soft-tissue injury prevention	Soft-tissue injuries Hypernatremia Muscle strain Fatigue	Analyte concentration Sweat rate Whole-body sweat loss	Biochemical markers cannot currently be monitored with wearable sensors.
Sleep monitoring	Fatigue Athletic performance DRT Executive functioning Learning	Heart Rate Sleep quality Tri-axial acceleration Body Temperature	WHOOP Band[13] FitBit Flex[14] FitBit Charge2[15]

*MOS, Muscle Oxygen Saturation; *Only the first three sensors; DRT, Decreased Reaction Time.*

Conclusion

Based on this review, analytics can be used to help researchers, companies, athletes, and coaches to improve performance in various sports. The prediction of athletes’ fatigue could be more explored, since it has been few studies about this subject. Additionally, the use of analytics is very useful to predict behaviors that are relevant to decision-making processes, thus, while more specific solutions are developed, more sports such as gaelic, soccer and rugby could benefit from it.

Future directions

The next steps will be the development of a capturing system that uses athletes’ data to improve sport performance and predict fatigue.

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REFERENCES

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This work was funded by TUS President’s Doctoral Scholarship 2021

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