

# Computer Science in Sport

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## INTRODUCTION

Information technologies (ITs) as well as applied informatics have been introduced in many research areas, in which they are by now well-established. One such area is sport, where the integration of informatics plays a significant factor for various purposes like, for instance, the analysis and enhancement of the training, coaching and competition processes.

## BACKGROUND

In general, the emerging and ambitious domain of computer science in sport focuses on the conjunction of theoretical background and practical aspects as well as methodologies of IT and sport science (Baca, 2006). The interdisciplinary discipline is getting more and more important for the support and advancement of the sport research by adapting and deploying computer-based but also mathematical concepts in sport. The application of computer science is particularly crucial for the acquisition, collection, transfer, analysis and interpretation of sport-related parameters and measurements. On the one hand, the combined approach is represented by the use of computing tools and methods in sport science. On the other hand, however, also the integration of sport-related background in computer science is relevant for various engineering purposes including the understanding of the human motor control and its implementation for the design of robots, intelligent and autonomous systems or the realization of optimized human-computer interaction tools (Link & Lames, 2009). A more detailed survey on the significance of the interdisciplinarity of the field is described in the above referenced paper.

## MAIN FOCUS OF THE ARTICLE

The emphasis of the article is to indicate and highlight the goals, activities, developments but also challenges of the rather newly established area of computer science in sport. This requires, first of all, knowledge about the historical background, the existing research communities as well as the most significant fields of interest. In addition, the benefits, controversies and issues as well as up-to-date solutions and recommendations regarding the discipline are presented.

Moreover, the goal of the article is also to illustrate and discuss the already observable and predictable fact that the current trends and future perspectives of computer science in sport are going to be highly influenced by present IT techniques and realizations. Some of the most influencing developments are related to the recently evolving pervasive, mobile and cloud computing routines including the implementation of sport-related sensor and Internet networks, miniaturized and intelligent equipment, social and virtual environments as well as real-time analysis and feedback routines.

## Historical Background

The history of computer science in sport is rather young, starting with more general information and documentation activities in the early 1960s. At that time the application of informatics was mainly important for the dissemination of sport scientific literature such as books and articles by the realization, expansion and maintenance of databases, allowing a more efficient storage and an easier distribution of scientific knowledge. A crucial step for the development of the field can be also seen in the establishment of the first international organization called International Association for Sports Information (IASI) in the 1970s.

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This foundation had an initial significant impact on the progress of the area, leading to a more frequent organization and holding of related meetings and conferences. Nevertheless, the main spotlight of the research field was still the propagation of information, rather than the implementation and application of computer-based routines in sport.

The actual beginning of computer science in sport, however, came with the evolution and further developments in informatics. An important factor was the appearance of the first microprocessors in the mid 1970s, allowing the realization of computers with higher capacities and increasing processing power. Based on these progresses, the newly established field began flourishing and expanding, initially starting with the introduction of statistical routines for the analysis of different performance measurements including, for instance, biomechanical data. Obviously, the developments in computer engineering started having a high impact on sport science as well.

Later on, in the 1980s, experts began analyzing and interpreting performance parameters in other areas such as sport games (Miethling & Perl, 1981) or human motions (Hatze, 1983; Furnée, 1989). Further advances in hardware and software had not only an influence on informatics with the computerized realization and use of fundamental paradigms like modeling and simulation but also became important for the establishment of computer science in sport. In the course of time, IT-based routines were progressively introduced for different purposes such as performance monitoring or game analysis. In this way, computer science has evolved to an essential element for sport science.

### **Scientific Research in Computer Science in Sport**

Another important stage for the development of computer science in sport (from a scientific point of view) dates back to the late 1980s and early 1990s, when first congresses were organized in Germany as well as Australia and New Zealand. After the organization of several national conferences, more and more international scientists got interested and started doing research in this field and hence the first cross-country meeting was held in 1997 in Cologne. The success of the event contributed to the organization of biennial conferences all over the world and the establishment of an

international organization called IACSS (International Association of Computer Science in Sport) in 2003.

Meanwhile, various institutions and research groups exist that have focused their research on computer science in sport and also offer specialized modules or courses on this topic. In addition, national organizations have been established in this area and officially recognized in different countries including Austria, Germany, China, India and Turkey. But also in other regions, like the United Kingdom or USA, several universities and scientists are getting more interested in the application of informatics in sport.

### **Research Areas**

A number of diverse research areas are meanwhile present and increasingly practiced in the field of computer science in sport. One particular focus is set on the implementation of measurement and data processing tools including the development of computer applications as well as complex information systems. Other research interests concentrate on the adaptation and further realization of IT-based modeling routines and simulation methods, which are significant factors for the assistance and improvement of the training and coaching processes. Finally, the development of the field is also of importance for the design of novel sports equipment and technology or for documentation and education purposes (Perl, 2006). More precisely, the field of computer science in sport is divided into the following research activities and areas of application:

- Data acquisition and processing,
- Pervasive computing,
- Databases and expert systems,
- Computer video systems (including tracking and motion analysis),
- Computer-aided applications (software and hardware),
- Modeling (IT-based, mathematical, biomechanical and physiological),
- Simulation (interactive and animation),
- Game analysis,
- Presentation and multimedia (including virtual reality and serious games),
- Development of theories, and
- Education and e-Learning.

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