

Computers in Sport

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Computers in Sport

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Foreword

Any treatise on *sport* presents the editors with an immediate challenge – what is sport? The definition is complex and has been evolving for more than 2000 years. In this book we use the simple definition of sport as a collective term for games or competitive activities. Although it looks very broad, such a definition excludes some activities such as extreme sports and differs from the meaning of sport for the ancient Greeks.

Applications of computers in sport (to be understood in its broadest sense) have been reported since the mid 1960s. Statistical computations, numerical calculations in biomechanical investigations and sport documentation tasks were carried out. During the last decades, not only has the pure application of computers as a tool been continuously growing, moreover, computer *science* has become an important interdisciplinary partner for sport and sport science. Activities in this interdisciplinary field were and are strongly affected by developments in computer science. In particular, progress in hardware (processor speed, storage capacity, communication technologies), software (tools), information management concepts (data bases, data mining) and media (internet, e-Learning, multimedia) are of essential importance.

Throughout the last 30 years, a scientific discipline *Computer Science in Sport* has been established. Working areas have evolved, national and international associations have been founded, journals are published and congresses are organized regularly to present research activities.

The current field of activity in *Computer Science in Sport* comprises the following main areas of research:

- Multimedia and presentation
- Modelling and simulation
- Biomechanics and sports technology
- Data bases and expert systems
- Information and communication technologies

The papers presented within this book give a good overview on current activities

in these areas and have been grouped accordingly.

Katz, Parker, Tyreman and Levy provide an overview of virtual reality, focusing on the most promising developments, especially in the area of sport and exercise. The systems presented are supposed to have enormous potential to change the way coaches and athletes approach training and performance.

The relentless progress in computer technology generates vast data that is difficult to absorb and analyse. It is even more difficult to communicate such analysis to the athletes. Baca discusses the multifaceted nature of feedback provision to athletes and coaches. He demonstrates the vast potential of feedback to influence motor learning; resulting in improved performance. In particular he demonstrates the possibilities afforded by techniques such as video analysis, kinematic analysis, feedback of results, kinetic feedback and their application in a number of sports such as gymnastics, table tennis, rowing and biathlon.

The chapter by Mueller highlights examples on how using computers to enhance social sports experiences. Long-distance sports are presented, which focus on physical exertion comparable to collocated sports, a shared experience although being geographically apart. This novel approach uses telecommunication technology, in particular, to enable participants to enjoy a social sports experience together.

One of the earliest areas of application of computer science in sport is coaching. Lames differentiates between three different stages of coaching – preparation, control and debriefing of competition – which create different conditions for support by computer science. His chapter starts with some remarks on the process of coaching, trying to make clear the requirements for giving support in this area. Technological standards for preparing and analyzing a competition are then lined out. A further paragraph describes the state of the art and possible developments in real time analysis of sports, which supplies coaches with tactical and strategic hints during a game.

Modelling of any complex systems behaviour presents a challenge in any science field. Perl focuses his attention on the formidable hurdles to researchers in this area. His evocative review illustrates that meaningful modelling in sport requires clearly defined terms and objectives could only be achieved by devising realistic rather than oversimplified models. This could only be achieved by the use of advanced techniques such as fuzzy modelling, evolutionary algorithms, artificial neural networks and pattern analysis, and antagonistic dynamics. Such complex approaches are made easy to understand through illustration of a variety of sport applications that illustrate the author's vast experience in this area.

The understanding of sport helps to understand ourselves. This philosophical issue may seem out of place in this book but Ferrein and co-workers demonstrate clearly that modelling of soccer decision making provides an important test in the development of artificial intelligence. This in turn helps sport scientists to better understand the complex decision making involved in the simple game of soccer.

Sport biomechanics and computers have been inseparable from the very beginning. The most valuable tool in this relationship has been the development of biomechanical models that are utilised in both performance analysis and equipment selection and development. Hartmann, Berti, Schmidt and Buzug highlight the

importance of this approach for the progress in equipment development, performance improvement and well-being of the athletes. They highlight the intrinsic necessity for integration of modelling and biomechanical measurement in the modern biomechanics.

From ancient times the vast water pools on the planet have been perceived as both a barrier and a challenge to humans. Lauder highlights how computers allow this barrier to be broken and hence the provision of constructive feedback for performance improvement in water sports. He focuses his attention on swimming and kayaking. The complex issues and the need to use a variety of custom made devices in conjunction with computers are illustrated in this work.

Chi points out, how sensors and other ubiquitous computing technologies have slowly penetrated the arena of sports. He examines some examples of pervasive technology in sports and points to future directions. Trends and implications of utilizing sensors in sports are outlined; technological challenges in introducing sensors in various sports are examined.

In the final contribution, Wiemeyer discusses advantages and disadvantages of multimedia learning in sport and sport science. Different types of multimedia systems regarding learning are introduced. Based on these distinctions, pros and cons of multimedia learning are elaborated. The potential of multimedia as a research tool is discussed.

We hope that the reader of this book will have the same enjoyment reading book and that researchers from the mainstream areas of computer science (informatics), mathematics, bionics and robotics will find inspiration to apply their knowledge and skills in this exciting discipline. We also hope that the book will help to disperse the impression of authors being “lone wolves” by setting a series of publications in his area that will communicate both significant achievements and formidable challenges.

Arnold Baca and Peter Dabnichki

Preface

The concepts and the possibilities provided by information and communication technologies have influenced and changed practically all aspects of our daily life. Sport and leisure activities are no exception at all from this observation. The present book offers snapshots of situations where Information Technology (IT; i.e., computer hardware and software) has been really helpful in supporting sporting activities, or has the potential to do so. This is due to the ever increasing processing power, and to IT's capability of modelling and solving problems which are of great help for a variety of sports disciplines.

The present book offers such a wealth of information that the sheer number and the complexity of the topics addressed make it next to impossible to pay adequate attention to every author and to every subject addressed. But let me give you a few examples.

- *Coaching and training:* Here techniques are discussed which enable a coach to better prepare and to control the performance of the team members through special software tools.
- *Biomedical modelling and motion analysis:* These approaches try to give a better understanding of the movement of the human body, and to enable and support corrective and improving actions of the athlete. Most new techniques in that area are supported by small computing units such as sensors, actors, wearable computing – and particularly by wireless transmission technologies and ubiquitous computing.
- *Development of new sport games:* Computer technologies and computer networking allow the invention of new games and which are independent of the geographical location of the players (traditionally that distance has been rather small – in most cases dictated by the “range of sight“ or even “range of reach” – but computers are not subject to such geographical bounds).
- *Sports and robotics:* Not only humans are able to perform sporting

activities. Machines can be constructed to simulate or to practice various disciplines. A prominent example for that is the Robocup that clearly demonstrates the enormous progress in robotics – even if the global performance of soccer robots is still considered as somewhat modest by many.

- *New management tasks* for huge computer systems which can only be tested at mega-events which most often occur in sports (world soccer championship, Olympic Games...): Such mega-events require the co-operation of numerous computers (e.g., for the organisation of Olympic Games). They pose considerable challenges since such situations can hardly be tested in a suitable way prior to the event itself – nobody would be prepared to pay for such a test.

The area of sports (and in particular the support of sports through IT) is a particularly delicate one. Many ethical issues need to be addressed (e.g., in biomechanics), and computers can comparably easily be misused. Experience indicates that some (athletes or managers) will stop short at nothing if they can profit from it. The problematic nature of doping is a particularly difficult area – and perhaps therefore not fully addressed in the present volume.

I'm convinced that the present book is a very important step in order to improve the visibility of “computers and sport” as a discipline which is of highest relevance for the future – both scientifically and economically.

Professor Dr Dr h.c. Otto Spaniol