38th Conference of the
International Society of Biomechanics in Sports*

Conference Proceedings

*The conference planned for Liverpool, UK did not go ahead due to COVID-19. These proceedings are the accepted papers for the cancelled conference.

Proceedings edited by
Mark A. Robinson
38th Conference of the
International Society of Biomechanics in Sports

Volume 38 Issue 1

Editors:
Mark Robinson (Liverpool John Moores University, UK)
Bill Baltzopoulos (Liverpool John Moores University, UK)
Mark Lake (Liverpool John Moores University, UK)
Jos Vanrenterghem (KU Leuven, Belgium)

Each paper in these proceedings has been reviewed by at least two members of the scientific committee.

The correct format for citations is as per the APA style guidelines for the Sports Biomechanics journal http://www.tandf.co.uk/journals/authors/style/reference/tf_APA.pdf:


A sample citation for this conference would be as follows:

The International Society of Biomechanics

Primary Purposes

- To provide a forum for the exchange of ideas for sports biomechanics researchers, coaches, and teachers.
- To bridge the gap between researchers and practitioners.
- To gather and disseminate information and materials on biomechanics in sports.

Members

The International Society of Biomechanics in Sports is composed of members from all over the world with a common desire to study and understand human movement, especially as it relates to applied sports biomechanics. Participants come from a wide range of backgrounds including exercise science, education, engineering, computer science, rehabilitation and medicine to name a few. ISBS members have written some of the most widely used university textbooks as well as practitioner books and manuals. Hundreds of refereed journal articles, as well as widely read practical articles in popular journals, have been published by ISBS members. In addition, members have developed new coaching, teaching and training strategies and patented sports, exercise and rehabilitation equipment. The majority of pioneers from the computer era of sports biomechanics have at one time or another participated in ISBS activities, with most innovations in biomechanics research technology having come from these individuals. In short, if it is sports biomechanics, ISBS members are in it.

Annual Conference

The first full scale conference of the International Society of Biomechanics in Sports (ISBS) was held June 20-25, 1982, in San Diego, California, with 123 participants. ISBS initiated a constitution on May 7, 1983, with subsequent constitutional revisions over time to suit the changing needs of the Society. Some of the first field-based research activities of ISBS were at the 1976 Olympic Games and 1978 Commonwealth Games, with numerous other research projects completed since that time. The Annual Conference of the ISBS family are conducted in a friendly atmosphere, which favours and encourages wide participation. This ISBS congeniality is unique and dear to its members. The quality of research presented and materials produced are at the cutting edge of knowledge and technology. In addition to oral and poster research presentations select sport science topics are covered in depth each year through special lectures. In addition, a special feature includes the Geoffrey H.G. Dyson lecture presented by an outstanding scientist in sports biomechanics. A number of other awards and recognitions are given each year including the new Investigator Award.
Acknowledgements

The 2020 ISBS conference was cancelled, the second time that this has happened. Despite not hosting a physical conference we would like to thanks ISBS President Duane Knudson, VP Conferences Tim Exell and VP Publications Sarah Breen and the ISBS committee for their help and support with all preparations and positive discussions in the lead up to the conference cancellation. We would also like to thank everyone who submitted a paper, all members of the scientific committee who conducted reviews and all sponsors who committed to support the conference. A special thanks goes to the Editorial Board and Kirsty Roberts as conference secretary.
Conference Organizing Committee

Mark Robinson (Liverpool John Moores University, UK)
Mark Lake (Liverpool John Moores University, UK)
Bill Baltzopoulos (Liverpool John Moores University, UK)
Kirsty Roberts (Liverpool John Moores University, UK)
ISBS Executive Committee

President Elect: Duane Knudson (Texas State University)
Past President: Young-Hoo Kwon (Texas Women's University)
Secretary General: Peter Sinclair (University of Sydney)
Treasurer: Silvio Lorenzetti (Swiss Federal Institute of Sport Magglingen)

VP Awards: Neil Bezodis (Swansea University)
VP Projects & Research: Ina Janssen (National Sports Centre, Netherlands)
VP Conferences & Meetings: Tim Exell (University of Portsmouth)
VP Public Relations: Floren Colloud (Université de Poitiers)
VP Publications: Sarah Breen (Northern Michigan University)

Directors (2019-2020)
Laura-Anne Furlong (Loughborough University)
Steffi Colyer (University of Bath)
Sina David (German Sport University Cologne)
Yashushi Enomoto (University of Tsukuba)
Shinji Sakurai (Chukyo University)
Drew Harrison (University of Limerick)
Mitsuo Otsuka (Ritsumeikan University)
Kelly Sheerin (Auckland University of Technology)

Directors (2018-2020)
Marcus Lee (Singapore Sports Institute)
Wen-Tzu Tang (National Taiwan Sport University)
Gillian Weir (University of Massachusetts)
Ezio Preatoni (University of Bath, UK)
Hiro Nunome (Fukuoka University)
Randall Jensen (Northern Michigan University)
Steffen Willwacher (German Sport University)
Pedro Morouco (Instituto Politécnico de Leiria, Portugal)
Johannes Funken (German Sport University)
Scientific Committee

Aaron Fox
Alek Z Diffendaffer
Alex Atack
Alexander Abel
Andrew Barnes
Andrew Greene
Andrew J Harrison
Anja Niehoff
Anne Benjaminse
Anne Deletrat
Archit Navandar
Arnold Baca
Athanasios Bissas
Barry Wilson
Benedicte Vanwanseele
Bill Baltzopoulos
Boyi Dai
Brook Galna
Callum McCavish
Cassie Wilson
Celeste Coltman
Charlotte Apps
Chenfu Huang
Christopher Geiser
Christopher Sole
Costis Maganaris
Cyril Donnelly
Daniel Cohen
Daniel Fong
Danilo Catelli
Dario Cazzola
David Britzman
David Mullineaux
Duane Knudson
Dustin Oranchuk
Eleftherios Kellis
Elizabeth Bradshaw
Eric Slattery
Evie Vereecke
Ezio Pretoni
F. Javier Rojas-Ruiz
Flavio Castro
Floren Colloud
Franky Mulloy
Gabor Barton
Gareth Irwin
Gareth Nicholson
Gaspar Epro
Georgios Giarmatzis
Gerda Strutenberger
Giannis Giakas
Gillian Weir
Giorgos Paradisis
Glen Blenkinsop
Glenn Fleisig
Grace Smith
Hannah Shepherd
Hannah Tang
Hannah Wyatt
Hans Kainz
Hans von Lieres und Wilkau
Helen Bayne
Heloise Debelle
Hermann Schwameder
Hiroaki Hobara
Hiroyuki Nunome
Ian C Kenny
Ian Harris Sujae
Ina Janssen
Ine Van Caekenberghe
Jason Lake
Jasper Verheul
Jenny Burbage
Jesper Bencke
Johannes Funken
John M. Barden
John Warnemhoven
Joseph Hamill
Joseph Moore
Julien Frere
Justin Keogh
Kam Ming Mok
Kane Middleton
Kat Daniels
Keiko Sakamoto
Keizo Takahashi
Kevin Ball
Kiros Karamanidis
Kristaan D’Aout
Kristof Kipp
Kurt Schütte
Laura-Anne Furlong
Lauren Benson
Liesbet De Baets
Lotte Janssens
M. R. (Fred) Yeadon
Maarten Afschrift
Marion Mundt
Mark A Robinson
Mark de Zee
Mark King
Mark Walsh
Matthew Pain
Melanie Bussey
Michael Hiley
Michelle Sabick
Michiel Hagen
Monique Mokha
Nachiappan
Chockalingam
Nahoko Sato
Nathalie Alexander
Neal Smith
Neil Bezodis
Neil Thomas
Nick Linthorne
Niels Nedergaard
Oliver R Runswick
Paul A Jones
Paul Comfort
Paul Felton
Pedro Morouço
Peter Lamb
Peter Sinclair
Philip Graham-Smith
Raihana Sharir
Raja Mohammed Raja Azdin
Randall L Jensen
Rene Ferdinands
Richard Foster
Richard Jones
Robert Needham
Robin Healy
Sam Allen
Sam Van Rossom
Sandy Willmott
Scott Brennan
Scott Selbie
Sean Sankey
Sentaro Koshida
Seokwon Lee
Shinji Sakurai
Sina David
Steffen Willwacher
Steffi Colyer
Stuart A McErlean-Naylor
Thomas Dupré
Thomas O’Brien
Thorsten Stein
Tim Doyle
Timmion Skervin
Timothy Exell
Timothy J Suchomel
Todd Pataky
Tron Krosshaug
Ventura Ferrer-Roca
Wayne Spratford
William Johnson
Wolfgang Potthast
Yaodong Gu
Young-Hoo Kwon
Scientific Program

A total of 242 papers were accepted into this year’s proceedings. These papers were not formally presented although members were invited to upload their presentation to the ISBS YouTube channel.

This year’s conference papers covered the following topics:

- Athletics
- Paralympics
- Racket Sports
- Combat Sports
- Water Sports
- Injury
- Rehabilitation
- Cycling
- Football
- Strength and Conditioning
- Muscle & Tendon
- Modelling
- Equipment
- Imaging
- Wearable Tech
- Education
- Motor Control
- Methods / Statistics
- Coaching