



PROCEEDINGS

39th Conference of the International Society of Biomechanics in Sport

Canberra, Australia

2021

The conference planned for Canberra, Australia did not go ahead in a face-to-face capacity due to COVID-19. The conference was instead delivered fully online. These proceedings are the accepted papers for the online conference.

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Volume 39 Issue 1

Editors:

Wayne Spratford (University of Canberra)

Celeste Coltman (University of Canberra)

Nick Brown (University of Canberra)

John Warmenhoven (University of New South Wales)

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3 September 2021 to 6 September 2021

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Each paper in these proceedings has been reviewed by at least two members of the scientific committee. The scientific committee comprises the current members of the board of directors of the ISBS and the keynote speakers for the upcoming conference.

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

Author, A. A. (Year). Title of article. Title of the Journal, Volume(Issue), pp–pp. Retrieved from WEBSITE

A sample citation using the 2014 Dyson lecture would be as follows:

Harrison, A. J. (2014, July). Applications of Functional Data Analysis in Sport Biomechanics. In K. Sato, W. A. Sands, & S. Mizuguchi (Eds.), *Proceedings of the 32nd International Conference of Biomechanics in Sports*. (pp. 1–9). Konstanz, Germany: International Society of Biomechanics in Sports. Retrieved from <https://ojs.ub.uni-konstanz.de/cpa/article/view/5905/5390>



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.

Acknowledgments

The 2021 ISBS conference this year has been held online. Despite not hosting a physical conference we would like to thank ISBS President Duane Knudson, VP of Conferences and Meetings Tim Exell and VP of 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 and acknowledge the sponsors of the ISBS 2021 including Vicon, Qualisys, Logemas, iMeasureU, Simi, Xsensor and Amti.

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, Wayne Spratford as Conference chair, and the Australian Institute of Sport and the University of Canberra for supporting the conference.

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Scientific Programme

Keynotes

Geoffrey Dyson Award
Emeritus Professor Julie Steele
University of Wollongong



Title: Long-term lessons learned in Biomechanics

Julie Steele is an Emeritus Professor in the School of Medicine, at University of Wollongong, Australia. She is also Founder of both the internationally renowned Biomechanics Research Laboratory and Breast Research Australia (BRA). Considered one of Australia's most eminent biomechanists, Julie's research over the past ~40 years, has focused on developing innovative strategies, based on rigorous applied biomechanics, to decrease injury potential and optimise quality of life for individuals across the age spectrum. She has investigated lower limb injuries caused by high impact landings; developed innovative wearable technologies for health applications; examined the effects of obesity, ageing and occupational loading on lower limb structure and function with implications for footwear design; and investigated breast health biomechanics to ensure all females can enjoy the health benefits associated with regularly participating in physical activity in comfort. Julie has received numerous awards, including 2005 NSW Telstra Business Woman of the Year, as well as being appointed as a Fellow of the International Society of Biomechanics and Sports Medicine Australia. One of only 44 biomechanists world-wide currently appointed to the World Council of Biomechanics, Julie has served on the Executive Council of several professional associations, including being President of ISB and the Australian & New Zealand Society of Biomechanics. She was also a member of the Board of Directors of ISBS from 1993-2003, holding various positions including Vice President (Publications).

In 2019 Julie was awarded a Member (AM) of the Order of Australia for significant service to science in the field of biomechanics, to higher education, and to professional associations.

Hans Gros Emerging Researcher Award

Dr. Gregory Tierney

Ulster University



Title: Concussion biomechanics and head acceleration exposure in sport: Can we develop player protection strategies without compromising the dynamics of the game?

Dr Tierney's research explores how mechanical impacts to the head translate into biological damage of the brain, from both concussive and sub-concussive impacts in sports such as football, rugby and American football. Dr Tierney's research aim is to further understand the biomechanical mechanisms of brain injury in order to develop player protection strategies and predictive technologies for concussion in sport. Dr Tierney has extensive experience working with elite-level sports teams, technology companies and governing bodies, both nationally and internationally, to ensure sports are played in the safest possible manner without compromising the dynamics of the game. Dr Tierney graduated from Trinity College Dublin with a PhD in Biomedical Engineering in December 2018 and worked as a lecturer in Biomechanics at the University of Leeds from February 2019. In May 2021, Dr Tierney joined the School of Sport at Ulster University as a lecturer in Biomechanics, teaching on the Sport and Exercise Sciences and Sport and Exercise Medicine programmes.

Keynote

Associate Professor Clare Minahan

Griffith University



Title: The elite and emerging female athlete

Clare Minahan is an Associate Professor at Griffith University, Queensland Australia, and has led the Griffith Sports Science group since 2002. Clare's interests are in the advancement of human performance with a key focus on the determinants of performance in female athletes. She has documented unique responses to exercise in female athletes including locomotor movement patterns, muscle damage, thermoregulation, and immune function. Clare has published over 85 peer-reviewed scientific articles, has successfully supervised multiple post-doctoral fellows and PhD students to completion, and is currently supervising numerous post-graduate students embedded in Australian high-performance sport organisations. These context specific partnerships provide the avenue for vigorous academic research and direct applied sports-science translation. Clare's research continues to influence a new generation of exercise and sport professionals to seriously consider the physiology unique to female athletes. In 2021, Clare was recognised by Exercise & Sports Science Australia as one of three Female Leaders in Exercise & Sports Science. Clare is a member of the ESSA* Sports Science Advisory Group and the AIS* Female Performance and Health Initiative Monitoring Group. She was

instrumental in establishing the strategic direction of the Female Performance and Health Initiative and setting and implementing the research agenda. In recent years, Clare has applied her knowledge of female athletes to lead the development, implementation and delivery of 'GAPS'; an inclusive sports pathway programme for emerging athletes in developing countries of the Pacific. GAPS has been highly successful and is now formally recognized and supported by the Commonwealth Games Federation as the key sports development initiative for women in developing countries of the Commonwealth. GAPS will be delivered in Oceania, Europe, and Africa in 2021 under Clare's leadership.

Keynote

Dr. Luke Kelly

University of Queensland



Title: How a better understanding of the human foot has implications for applied biomechanics.

Luke is a Senior Research Fellow within the Centre for Sensorimotor Performance in the School of Human Movement & Nutrition Sciences. His primary area of research is focused on enhancing our understanding of the complex function of the human foot. Despite the importance of our feet in our daily lives, we know little about this complex anatomical structure. He is driven to understand how the foot has evolved, to perform such a diverse array of locomotor tasks with relative effectiveness and efficiency. Specifically, how the brain and spinal cord control foot function, and the role of elastic connective tissues in providing structural support and energy conservation. He is fascinated by the intricate interaction of the many small bones within the foot, and how variations in structure may influence the physical performance of the foot. Beyond fundamental science, his research has broad application across a range of areas. His research program has both direct industry connections (e.g. Australian Sports Commission and Asics Oceania) and potential applications in different areas of health (e.g. chronic musculoskeletal conditions – osteoarthritis), rehabilitation, and robotic/prosthetic design.

Keynote

Dr. Conny Draper

Biomechanical Consultant



Title: The challenges of delivering applied biomechanical servicing to elite athletes.

Dr. Conny Draper is one of the world's leading Sports Biomechanists focussing on Rowing. Conny has many Olympic teams as her clients and spends her time travelling the world assessing the Biomechanics of crews and individuals. Conny is renowned for being able to translate a vast amount of data from the devices she uses into plain English. Coaches often remark how Conny is able to get athletes and coaches alike to understand what is going on and how to use this information to make meaningful change. Conny completed a Masters in Sports Science in Halle-

Wittenberg followed by a PhD at the University of Sydney and has held full time roles at the Australian institute of Sport. Since becoming freelance, Conny has also completed project work for FIFA, and is currently on the FISA Equipment and Technology Commission.

Keynote

Dr. Katherine Daniels

Manchester Metropolitan University



Title: How clinical biomechanics can inform applied sports research

Kat Daniels is a Senior Lecturer at Manchester Metropolitan University and previously Head of Biomechanics at Sports Surgery Clinic Dublin, where she oversaw the delivery of biomechanical testing and reporting for both elite and amateur athletes returning from injury. The potential for biomechanical data to inform clinical decision-making and guide interventions in a sports rehabilitation setting offers exciting opportunities to extend the impact of the field and improve patient outcomes. The multitude of possibilities and challenges associated with large-scale biomechanics service provision have thus been a major focus of Kat's work to date, alongside clinical research on assessment of rehabilitation after musculoskeletal injury. Her other active research interests are in the control and optimisation of locomotor manoeuvres, such as turning, jumping and negotiating obstacles, in both healthy and physically impaired populations.

Applied Sessions

Teaching Sports Biomechanics using Problem-Based Learning

Workshop facilitators: Dr. Sarah Breen (University of Oklahoma), Dr. Cheng Tu Hsieh (California State University), Dr. Duane Knudson (Texas State University) & Dr. Melissa Mache (California State University).

This workshop will present a model of Problem-based Learning (PBL) that supports the best practices of biomechanics teaching and learning, including facilitating the development of problem-solving skills, group work and oral and written communication skills in the field of biomechanics. PBL is a learner-centered teaching approach in which students work over a period of time on a multi-faceted task that involves engaging with complex issues, solving problems, or meeting particular challenges from the real world (Buck Institute for Education, n.d.). To communicate their learning, students develop a solution to a problem or a product.

This workshop will have three core elements:

- (i) An asynchronous online learning activity for all workshop participants where you will learn about the basics of PBL and prepare learning objectives for a PBL problem you wish to create for a course you teach.
- (ii) A two-hour synchronous workshop where you will work in a small group with a dedicated facilitator to develop a PBL problem for a course you teach.

- (iii) A follow-up optional submission of your PBL project for review and potential publication in the ISBS repository as an open education resource package.

This workshop will discuss the guiding principles and strategies involved in using PBL when teaching learners in the field of sport biomechanics and illustrate them through sample problems. Adaptations of these problems for a range of levels, and teaching contexts will be discussed. Working in small groups, workshop participants will discuss how to apply the proposed principles and strategies in their own teaching and have the option to submit and publish their problems to the sports biomechanics community at large.

Applied Cycling Workshop

Workshop facilitators: Dr. Rodrigo Bini (La Trobe University), Prof. Nick Brown (University of Canberra) & Dr. Ina Janssen (Sportcentrum Papendal).

The goal of this workshop is to provide theoretical and practical knowledge on how to determine body position on the bike through real case studies. In this one-hour workshop you will:

- (i) Learn how to use free software (i.e. Tracker) to measure joint angles in cycling.
- (ii) Measure joint angles in the sagittal plane for an athlete cycling (from video).
- (iii) Learn about the relationship between static and dynamic joint angles and pedal forces.
- (iv) Review data for joint angles and pedal forces for an able-bodied cyclist and a Paralympian.

This session is open to all, but due to the limited number of available spots, please register to participate in this Applied Cycling Workshop here using this link. Continued discussion can occur in the ISBS Slack Channel (Cycling-interest-group). This workshop is supported by the Cycling Research Network.

Mother's Cafe

Workshop guest speaker: Dr. Isabel Torres (Mothers in Science).

Workshop moderators: Diana Soares (University of Bedfordshire) & Dr. Ina Janssen (Sportcentrum Papendal).

We are thrilled to be able to welcome Dr Isabel Torres, co-founder & CEO of Mothers in Science (www.mothersinscience.com), to our 4th ISBS Mother's Café during the ISBS Annual Conference. Mothers in Science held their first conference in May 2021 entitled 'Motherhood and Career Retention in STEMM'. This conference brought together STEMM students and professionals, non-profit organizations, research institutions and science societies to discuss the structural barriers holding mothers back and to brainstorm long-term actionable solutions to close the gender gap in STEMM. Dr Torres will share findings and resources from the conference. Of course, there will be time for the informal catch up with fellow ISBS members. We will start the first hour with a catch up and the second hour with Dr Torres. This session is open to all members and delegates! Continued discussion can occur in our separate mothers-café channel within the ISBS Slack Channel.

Data Science and Sports Biomechanics Panels

Panel Chair: Dr. John Warmenhoven (University of New South Wales).

Panel 1 Members: Associate Prof. Kristin Sainani (Stanford University), Dr. Paul Wu (Queensland University of Technology), Prof. Kerrie Mengersen (Queensland University of Technology) & Dr. William Johnson (Houston Astros Baseball).

Panel 2 Members: Prof. Norma Bargary (University of Limerick), Associate Prof. Dominik Liebl (University of Bonn), Dr. Marion Mundt (University of Western Australia) & Dr. Chris Richter (Kaia Health).

We are pleased to offer two separate panel discussions on Data Science in Sports Biomechanics at ISBS 2021, deliberately spanning different time zones so that attendees from around the world can tune into at least one discussion. Each discussion has panel members that are currently embedded in academic or industry data-science roles, but come from a diverse range of backgrounds including statistics, computer science, engineering and sport science. All panel members have worked in sport science or sports biomechanics. The panel discussions will touch on everything from understanding what data science is, exploring the current state-of-the-art for data science and how it can intersect with sports biomechanics in both research and practice settings, exploring how sports biomechanics and biomechanists can leverage data-science and better understanding pathways for sports biomechanists to become more involved with data-science... plus more!

Biomechanics on the driving range; following the role biomechanics has played in the path from talented juniors to major winners

Panel Chair: Dr. Kevin Ball (Victoria University).

Panel Members: Ryan Lumsden (Q Golf), Richie Smith (Perth Golf Academy) & Dr. Alex Buttfield (BioAlchemy).

This roundtable discussion with consultant golf biomechanist Ryan Lumsden, coach Ritchie Smith, consultant biomechanist Alec Buttfield and chair Kevin Ball will talk about the role biomechanics has played in the development of two elite golfers, Minjee Lee and Hannah Green. Ryan Lumsden has provided biomechanics feedback to Minjee and Hannah since they were juniors, working with their long-time coach Ritchie Smith to integrate biomechanics analysis and feedback into the development of their technique over time. Ryan has also worked with Alec Buttfield for many years, looking at ways to analyse and present golf biomechanics data to maximise learning opportunities. This discussion will provide some insights into how biomechanics can be applied to make a real difference in the longitudinal development of elite golfers.

Women in Sports Biomechanics Panel – From ‘missing ingredient’ to ‘career accelerator’: Everything you should know about sponsorship but never thought to ask.”

Facilitator: Dr. Jen de Vries (Organisation and Development Consultant).

Chair: Dr Crystal Kean (Central Queensland University)

This year's ISBS Women in Sports Biomechanics Event at ISBS 2021 is sponsored by Vicon and entitled: "From 'missing ingredient' to 'career accelerator': Everything you should know about sponsorship but never thought to ask." Dr Jen de Vries will provide insight and practical strategies based on her research investigating how sponsorship works in higher education and research institutes. Jen's presentation, followed by Q & A is targeted at women and men, at all career stages. Sponsorship is a critical ingredient for success, and this presentation will develop your sponsorship 'savvy', both as sponsor and sponsee. Key content areas include: (i) mentoring and sponsorship, how are they different and why this is important, (ii) how sponsorship works and its impact on careers, including the career spiral, (iii) bias and sponsorship – how you can be part of the solution rather than part of the problem, (iv) are you missing out – identifying sponsorship gaps, and what to do about it, (v) building enabling cultures to support career success – what leaders, colleagues and departments can do.

Sponsored Sessions

Logemas & Vicon, Chair: Dr. Denny Wells

The many hats of the sports biomechanist: A glimpse into the many careers that sports biomechanics can lead to. This session included a panel with industry biomechanics experts Prof. Sophia Nimphius (Edith Cowan University), Dr. Daniel Cottam (Australian Institute of Sport), Dr. Emma Millet (New South Wales Institute of Sport), Tim McGrath (Pitch Ready) and Tom carter (Australian Women's Rugby Sevens).

Simi®, *Chair:* Dr. Wayne Spratford, *Presenter:* Thomas Hock

Industry presentation- Simi® will showcase their latest computer vision and AI Methods or Full Body 3D markerless capture for sports training and competition analysis.

Qualisys, *Chair:* Dr. Wayne Spratford, *Presenters:* Dr. Steffen Willwacher, Dr. Bjoern Zimmerman, Dr. Nils Betzler.

Three industry presentations on motion capture.

Vicon, *Chair:* Dr. Wayne Spratford

Two industry sponsored social events.

Xsenor, *Chair:* Dr. Wayne Spratford

Overview and demonstration of X4 Intelligent Insole System.

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Conference Presentations

ANALYSIS OF RUNNING MOTION IN THE STARTING PHASE OF MALE SKELETON ATHLETES AT INTERNATIONAL COMPETITIONS

PADDLE MECHANICS DIFFER BETWEEN ON-WATER AND ERGOMETER SPRINT KAYAKING

PREDICTING GROUND REACTION FORCES FROM 2D VIDEO: BRIDGING THE LAB TO FIELD NEXUS

COMPARISON OF MARKER AND MARKER-LESS AUTOMATED MOTION CAPTURE FOR BASEBALL PITCHING BIOMECHANICS

PERSPECTIVES AND PRACTICES OF ACCREDITED TENNIS COACHES WHEN DEVELOPING STROKE TECHNIQUE

TRUNK BIOMECHANICS OF TRANSTIBIAL AMPUTEES IN LEVEL AND SLOPED GAIT USING RIGID, HYDRAULIC AND MICROPROCESSOR CONTROLLED ANKLES

NO DATASET TOO SMALL! ANIMATING 3D MOTION DATA TO ENLARGE 2D VIDEO DATABASES

DOES POSTURAL STABILITY IMPROVE AFTER USING A NOVEL BIOMECHANICAL DEVICE IN RECREATIONAL FEMALE ATHLETES AT A HIGH RISK OF ANTERIOR CRUCIATE LIGAMENT INJURY?

A KINEMATIC COMPARISON OF CONVENTIONAL INSWING AND OUTSWING BOWLING IN CRICKET

ASSESSMENT OF A MARKLESS MOTION TRACKING METHOD TO DETERMINE BODY POSITION ON THE BIKE

EFFECTS OF KINEMATIC FEEDBACK ON VERTICAL JUMP PERFORMANCE

COGNITIVE AND MOTOR PROCESSES IN A VOLLEYBALL SPECIFIC ANTICIPATION TASK

SHOT PERFORMANCE AND CUE STICK KINEMATICS OF TOP SPIN SHOTS IN CUE SPORTS PLAYERS OF VARIOUS PLAYING LEVELS

CHANGES IN THE THROWING TECHNIQUE OF COLLEGE MALE JAVELIN THROWERS BY AN IMMEDIATE FEEDBACK TRAINING.

LOWER LIMB KINETIC CHARACTERISTICS OF THE SIDE-HOP TEST IN HEALTHY INDIVIDUALS

SWIMMING PHASE-BASED PERFORMANCE EVALUATION USING A SINGLE IMU IN FRONT CRAWL

COMPARING THE RESPECTIVE EFFECTS OF THREE TYPES OF WARM-UP ON THE COUNTERMOVEMENT JUMP: AN ANALYSIS OF NON-ATHLETE COLLEGE STUDENTS

THE RELATIONSHIP BETWEEN ANGULAR MOMENTUM OF THE LOWER TRUNK AND SHOULDER JOINT FORCES DURING AN OVERARM THROW

JOINT- AND LOAD-SPECIFIC ASYMMETRIES DURING THREE LOWER EXTREMITY RESISTANCE TRAINING EXERCISES

BIOMECHANICAL AND PHYSICAL PROFILE COMPARISON IN MILITARIES WITH AND WITHOUT MUSCULOSKELETAL INJURIES: A PRELIMINARY STUDY

ANALYSIS OF THE SERVING MOTION OF MALE COLLEGE TENNIS PLAYERS IN A SIMULATED MATCHES

AN INERTIAL SENSORS-BASED METHOD FOR PHASES AND EVENTS IDENTIFICATION IN PARA-ROWING: TOWARDS AN ON-WATER PERFORMANCE ASSESSMENT

EFFECT OF LOWER EXTREMITIES POSITION ON VOLLEYBALL ATTACK TAKE-OFF HEIGHT

EFFECTS OF AGEING ON GAIT COMPLEXITY

THREE DIMENSIONAL KINEMATIC DIFFERENCES BETWEEN MALE AND FEMALE SOCCER PLAYERS

THE EFFECTS OF EIGHT-WEEK SPORTS-SPECIFIC TRAINING ON THE KINEMATICS OF DOUBLE-POLE TECHNIQUES IN NOVICE CROSS-COUNTRY SKIERS

COMPARISONS OF PRE-LANDING AND EARLY LANDING KNEE FLEXION ANGLES BETWEEN SEXES AND LANDING TASKS

ROCK CLIMBING HELMET IMPACT PERFORMANCE VARIES BY HELMET MODEL TYPE

MEDIAL-LATERAL HIP POSITIONS PREDICTED KINETIC ASYMMETRIES DURING BILATERAL SQUATS IN COLLEGIATE ATHLETES FOLLOWING ACLR

LATERAL EDGE FRICTION VARIABILITY IN INDOOR SPORTS SHOES

DEVELOPMENT AND EVALUATION OF A DEEP LEARNING BASED MARKERLESS MOTION CAPTURE SYSTEM

LABORATORY VERSUS ECOLOGICAL RUNNING: A COMPARISON OF FOOT STRIKE ANGLE AND PATTERN ESTIMATION

KINEMATIC ATTRIBUTES ASSOCIATED WITH OVERARM THROWING PERFORMANCE IN CRICKET

WHOLE BODY DYNAMIC POSTURAL CONTROL DURING BEND RUNNING

LOWER BODY CONTRIBUTIONS TO PELVIS ENERGY FLOW AND PITCH VELOCITY IN COLLEGIATE BASEBALL PLAYERS

EXAMINATION OF AN APPLICABLE RANGE FOR A MARKERLESS MOTION CAPTURE SYSTEM IN GAIT ANALYSIS

FOREARM LOADING AND SYMMETRY DURING ARTISTICS GYMNASTICS VAULT TRAINING SESSIONS.

LOWER BODY MUSCULOTENDON UNIT FUNCTION DURING BOUNDING, HURDLE JUMPING AND RUNNING

EFFECT OF A SIX-WEEK NEUROMUSCULAR TRAINING PROGRAM ON VERTICAL STIFFNESS IN HEALTHY HIGH SCHOOL DISTANCE RUNNERS

REAL-TIME HAPTIC FEEDBACK SYSTEM VALIDITY AND ITS FEASIBILITY FOR RUNNERS IN A REAL-WORLD TRAINING ENVIRONMENT

JOINT DISPLACEMENTS AND PEAK ACHILLES TENDON FORCE DURING IRISH DANCING-SPECIFIC LANDING TASKS

CONTINUOUS CHANGES IN LEG STIFFNESS USING A MASS-SPRING-DAMPER MODEL WITH AN ACTUATOR DURING THE STEP PHASE OF THE TRIPLE JUMP

COMBINATIONS OF CLINICAL TESTS PREDICT FRONTAL PLANE KNEE ANGLE AND MOMENT IN BILATERAL DROP JUMP

BIOMECHANICAL DIFFERENCES DURING LANDING BETWEEN INDIVIDUALS WITH PROXIMAL AND COMBINED DEVIATIONS DURING LATERAL STEP DOWN

MEDIO-LATERAL ACCELERATION OF FEMALE ATHLETES WITH AN ACL RECONSTRUCTION IN COMPARISON WITH A HEALTHY POPULATION

FORCE-VELOCITY PROFILING FOR SHORT ICE HOCKEY SKATING SPRINTS: EFFECT OF EXPONENTIAL FUNCTION

OPTIMAL MOVEMENT FOR LOWER EXTREMITY INJURY PREVENTION; HOW TO CREATE AN OPTIMAL LEARNING ENVIRONMENT FOR YOUTH SOCCER GIRLS

AN INVESTIGATION INTO THE EFFECT OF LANE RADIUS ON STEP CHARACTERISTICS IN INDOOR BEND SPRINTING

RELATIONSHIP BETWEEN MUSCLE ARCHITECTURE AND CONCENTRIC MOVEMENT VELOCITY DURING RESISTANCE EXERCISE

EXPLOSIVE PLANTAR FLEXOR PERFORMANCE: A COMPARISON OF ELITE SPRINTERS VERSUS PHYSICALLY ACTIVE INDIVIDUALS

IDENTIFYING JOINT-SPECIFIC LIMITATIONS AND TARGETS FOR IMPROVING WEIGHTLIFTING PERFORMANCE

RESULTS OF INVERSE DYNAMICS CALCULATIONS IN JAVELIN THROWING ARE STRONGLY INFLUENCED BY INDIVIDUAL BODY SEGMENT PROPERTIES

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