Applied Swimming Programme

Schedule

27th International Conference on Biomechanics in Sports
Welcome and Introduction (09:00 – 09:15 – Room C)
Ross Sanders (ISBS) & Charlotte Parker (Swim Ireland)

Opening Oral Session (09:15 – 10:45 – Room C)
British swimming – Creating a platform for elite swim performances Andrew Logan
Preventing Injuries in swimming Kevin Boyd
Recognising and avoiding overtraining Francisco Alves

Break (10:45 – 11:15)

Parallel Session One (11:15 – 13:15 – Room C)
Green swimming: Getting into the energy saving rhythm Ross Sanders
How to start in backstroke considering the new rules Joao Paulo Vilas Boas
Physiological monitoring of swimmers John Bradley
Computational fluid dynamics: Practical applications Antonio Silva/Daniel Marinho

Parallel Session Two (11:15 – 13:15 – Room D)
Body roll: What we now know Carl Payton
A guide for coordination in the variants of frontcrawl Ulrik Persyn
Underwater dolphin kicking in starts and turns Raul Arellano
I always swim badly in the final! Brian Marshall

Lunch (13:15 – 14:00)

Pool Based Demonstrations (14:00 – 15:00 – UL Arena Pool)
Mid-pool video analysis Conor Osborough
Dive & turn analysis Georgios Machtsiras
Shoulder stability exercises Kevin Boyd

Parallel Session One (15:00 – 16:30 – Room C)
Correcting physical and technical asymmetries of swimmers Alison Fantom
Sprint and distance swimmers: The same animal? Carla McCabe
Land training for swimming Neil Donald

Parallel Session Two (15:00 – 16:30 – Room D)
Breathing and stroke frequency strategies for top performance Per-Ludvik Kjendlie
Supporting the coach with science: The Irish experience Conor Osborough
Using critical velocities to set training intensities Jeanne Dekerle

Closing Oral Session (17:00 – 18:00 – Room C)
Coordination: How elite swimmers differ from sub-elite Didier Chollet/Ludovic Seifert
Successful interventions following analysis Bruce Mason
In 2008, British Swimming (BS) restructured the World Class Programme (WCP) for swimming with the establishment of five Intensive Training Centres (ITC) throughout the United Kingdom. The aim being to provide an optimal environment for elite athletes to best prepare for winning performances at international competitions. Integral to each ITC is a sport science and medical service delivery platform whereby coaches and athletes are provided access to a comprehensive array of science and medical support within their daily training and competition environment.

The purpose of this talk is to provide an overview of the integration and applied application of swimming sciences, by coaches, within the ITC daily training environment. Particularly, the focus will be on the processes established within the ITC to identify the best use of swimming science. As well, the talk will provide an insight into the current tools and practices that the ITC coaches have embraced to create an environment that will impact and optimise an individual swimmer’s performance.

KEY WORDS: british swimming, intensive training centres, swimming science

Speaker Biography
Andrew Logan (DipT, BEd, Dip Coaching Science) is British Swimming’s Manager of Sport Science and Sports Medicine. Andrew has over 20yrs experience within elite and Olympic sport, initially as an athlete representing Australia in road cycling at the 1990 Commonwealth Games and World Championships and then in subsequent roles within Australian Sport: National Women’s and Australian Institute of Sport Road Cycling Coach; Australian Swimming’s Sport Science Coordinator; Skiing Australia / NSW Institute of Sport Winter Sports Programme – Performance Manager; Australian Institute of Sport Triathlon Program – Performance Manager.
PREVENTING INJURIES IN SWIMMING

Mr Kevin T. Boyd  MBBS  FRCS(Tr&Orth) FFSEM(UK) DipSportsMed
Consultant Orthopaedic & Sports Surgeon, University Hospitals of Leicester NHS Trust, United Kingdom
Chairman, British Swimming Medical Committee

Statistics tell us that overall injury rates in swimming are very low in comparison with other sports. It is the elite swimmer that suffers the majority of injuries. This is largely due to the substantial training loads undertaken and the large reliance on the upper limbs for propulsion. The four strokes differ in subtle ways in their injury patterns.

Acute injuries are relatively rare due to the lack of bodily contact and the relatively slow speeds. Discipline in and around the pool and caution when diving are important. Blunt injuries for the majority are minor and self-limiting. Indirect muscle strains can occur following failure to perform a suitable warm-up.

Overuse injuries are often multi-factorial and present the greatest challenge. They result when biomechanical demands are not matched by appropriate adaptation and recovery. Training errors may be factors but these can be minimised by individualised, responsive programmes with in-built recovery periods for each physiological system. Any external demands on the athlete must not be underestimated.

Shoulder problems are most common. The joint relies heavily on dynamic control of the rotator cuff and the scapular stabilising muscles. Instability is exacerbated as muscles fatigue with activity. Specific strengthening exercises should be part of an overall training programme. The knees of Breaststrokers are vulnerable to combination stresses. Thigh strengthening should focus on closed-chain, terminal-range exercises. The streamline position encourages repeated hyperextension of the lumbar spine, particularly in Butterfly and Breaststroke. Such actions focus stress on the posterior structures of the spine. Core stability programmes concentrating on the endurance and tone of the major muscle masses are key. Inherent or acquired anatomical variations may make some athletes more susceptible to injury than others.

Understanding the causes of injury allows doctors and coaches to minimise risks and allow prompt intervention to prevent chronicity and underperformance.

Speaker Biography

Kevin Boyd is a Consultant Orthopaedic Surgeon at the University Hospitals of Leicester NHS Trust in England, where he is head of the Sports Medicine Department. He trained in Newcastle-Upon-Tyne, Nottingham and Brisbane, Australia. He is a Fellow of the Royal College of Surgeons of England and the Faculty of Sport & Exercise Medicine of the United Kingdom. He has active roles in research, teaching and examining and has lectured widely on swimming injuries. He has worked with the Amateur Swimming Association and British Swimming for over 15 years and is the current Chairman their medical committees. He swam internationally from 1979-1991, competing in Olympic, World and Commonwealth Games finals. He has held numerous British and Commonwealth records for middle and long distance freestyle events.
RECOGNISING AND AVOIDING OVERTRAINING

Francisco Alves
Faculty of Human Kinetics, Technical University of Lisbon, Portugal

Training induces both physiological adaptations that improve performance and fatigue that decreases performance. The purpose of recovery or peaking (taper) periods is to eliminate the fatigue and allow the full benefits of the adaptations that should have occurred during overload phases to emerge at the right time. Stress encompasses all aspects of training, competition and non-training factors. Stress can have both positive and negative effects depending on the state of the athlete and recovery process. Increased exercise stress is manifested in physiological and biochemical changes and is often in conjunction with psychological alterations, all of which result from an imbalance in homeostasis. However, the quantity of training stimuli that result in either performance enhancement or a chronic fatigue state is presently unknown.

It is usual in training regimes of endurance athletes the integration of high training volumes combined with limited recovery periods. This may disrupt the fragile balance in the interaction between fatigue and adaptation, and the accumulation of exercise stress may exceed an athlete’s finite capacity of coping with the demands put on him.

Because it is difficult to ascertain the volume of training that will result in overreaching or overtraining, it would be important to identify markers that distinguish between acute training-related fatigue and overreaching. However, a “golden standard” to diagnose overreaching or early detection of overtraining does not exist. The combination of several criteria as maximal lactate concentration, OBLA or other sub-maximal markers, and RPE require intra-individual comparative data to be meaningful. On the other hand, fatigue and state moods inquiries seem to be very helpful in checking how the swimmers are coping with training-induced stress.

Keeping a training log is an easy way to track your progress and watch for symptoms of overtraining. Indicators that are easy and inexpensive to obtain, are exactly the ones that may prove most suitable for inclusion in a training diary based system for monitoring adaptation to training.

KEY WORDS: swimming, overreaching, overtraining, recovery

Speaker Biography
PhD in Sports Sciences
Full Professor at the Department of Sport Sciences of the Technical University of Lisbon/ Faculty of Human Kinetics
Coaching experience on swimming
On the club level – 20 years
Member of the Sports Coach Education National Board
Areas of interest in Research
Biomechanics of swimming
Performance assessment in endurance athletes
Training periodisation, fatigue and recovery
GREEN SWIMMING: GETTING INTO THE ENERGY SAVING RHYTHM

Ross Sanders
Centre for Aquatics Research and Education, PESLS, The University of Edinburgh, Edinburgh, UK

Why is butterfly almost as fast as freestyle? By developing good rhythm and timing of body actions skilled butterfly swimmers are able to swim more economically than less skilled swimmers – almost as economically as freestyle! Implications for coaching and identification of swimmers suited to competitive butterfly swimming are discussed.

Speaker Biography
Ross Sanders is Chair of Sport Science, Department of Physical Education, Sport and Leisure Studies (PESLS), The University of Edinburgh (from 2000). In 2001 he founded the Centre for Aquatics Research and Education (CARE) to meet the needs of academics and coaches alike. Ross completed his PhD through the University of Queensland (1991) following employment as a teacher of Physical Education (1977-1984). Previous academic appointments include The University of Otago, Dunedin, New Zealand (1987-1996), and Edith Cowan University, Perth, Western Australia (1996-1999). His research applies the scientific disciplines of biomechanics and motor control with particular emphasis on enhancing performance in aquatic sports. Ross has a particular interest in rhythms used in swimming and their use in maximising economy. He is the founder of a website www.coachesinfo.com designed to inform and educate coaches. In 2008 the site became the official sports science delivery site for FINA. In recent years Ross has been a keen masters swimmer in Dunedin New Zealand and a member of the Mullaloo Surf Life Saving Club in Perth Australia competing in local and National championships in both. As is evident by his organisation of this applied session for coaches Ross is devoted to ensuring that swimming science is applied in the field through teacher and coach education.
BODY ROLL: WHAT WE NOW KNOW

Carl J. Payton

Department of Exercise & Sport Science, Manchester Metropolitan University, Cheshire, England

This presentation will discuss the importance of body roll in competitive swimming. It will critically evaluate the scientific evidence supporting the potential benefits associated with body roll and provide some practical recommendations for coaches.

When swimmers rotate about their longitudinal axis in the front crawl and backstroke, this is commonly referred to as body roll. This rolling movement is considered an essential component of these two strokes. Body roll occurs as a consequence of the asymmetrical movements of the lower and upper limbs, and gravitational effects. Studies have shown that the shoulders and hips do not roll as one unit and that the timing and the magnitude of hip and shoulder roll depends on a number of factors including the swimmer’s speed, stroke rate, kick technique, breathing action and skill level. The key findings from these studies will be presented and their relevance to coaching discussed.

There is some speculation that body roll can enhance the amount of propulsion created during front crawl swimming. Several studies have attempted to quantify the relationship between body roll and the underwater actions of the swimmer’s arm, shedding some light on the possible links between body roll and propulsion. The implications of this research for coaching will be discussed.

It seems likely that body roll would have a considerable influence on the amount of hydrodynamic drag experienced by swimmers, although the precise nature of this influence is unclear. The potential links between body roll and drag will be addressed.

Swimmers can reduce the risk of shoulder impingement injury by altering their stroke mechanics. One of the most common recommendations given to front crawl swimmers that suffer from impingement syndrome is to increase the amount of body roll they use. The scientific evidence supporting the proposed link between body roll and shoulder impingement will be discussed.

KEY WORDS: body roll, performance, shoulder injury

Speaker Biography

Carl Payton is a Senior Enterprise Fellow in biomechanics based in the Department of Exercise & Sport Science at Manchester Metropolitan University, England. He is High Performance Sport Accredited by the British Association of Sport and Exercise and has been actively involved in swimming biomechanics research and consultancy for over 20 years. Since 2000, Carl has led the delivery of biomechanics support services to athletes and coaches on the British Disability Swimming World Class programmes. He has presented at numerous national and international coaching conferences and workshops. His Ph.D, completed in 1999, focussed on the relationships between body roll, upper extremity rotations and hand pull paths in front crawl swimming. He has published a number of scientific papers on body roll and its relationship with swimming performance. He has also presented on this topic at several international scientific conferences. His current interests include the use of computational fluid dynamics for performance optimisation, determining anaerobic power in swimmers, and measurement of active drag.
HOW TO START IN BACKSTROKE CONSIDERING THE NEW RULES

J. Paulo Vilas-Boas, Karla de Jesus, Kelly de Jesus, Pedro Figueiredo, Suzana Pereira, Pedro Gonçalves, Leandro Machado, Ricardo Fernandes

University of Porto, Faculty of Sport, CIFI2D, Porto, Portugal

FINA recently changed the rule that governs the starting position for the backstroke starting technique. With this change, swimmers may now decide to start with the feet emerged, which was previously strictly forbidden. This new liberalization naturally determines the rise of a new technical question for swimmers and coaches: do a starting position with the feet emerged allow a better performance, or better performance conditions for the following actions?

To our knowledge no previous scientific results are available concerning this question, allowing to support any technical decision. During this presentation we will try to deliver arguments to support a technical option in this particular topic, based on the research developed by our group, comparing the traditional starting technique with the feet immerged (BSFI), with the one allowed nowadays, with both feet totally, or partially, emerged (BSFE).

To fulfil this purpose, we studied six experienced male swimmers that maximally performed 4 repetitions of each technique over a distance of 15 meters. All performances were dual-media videotaped (50 Hz) in the sagittal plane, synchronized with kinetic and EMG data simultaneously registered. Kinetic data were assessed using an underwater force plate mounted on a special support on the wall of the pool, allowing the registration of the horizontal component of the forces exerted by the swimmers’ feet. The handgrip system was adapted to reproduce its legal position and configuration, but instrumented with a load cell (Globus, Italy) to allow the assessment of the horizontal component of the forces exerted by swimmers’ upper limbs.

Findings pointed out that BSFI was significantly faster till the 5m reference, with less muscular activity, and with a tendency to produce higher forces against the starting wall. No argument was obtained to support the use of the BSFE in swimming competitions.

KEY WORDS: swimming, backstroke start, EMG, kinematics, kinetics.

Speaker Biography

A GUIDE FOR CO-ORDINATION IN THE FRONT CRAWL VARIANTS

Ulrik Persyn & Filip Roelandt
Faculty of Kinesiology, K.U.Leuven, Belgium
Universiteit Gent, Belgium

In this presentation an interactive CDROM, describing and discussing the front crawl of high level swimmers, is introduced; more specifically several variants (e.g. 6-beat, 2-beat, 2 beat crossover) and different technique aspects. The intention is that the coach corrects the own competition swimmers and triathletes, based on a careful video observation. Therefore, only practical knowledge is collected, confirmed by expertise and applied research at the K.U.Leuven Evaluation Centre. Different variants and technique aspects are clarified by video images of recent swimmers at national level in different speeds, obtained with 5 rotating cameras from 5 points of view.

To be able to start with an Evaluation Centre, in the movement analysis of high level swimmers special attention was given to the co-ordination of the arm, leg and head movements (relative to the body) and of the body movements (relative to the water surface). Since the Olympic Games in Munich (1972), for each segment clearly delimited phases were studied in the stroke cycle of each variant. An interesting criterion for propulsion is the speed variation of the body from phase to phase. Each swimmer can feel propulsion per phase, estimated by the coach on video, from bubbles displaced backward; each swimmer can also feel the coordination, observable by the coach on video.

Although the optimal variant per distance of a swimmer could be determined from his physical profile (e.g.; body structure, buoyancy, flexibility, strength,...), each individual is advised to experiment with the different variants and technique aspects. Speed and/or economy remain the essential criterions. The body control of swimmers must thus be very adaptable.

KEY WORDS: swimming, front crawl, variants

Speaker Biography
Ulrik Persyn is Professor Emeritus, at the faculty of Kinesiology, K.U.Leuven, Belgium. He was responsible for the unit "Aquatics", the "Evaluation Centre for Swimmers" and the "Centre for Didactical Software". Since the sixties, he was responsible for the highest level of the amateur swimming coaches education. In the nineties, he organised a post-graduate coaches course, in cooperation with all the Flemish universities. In the nineties, he organised a scientific European coaches program, being responsible for the university level in the "European Network of sport sciences in higher education."
PHYSIOLOGICAL MONITORING OF SWIMMING

John Bradley

Department of Education, University College Cork

This talk will discuss the Why? What? and How? of the physiological monitoring of swimming. The goal of any support programme is to enhance swim performance. The role of an exercise physiologist and the impact of exercise physiology in that support programme can be very valuable. The talk will be very practically orientated, illustrated by examples taken from a variety of physiological support programmes including from a successful support team for swimmers preparing for the Paralympic Games in Beijing.

The presentation will start by outlining why a coach may want to include physiological monitoring in his/her swimming programme. What does a coach/swimmer do with the results of testing? The rationale behind physiological testing and why certain tests may be used in particular situations will be discussed. Examples of how the results of physiological tests can be interpreted and how they can then be incorporated into the coaching programme to enhance the preparation of swimmers will be shown.

With particular reference to the Paralympic preparation programme the talk will present how a physiologist can successfully interact with a swimmer-coach unit and how physiological results can be related to coaching objectives.

Speaker Biography

John Bradley comes from a competitive swimming background and was a member of the British and English Senior Swim Squad from 1991-1994. Originally from Darlington in the North-East of England, John was the holder of a Swimming Sports Scholarship during his undergraduate degree at Bath University (Biochemistry). He then completed a PhD in Exercise Physiology at Glasgow University. Following a number of years lecturing in Exercise Physiology and Sports Science he spent three years working with elite sportsmen and women in a number of sports at the Scottish Institute of Sport before moving to his current role as lecturer in Coaching Science at University College Cork in Ireland.
UNDERWATER DOLPHIN KICKING IN STARTS AND TURNS

Raúl Arellano
Faculty of Physical Activity and Sports Science, University of Granada, Granada, Spain

Our studies related with underwater dolphin kicking helped us to understand the complexity of this propulsive action (applying kinematic analysis and flow visualization) to develop more appropriate prescriptive information to be applied in application of this technique in the performances of national and international swimmers.

Under the rules limitations (15m), the swimmers can apply properly this technique and reduce the starting time until times close to 5 s. (considered impossible in the past). New swimsuit technology improves particularly the performance in this technique.

Some aspects need to be considered based on our research in this technique: a) when start the dolphin kick after the start or turn [how long should glide]; b) influence of the previous gliding velocity; c) undulating or oscillating; d) influence of the morphological factors; e) different models and variables to measure its efficiency; f) how long should keep the dolphin kick and; g) when to finish the dolphin kicking.

In our talk we will advise on the aspects mentioned and to show the kind of methodology we are applying to improve the use of this technique to the Spanish swimmers.

KEY WORDS: undulatory, oscillatory, vortices, body wave

Speaker Biography

Prof. Raúl Arellano is teaching “Biomechanics and Training applied to Swimming Sport” and “Analysis and Evaluation of Sport Technique”. He received his Ph.D. from University of Granada in Physical Education in 1992 studying the swimming propulsion. He became a Titular Professor (Ass. Prof.) of the previous subjects at University the Granada in 1993.

Raul participated in the Analysis of Swimming Competition International Projects developed during the 1992 and 2000 Olympic Games, 1993 FINA Short course World Swimming Championships, 2001 JOJE European Swimming Championships and 2003 FINA World Swimming Championships. Nearly three thousand participants were analyzed in those competitions, developing after these analyses statistical models of race swimming performances. This methodology was applied in Spain in 12 times extending the model to different levels of performance and ages. This work have started again this session in the Spanish Open Championships May 2009 (www.rfen.es)

He developed and directed the Biomechanics Lab (1994-99) in the Altitude Training Centre of Sierra Nevada (Granada, Spain) and he cooperated in the design of the 50m indoor swimming pool. During this period of research and advice more than five thousand swimmers were tested and evaluated from many different countries. Now he has been named biomechanics responsible of the Spanish Swimming National Team until London 2012 Olympics.
CFD AND SWIMMING: PRACTICAL APPLICATIONS

António J. Silva¹,² Daniel A. Marinho²,³

Department of Sport, Health and Exercise, University of Trás-os-Montes and Alto Douro, Vila Real, Portugal¹

Research Centre in Sports Sciences, Health Sciences and Human Development, Vila Real, Portugal²

Department of Sport Sciences, University of Beira Interior, Covilhã, Portugal³

In this presentation, topics in swimming simulation from a computational fluid dynamics perspective are discussed. This perspective means emphasis on the fluid mechanics and computational fluid dynamics methodology applied in swimming research. This talk presents new information based on recent scientific research conducted at the Research Centre in Sports Sciences, Health Sciences and Human Development (CIDESD, Vila Real, Portugal). We concentrated on numerical simulation results, considering the scientific simulation point-of-view and especially the practical implications with swimmers and coaches. Computational Fluid Dynamics has been applied to swimming in order to understand its relationships with performance. The numerical techniques have been applied to the analysis of the propulsive forces generated by the propelling segments and to the analysis of the hydrodynamic drag forces resisting forward motion.

KEY WORDS: swimming, CFD, drag, lift

Speaker Biographies:

António José Rocha Martins Silva: Ph.D. in Sports Science
Professor In UTAD, Vila Real, Portugal
President of The Portuguese Swimming Coaches Association
High level Swimming Coach
Director of The Research Center for Sports, Health and Human Development
Director of Master and Ph.D. course in Sports Science, UTAD, Vila Real

Daniel A. Marinho²
Since 2008: Teacher of the University of Beira Interior in the Sports Sciences Department.
Between 1999 and 2004 Daniel studied for a degree in Sport and Physical Education from Porto University. In 2009 gained a PhD in Sports Sciences with Distinction at the University of Alto Douro studying propulsion using Computational Fluid Dynamics. He is a swimming coach and in 2007 was nominated for Coach of the Year by the Portuguese Association of Swimming Coaches.
As coaches we have all experienced the situation where a swimmer starts making destructive or negative comments that impact their ability to perform to their maximum. Such destructive thinking is well known in psychology, for example, amongst clients who experience anxiety or are depressed. In swimmers, we hear them blaming others, feeling guilty, predicting (negative) results before they happen and exaggerating previous negative results. Furthermore, swimmers can experience a mental block in terms of how to overcome an obstacle which, in their minds, seem impossible to overcome.

In this talk I will introduce several practical tools and techniques that can be used by the coach to aid the swimmer in thinking in a constructive way. These tools and techniques have been developed in the fields of Cognitive Behavioural Therapy and within Life Coaching (sometimes referred to as Executive Coaching) and can be applied over a period of weeks or months, or at the competition site itself. By developing the practical tools that I introduce here, coaches should feel more empowered in dealing with these problems rather than feeling exasperated or annoyed at the negative thoughts of their swimmers.

**KEY WORDS:** swimmers, destructive thinking, negative thinking, cognitive behavioural therapy, life coaching

**Speaker Biography**

Brian D. Marshall has coached clubs in England, Iceland and Denmark and is the former National Team Coach for Iceland. Results include coaching Örn Arnarson to 4th place at the Olympic Games in 2000 and to silver and bronze at the World Long Course Championships in 2001. Brian has a MEd in Public Health and Education and current positions include being a lecturer at Reykjavik University, a member of the Icelandic Swimming Association's Education Committee, teaching psychological preparation for golf coaches (PGA Iceland) and providing mental support and life coaching for swimmers and adult students (in Iceland and overseas).
CORRECTING PHYSICAL AND TECHNICAL ASYMMETRIES OF SWIMMERS

Alison Fantom

Inverurie Chartered Physiotherapy Clinic, Aberdeenshire, Scotland

This talk will look at the importance of maintaining a sound postural base and its links to efficiency when in the water. The common postural habits of swimmers including typical patterns of asymmetry will be discussed and their possible impact on performance.

A case study of an Olympic swimmer will be presented with video footage of the programme she followed as she prepared for the 2008 Olympic Games in Beijing. The work with this athlete from initial screening and basic postural control through to high level challenges will be discussed. The importance of strong communication links between swimmer, coach and physiotherapist will be highlighted.

The possible implications on technique for both elite and non elite swimmers will be discussed.

KEY WORDS: swimmers, posture, asymmetry

Speaker Biography:
Alison Fantom (MCSP SRP MMACP) graduated from Queens College, Glasgow as a physiotherapist in 1980 and worked in major teaching hospitals for the first 15 years of her career before setting up her own practice in 1999. She has worked with elite swimmers for the past 6 years and following discussions with coaches developed a keen interest in the importance of postural control in the water. She worked closely with local coaches in developing an exercise programme which addresses posture and is swim specific. This programme was delivered to two elite swimmers in the 2 years prior to the Beijing Olympic Games.
How do you optimise the stroke frequency in swimming? The answer to this question is important in the pursuit of higher performances in the pool. Selecting the right stroke frequency is detrimental for an optimal performance. It should be adjusted to each individual athlete’s characteristics.

For running and cycling, we know much on energy consumption and stride frequency. In swimming though, which is a relatively new activity for humans, the optimum stroke frequency is less researched. In this lecture we will look briefly to running and cycling, and the models that explain the optimal human cadence. How these models can be transferred to swimming will be discussed. What we know from swimming studies, optimising stroke frequency for different age- and performance levels swimmers in different strokes will be reviewed. Finally, our research shows that certain stroke rate strategies seem to be ideal during a race. This lecture will examine what stroke rates strategies to choose during a race in order to win.

Speaker Biography
Per-Ludvik Kjendlie (36) has been a swimming instructor and coach since the age of 15. His experience spans from the club to national team level, and has spent several years as a National Junior team head coach and handicapped national team technique coach. After working as the technical director of the Norwegian Swimming Federation, he started an academic career at the Norwegian School of Sport Sciences with master and PhD studies in swimming, physiology and biomechanics. The PhD title was “The swimming Child: Working Economy” (2004). A strong research interest has been the differences between children and adults in swimming, problems of scaling performance parameters in swimming for size, and performance determining factors of anthropometry, biomechanics and physiology in swimming. Furthermore, Per-Ludvik has been involved in coaches’ education for the Norwegian Swimming Federation for many years. Currently he is working as the associate professor in charge of aquatic activities at the Department of Physical Performance, Norwegian School of Sport Sciences. Per-Ludvik Kjendlie is a co-chairman of the 11th International symposium for Biomechanics and Medicine in Swimming, Oslo 2010.
SPRINT AND DISTANCE SWIMMERS: THE SAME ANIMAL?

Carla B. McCabe

Centre of Aquatics Research and Education, University of Edinburgh, Edinburgh, Scotland

In this talk the techniques of sprint and distance swimmers are discussed with a view to informing coaches of the similarities and differences between these groups. In the past it has been reported that sprint and distance swimmers are different in several aspects of technique. However, previous comparisons were at the respective race pace and sprint and distance specialists have not been compared when swimming at the same pace. Therefore it is difficult for coaches to know whether to teach the swimmers the same way when developing good technique.

This talk presents new information based on recent scientific research conducted at the Centre for Aquatics Research and Education (CARE). The variables of interest were: average swim speed, stroke length, stroke frequency, stroke index, hand stroke pattern, foot range of motion, elbow angle, shoulder and hip roll angle and stroke phase durations. Interesting and unexpected findings emerged that have implications for the way specialist sprint and distance swimmers should be coached.

KEY WORDS: swimming, distance, specialisation, sprint

Speaker Biography

Carla graduated from the University of Limerick (2003) with her first degree in Sports and Exercise Science. Under the supervision of Prof. Ross Sanders Carla completed her PhD at the University of Edinburgh (2008), entitled: ‘Effect of 50m and 400m race paces on three-dimensional kinematics and linear kinetics of sprint and distance swimmers’.

During her time in Edinburgh Carla has worked at the Centre of Aquatics Research and Education (CARE) providing biomechanical support to elite and non-elite swimmers and producing research publications.

Carla has a rich sporting background. Her primary sport is swimming, which she successfully competed at a national and international level representing both her province and country for over a decade. Carla also competed successfully at national and international level in athletics, triathlon, volleyball and rugby.

Carla has been heavily involved with teaching swimming to both adults and children for over a decade and has gained coaching qualifications in diving, aqua-fit, leprechaun rugby, Gaelic football, athletics and volleyball.
Recognising the need for a strong sport science support system, a programme of biomechanical support was set up by Swim Ireland (the Irish Swimming Federation) in 2006. This programme, which forms part of a larger overall inter-disciplinary sport science and medicine service, aims to provide a comprehensive level of biomechanical support for Irish high-performing swimmers and their coaches to enhance performance at elite level. At the centre of the biomechanics programme is the swimmer-coach unit; their performance needs are critical. The scientist’s role is to provide the coach with useful, user-friendly and objective evidence upon which the coach can make effective informed training decisions. Both qualitative and quantitative biomechanical assessment techniques are used to analyse swimmers in training and competition, which typically require the use of above and below water digital video recordings. Suitable intervention strategies for modifying swimming techniques, where necessary, can then be implemented and regularly monitored for effectiveness. The aim of this presentation is to provide an overview of the biomechanics support programme being provided to elite Irish swimmers and their coaches, with particular reference to: 1) competition analysis; and 2) two-dimensional video analysis. Such examples encourage the use of evidence-based coaching.

**KEY WORDS:** swimming, biomechanics, competition analysis, video analysis, feedback

**Speaker Biography**
After representing Ireland internationally at junior, intermediate and senior level in swimming, Conor graduated from Nottingham Trent University in 1998 with a BSc (Hon) in Sport (Science and Administration) and from Loughborough University in 2004 with a MSc (with Distinction) in Sport Biomechanics. Since 2006, Conor has been working with Swim Ireland (the Irish Swimming Federation) and the Paralympic Council of Ireland, providing biomechanics support to their swimmers and coaches. Before this, Conor worked with British Swimming providing biomechanical and physiological support to elite swimmers. Conor’s research is particularly focused on how swimming technique is modified as a consequence of fatigue or physical impairment. Conor is currently investigating the biomechanical characteristics of highly trained swimmers with a single-arm amputation. This work is in collaboration with colleagues at Manchester Metropolitan University and the Katholieke Universiteit Leuven and is supported by British Disability Swimming. At present, Conor works as a Senior Lecturer in Sport Biomechanics at the School of Science and Technology, Nottingham Trent University and is a Professional Member of the Irish Institute of Sport.
LAND TRAINING FOR SWIMMING

Neil Donald

Lead Strength & Conditioning Coach for Swimming
SportScotland Institute of Sport and Stirling Intensive Training Centre (ITC)

This presentation looks at the role land training plays in the physical preparation of swimmers for performance, covering the following areas: identification of postural dysfunction and compensation patterns, effects it has on the swimmer on land and in the water, strategies to correct these patterns and in turn reduce injury potential and improve performance.

The aim of the presentation is to give coaches practical information they can take away and apply immediately within the various aspects of their land programme to enhance performance and reduce injuries through exercise modifications and training strategies.

Speaker Biography
Currently Strength & Conditioning Swimming Lead for Sport Scotland Institute of Sport and also for Stirling Intensive Training Centre (ITC) co-ordinating and delivering strength and conditioning support to all high performance swimmers in Scotland. Prior to this role worked for Tayside and Fife Institute of Sport for 5 years delivering strength and conditioning support to athletes in a wide range of sports and also was consultant to Sport Scotland on establishing strength & conditioning programme for the Sport Scotland Academy Programme.
Determining training intensities is a real challenge for a swimming coach because of the few physiological variables measurable on pool-side. The use of blood markers such as lactate can help in the assessment of a swimmer’s aerobic endurance through the identification of a lactate threshold although a) blood sampling is not necessary an option and b) lactate threshold is such a low intensity (maintainable for hours) that it is not necessary very pertinent for setting training intensities. Similarly, performances over long distances (2-km or 3-km time trials) have been suggested to help defining training intensities but have their own limitations (pacing issues; physiological meaning).

This talk will focus on the critical velocity concept, which in swimming research, and since the early nineties, has been suggested to be a valuable tool to assess aerobic endurance. A stop watch is the only equipment required to determine a swimmer’s critical velocity. The method relies solely on the measure of two or more performances (from 3 to 15-20 min) from which a distance vs time relationship is plotted and modelled using a 2-parameter model (y=ax+b). The slope of this relationship (a) is recognised as critical velocity, an intensity a swimmer would maintain, in theory, indefinitely. In reality, critical velocity can be sustained for around 30 minutes.

This presentation will focus on the latest findings on critical velocity and the reasons why it can be seen as an attractive tool to set training intensities. Critical velocity will be compared with more classical “thresholds” and the findings will lead the audience to consider their own ways of setting their aerobic training zones. Some concepts such as aerobic power and capacity will be challenged in an attempt to gain an appreciation of the physiological mechanisms behind swimming endurance.

**KEY WORDS:** training zones, exercise tolerance, endurance

**Speaker Biography**

Jeanne Dekerle completed her BSc, MSc and then PhD at the University of Lille 2, France (1995-2003). Her academic curriculum combined Sports and Exercise Science and Physical Education with a particular insight into swimming biomechanics, physiology, teaching and coaching. Alongside her MSc, Jeanne followed a 2-year training program to become a swimming coach (Equivalent of level 3 ASA coaching qualification).

Jeanne has been teaching and then coaching swimming for several years in France. She was involved in the regional swimming squad as a coach providing sports science support as well (Region Nord Pas-de-Calais), before being recruited at the University of Brighton, United Kingdom (2004). She is today Head Coach of the Eastbourne Swimming Club and works on the club’s teaching and coaching framework.

Jeanne’s research work is mainly on the concept of endurance with a particular interest in the physiological mechanisms explaining fatigue within the wide range of swimming speeds. The several scientific and more applied articles Jeanne has so far published on the critical velocity concept demonstrates her wish to make her research work useable for coaches and swimmers. Jeanne continues her work in swimming physiology within her Lecturing position as a Sports and Exercise Physiologist, University of Brighton.
In this talk the inter-limb coordination of elite and sub-elite swimmers are discussed with a view to informing coaches of the similarities and differences between these groups. In the past it has been reported that the inter-limb coordination should show an opposition mode, i.e. a propulsive continuity between the propulsion of one limb and those of the other limb, in order to minimize the intra-cyclic velocity variations. However, the research of our centre of research highlighted the fact that the inter-limb coordination mode adopted by the swimmers corresponds to three types of constraint defined by Newell (1986): organismic, task and environmental constraint. The skill level of the swimmers, the specialty, the gender, the handedness and the breathing laterality act as organismic constraints; the imposed race pace, the stroke frequency, the number of strokes, the breathing frequency and pattern could be consider as task constraints while the active drag and his correspondent velocity relate to the environmental constraints. Inter-limb coordination was found to vary from catch or glide coordination mode to superposition mode, showing that the opposition mode is only the best “theoretical” mode and the glide mode is not a technical mistake. Therefore it is advised for coaches to don’t consider an ideal coordination mode in the absolute but to teach the swimmers in different ways when developing coordination.

This talk presents new information based on recent scientific research conducted at the CETAPS. The variables of interest were: average swim speed, stroke length, stroke frequency, intra-cyclic velocity variations, breathing laterality, relative duration of arm and leg stroke phases, time gap between propulsive actions assessed by total time gap (TTG) in the simultaneous strokes and by index of coordination (IdC) in the alternate strokes.

Interesting findings emerged that have implications for how both elite and sub-elite swimmers should be coached.

**KEY WORDS:** swimming, coordination mode, constraint, intra-cyclic velocity variations.

**Speaker Biographies**

**Didier Chollet**
Professor of the University of Rouen in France since 1999 (previously 20 years in University of Montpellier). Director of Rouen Sport Science Laboratory: UPRES EA 3832 “Centre d’Etude des Transformations en APS” Head Coach of National French University Swimming Team before 1985: Universiades of Kobe (Japan, 1985), Sheffield (U.K., 1991), Buffalo (USA, 1993), Fukuoka (Japan, 1995), Sicilia (Italy, 1997), Palma (Spain, 1999), Beijing (China, 2001), Daegu (Korea, 2003), Izmir (Turkey). His research interests are in Motor Control and Applied Biomechanics on Performance with the major themes being: Swimming Coordination, Skill Acquisition and Feedback.

**Ludovic Seifert**
Ludovic Seifert is assistant professor at the faculty of sport sciences at the University of Rouen in France since 2004. His Ph.D. completed in 2003 focused on the “Flexibility and stability in front crawl coordination: biomechanical and dynamical approach”. He has published around 40 scientific papers and has authored five book chapters on inter-limb coordination in swimming in relationships to different constraints, such as organismic, task and environmental constraints. Dr. Seifert’s Ph.D students are currently exploring the relationships between inter-limb coordination and the mechanical and energetic costs.
SUCCESSFUL INTERVENTIONS FOLLOWING ANALYSIS

Bruce R. Mason

Aquatics Testing, Training and Research Unit, Australian Institute of Sport, Canberra, Australia

Of all sports, swimming is probably the most challenging to provide biomechanical analysis that will result in improved performance. The three main reasons for this are: biomechanical equipment will not perform well or possibly even survive for any length of time in an aquatics environment; in free swimming, propulsion occurs as a consequence of the swimmer’s body reacting with water, which makes the measurement of force almost impossible; because swimming occurs at the interface between water and air it is difficult to capture data from measuring apparatus and provide immediate feedback to the swimmer. Consequently, much of the technique analysis in the sport generally involves video cameras to obtain footage of the swimmer’s performance. As a consequence of such video usage, both biomechanists and coaches often rely upon subjective analysis based on just moving images to provide advice to the swimmer. If it looks good and fits the mould it must be good.

At the Australian Institute of Sport, the Australian government has invested in an aquatics testing, training and research centre. The centre was opened in 2006 at a cost of AUD17million. Purpose built analysis systems have been developed to provide immediate feedback to swimmers and coaches concerning performance. Here the biomechanists operate the analysis systems and the coaches are encouraged to provide the feedback to the swimmers on pool deck. As well as provide a high quality image of the performance, the analysis systems also provide quantitative parameters to objectively assess the performance. Information such as the magnitude and the direction of forces generated by the swimmer, the velocity of the swimmer at various stages of performance, the angles of movement of the swimmer’s body and the times taken to reach various points in the activity are provided so that objective assessment may be made to evaluate the performance. Here the coach can objectively identify not only if the performance has improved but also the degree of such improvement. This talk will focus on technique inefficiencies that have been disclosed in Australia’s top swimmers and how they were dealt with using the analysis systems available at the institute.

KEY WORDS: swimming, technique, analysis, biomechanics, performance

Speaker Biography

The combination of a physical education teacher together with a science degree from Sydney University in mathematics and a doctoral degree in Biomechanics from University of Oregon. Bruce worked as a biomechanics lecturer for several years at Wollongong University before coming to the Australian Institute of Sport to head up the Biomechanics Department He was in this position until 2006. Bruce’s major emphasis at the A.I.S. has been with swimming, providing biomechanical support throughout that period to the A.I.S. Swimming Programme as well as to the Australian national team from the early 1990’s through until 2002. As recognition of his work in the Biomechanics of Swimming Bruce was awarded the major award of the International Society of Biomechanics in Sport, “Geoffrey Dyson Memorial Lecture” in 2000 at the annual conference of the society in Hong Kong. He was also awarded major recognition awards from the Australian Swim Coaches and Teachers Association in 1999, and 1998. Bruce has in January, 2006, taken over the reins of the Aquatics Testing Training and Research Unit at the Australian Institute of Sport which utilises a new $17million investment by the Australian government in an Aquatics laboratory comprising a 50m, 10 lane Olympic pool which is 3m deep and full of biomechanical equipment to assist swim coaches.