2ND WORLD CONGRESS OF CYCLING SCIENCE

2nd & 3rd July 2014, Leeds, UK

Delegate Programme
Dear Delegates,

It is a great pleasure to welcome you all to the 2nd World Congress of Cycling Science. We are pleased to see so many of you joining us from all parts of the UK, as well as mainland Europe and from further afield.

We are situated at the magnificent Rose Bowl in Leeds. The Congress has been organized and sponsored by the School of Sport and Exercise Sciences at the University of Kent. Over the past 10 years we have established a national and international reputation for the quality of our academic programmes and applied research on endurance exercise performance. Many staff and students are involved with applied sport science, both as researchers and practitioners both in the UK and around the world.

As the Congress coincides with the Grand Depart, the theme is the science behind the Tour de France. The conference is endorsed by the Union Cycliste Internationale (UCI) and aims to bring together coaches, sports scientists, medical practitioners, students and researchers to share knowledge from the world of cycling science. The conference will integrate the various aspects of coaching, sports science, medicine, technology and performance to provide a forum for the discussion of performance enhancement with a focus on the Tour de France.

We hope you have a wonderful time and that you find the Congress challenging, thought provoking and inspiring.
USEFUL INFORMATION

Registration
The registration desk will be located on the Ground Floor of the Rose Bowl. It will be open from 08:00-9:30 on both Wednesday 2nd and Thursday 3rd July.

Congress catering
All catering provided as part of the Congress on site (not including breakfasts) will be on the Ground Floor of the Rose Bowl near the food court area, on production of your Congress name badge. Congress catering includes coffee and lunch on both Wednesday and Thursday.

Congress dinner
The Congress dinner is at 7pm on Wednesday 2nd July. If you would like to attend the dinner and have not yet booked a place, please contact the Congress Registration Desk.

Speaker Ready Room
The Speaker Room is located in Room 216 so that presenters can check their slides prior to their presentation. This can be done between 8 and 10am on both days of the Congress.

Taxis
If you need to hire a Taxi whilst in Leeds there are two main companies; Amber Taxis: 0113 231 1366 and Arrow Taxis: 0113 258 0606.

Wi-Fi access
Wi-Fi access is available throughout the Rose Bowl. To gain Wi-Fi access, search for available wireless networks within range, select “Visitor Wi-Fi” and click connect. The network will issue a network address to your laptop or mobile device. It should then say connected. Next, open your web browser, you should then be directed to a University Wireless Portal. Enter your email address in the top left of the page, accept the terms and conditions then click “Login”. You will be directed to the www.leedsmet.ac.uk/wireless webpage. You should now have internet connectivity.

Fire alarms
There is a short alarm test that lasts about 5-10 seconds every Thursday in the Rose Bowl any time between 1-3pm, but does not require an evacuation unless it is prolonged. If you hear a fire alarm sound for a prolonged period, please leave the building in a calm and orderly fashion, and you will be guided to the nearest Fire Assembly Point which is located in the car park on Level 2.

Social media
During the Congress we would encourage delegates to connect via Twitter using the hashtag #wcss2014. There will also be a Twitter feed board in the Exhibition hall for Congress information.

Public symposium
On the 3rd July we are hosting a free public open symposium titled “The Science of Cycling Performance 2014: The Tour de France.” Professor Louis Passfield hosts an evening of debate that looks at the research that lies behind success at the Tour de France. Recently retired world-class cyclist Marco Pinotti will join panellists, Dr Mikel Zabala (Movistar Professional Cycling Team) in discussing how to enhance elite cycling performance, and Professor Yannis Pitsiladis in exploring the question as to whether Tour de France riders are born or made. Dirk Friel from TrainingPeaks will discuss evolution of power measurement in cycling and look at where developments are still being made. Finally, Dr Simon Choppin will lead discussions on the role of biomechanics and aerodynamics in the quest to develop the ultimate time trial performance. If you would like to attend this event and have not registered in advance, please enquire at the Congress Registration desk.

Other queries
If you have any queries or questions related to the Congress that are not answered by the information in this delegate pack please ask at Registration Desk.

wcss2014_leeds
wcss2014
The Congress is organized by the University’s School of Sport and Exercise Sciences, which was established in 2001. The School is the University’s fastest-growing research school with an international reputation, in particular for its research on endurance. Our research is grouped into two areas: the Endurance Research Group, and the Sports Therapy, Physical Activity and Health Research Group. Both of these research groups are multi- and inter-disciplinary, and include PhD students, research staff, and technical staff as well as academic staff. The Endurance Research Group advances knowledge on endurance exercise, training and performance, not just for traditional endurance sports such as road cycling and distance running, but also for any aspects of human performance in which resistance to fatigue is important. Members of this research group have conducted research on the psychobiological, neuromuscular, thermoregulatory and bioenergetics aspects of exercise tolerance, pacing, cycling efficiency, and sport nutrition. They have also developed innovative training methods to reduce mental fatigue in soldiers and endurance athletes, and novel testing protocols to measure maximal oxygen consumption.

Sponsors and exhibitors
We are grateful to the sponsors and exhibitors who have supported us with the conference. All exhibitor stands can be found in the Exhibition area on the Ground Floor of the Rose Bowl for the duration of the conference.

Sponsors

L’Union Cycliste Internationale (UCI) is cycling’s International Federation recognised by the International Olympic Committee (IOC). The UCI administers and promotes the development of the eight disciplines of cycling. The UCI’s mission is to develop and promote cycling, in close collaboration with National Federations.

Bloomsbury Publishing represents the best in cycling books. From the iconoclastic training programmes of Graeme Obree to our step by step road bike manuals, we cover all forms of cycling. We are proud publishers of Rouleur books.

British Cycling is the national governing body for cycling as recognised by the UCI – the international federation for the sport.

Sport Service Mapei was founded to support the athletes of the Mapei professional cycling team, through scientific reason and a precise ethical approach.

Publisher of over 1,800 journals and 2,500 new books each year in association with 500 society and university partners worldwide, from 20 global offices.

TrainingPeaks provides the complete web, mobile and desktop solution for enabling smart and effective endurance training.

Exhibitors

HaB Direct personally select suppliers of bestselling and cutting-edge products, devices and equipment from across the world.

POWERbreathe is an Inspiratory Muscle Trainer, exercising and strengthening the muscles we use to breathe.

Premier suppliers of medical diagnostic and physiological testing equipment. Sole UK agents for Woodway Treadmills.

For more than 40 years sports medical scientists, sports physicians and top-class athletes rely on the innovative strength of the Cyclus2 in performance diagnostics and training.

PowerBar is one of the world’s leading manufacturers of high-quality sports nutrition.

Cadence is a cycling performance centre located in South London and we offer a range of services to help riders perform more effectively. Our services include bike fit, pedal stroke analysis, fitness testing and coaching and we work with a range of clients from complete beginner to competing athletes.

The secret to ultimately improving performance, health, and development lies within our ability to collect data which is relevant, analyse it effectively, and use it to guide our actions and decisions in the future. In SMARTBASE you can store all of your data, and bring it to life with simple yet powerful reports which truly explain the whole story.
PRESENTATIONS

Oral presentations
Before the session
Please locate the room where you are will present well in advance of your session (see detailed presentation information below) and familiarise yourself with the layout. The oral presentation file format will be Microsoft PowerPoint.

Please be aware that your PowerPoint presentation needs a 4:3 slide format to use the full screen capacity available onsite. The 16:9 slide ratio format should be perfectly acceptable but may not fill the entire screen.

Please upload your presentation prior to the Congress, which will be on the Congress server ready for you to present. If you have not done this, please notify a Congress Volunteer as soon as possible prior to your presentation.

Once at your presentation room please check that the file is available on the PC and that it is showing correctly. Note that you will not be able to present using your own laptop computer.

Please introduce yourself to the Chair in your presentation room at least 5 minutes before the session starts. There will also be a Congress volunteer in the lecture room to help you with logistics, IT and timing of your presentation.

During the session
The Chair will introduce you and call you to speak.
Please practice beforehand to ensure that you do not exceed the maximum time available for your session of 10 minutes. There will be time for a brief discussion of up to 5 min after your talk.
A Congress Volunteer will show a yellow card at 8 minutes and a red card at 9 minutes, in order to guide you with the timing of your presentation. In order to be fair to all presenters and the audience the chair will follow the specified timetable strictly.

Poster presentations
Poster sessions will take place in the main Exhibition area on the Ground Floor of the Rose Bowl from 12.45-13.30 on both days of the Congress. On the day of presentation, please be present at your poster board for the whole 45-minute period. Please ensure that your poster is displayed in its location from 9am on the day of your presentation.

All poster boards are numbered, and presenters should ensure that their poster goes on the correspondingly numbered board (check information in the detailed programme on page 18).

Presentations should be taken down at the end of the day if you do not want it to be discarded.
KEYNOTE PRESENTATIONS

Charly Wegelius (Garmin-Sharp Sporting Director)
Can Sport Science help make race-winning decisions?
Wednesday 2nd July
Lecture Theatre A: 9.30-10.00

Science has become a key component in professional cycling, from the development of training methods and monitoring of physical condition, to directly influencing race tactics.

As a sports director Garmin Sharp*, one of the world’s most innovative and advanced professional cycling teams, I am constantly looking for the advantages that can be found through the use of science and technology. In my presentation I will outline the ways in which I use sports science in this role. These topics will include: How we gather power data from training tools to accurately gauge riders’ condition before events, and how this allows me to make informed tactical decisions prior to the event. For example, weather and wind analysis, and how the collation of this data can help us predict with reasonable accuracy the influence that weather conditions are likely to have on events such as time trials, where changing conditions over a period of a number of hours can have a major effect on race outcome. I will also discuss how we analyse a rider’s position to ensure they are set up in the optimum position for maximal power output and aerodynamics. I will highlight the use of sports science to gauge the correct choice of materials in any one given event, where we use data based on a riders power and weight, and the particulars of the race route to determine which type of bike and wheels will be best suited to the rider on the day. Finally, I will conclude by explaining the importance that I put on an ability to combine this sports science knowledge with other non-sports science skills such as personal insight, and acquired knowledge (or instinct), to make sure that the benefits of sports science can be applied on a practical level.

Ross Tucker (University of Cape Town, Cape Town, South Africa)
Fatigue, pacing strategy and the limits to performance
Wednesday 2nd July
Lecture Theatre A: 10.30-11.00


In this regard, pacing strategy can be thought of as a budgeting decision, by means of which an exercising athlete makes decisions about how best to ‘spend’ physiological capital while accumulating the ‘costs’ of the exercise exertions. The optimal pacing strategy is influenced by exercise modality and exercise duration, with all-out, positive strategies optimal for short duration exercise, while longer durations are characterized by even or negative splits, and an endspurt which reveals the presence of a motor unit reserve (Tucker & Noakes, 2009: Br J Sports Med, 43, e1. doi: 10.1136/bjsm.2009.057562). In this regard, performance under various conditions has been shown to be limited or regulated by factors including, but not limited to: the depletion of energy reserves, the accumulation and storage of heat, accumulation of metabolites and resultant afferent feedback, cerebral oxygen delivery, anticipation of exercise duration, and a range of psychosocial factors related to motivation, mental performance and reward (cost-benefit decisions) (Amann et al 2006: J Physiol, 575, 937-952; Tucker, 2009: Br J Sports Med, 43, 392-400; Billaut et al 2010: Acta Physiol, 198, 477-486; St Clair Gibson et al 2013: Sports Med, 43, 413-424). Fatigue, and therefore the regulation of pacing strategy, are thus complex phenomena that include both central (neural), peripheral and psychological factors. Appropriate pacing strategies require the integration of various afferent information to regulate efferent motor command, with knowledge of the endpoint of exercise an anchor against which pacing strategy “decisions” can be made.

This presentation will explore these complex interactions, introducing the broad and somewhat unnecessarily polarized models for fatigue, and expanding these into a practical understanding for the limits to performance, including discussion of the two-hour marathon and the extent to which human performance can continue to evolve and improve.

Peter Hespel (Exercise Physiology Research Group, Department of Kinesiology, KU Leuven, Belgium)
Extreme Nutrition: Grand Tour Cycling
Wednesday 2nd July
Lecture Theatre A: 11.30-12.00

In one-day races high-dose carbohydrate intake before and during the event is sufficient to support optimal race performance. Energy (kcal) intake per se is not a critical issue. Conversely, the extreme physiological stress induced by grand tour cycling is a permanent challenge to the energy status of the riders. They risk to develop a growing energy deficit, which eventually translates into a catabolic state and body weight loss from day to day. Even if carbohydrate intake during (90g per hr) and between (12g/kg b.w. per day) stages is maximized, this will deliver no more than 5,000 – 5,500 kcal per day at best, which is still far below the daily energy expenditure (6,000 – 9,000 kcal per stage). Hence besides carbohydrates, high-rate protein intake (2-3g/kg b.w. per day) and even extra fat intake are needed to maintain sufficient energy availability. In addition, during strenuous mountain stages in the heat, euhydration often requires to consume >10L of water per day. Taken together, the nutritional challenge inherent to grand tour cycling is enormous, and especially the initial 4-6 hours following each stage are crucial to recovery. Well-structured nutritional interventions must be installed to adequately promote muscle glycogen reloading and protein synthesis, restore the body fluid and electrolyte balance, and stimulate energy intake per se. However, eating comfort is often impaired due to post-arrival press and commercial events, travelling between stages, and last but not least loss of appetite due to physical and mental exhaustion and incidence of gastrointestinal symptoms. Therefore, dietary programs designed for grand tour cyclists must be functional and delicious at the same, which makes ‘The Kitchen’ to be a key-factor in team success.
Ulrich Schroberer (SRM)  
Nicolas Roche (Tinkoff-Saxo Professional Cycling Team)  

**The Use of Power Meters in Professional Cycling**  
Session Sponsored by SRM  

**Thursday 3rd July**  
**Lecture Theatre A: 9.00-9.30**

As a junior and amateur cyclist since the age of 15, I always focused to make my training and race preparation as perfect as possible. At the age of 19, I started an engineering degree at Fachhochschule Aachen focused on Biomedical Engineering. With bike races every weekend and not too much spare time during the week to spend all day training on the bike, I wanted to make the training as efficient as possible. With the knowledge I had reading all the training books available at the time, I came to the conclusion that to improve my performance, I would have to measure my Power output on my bicycle during my daily training.

I had the idea in 1986 to create a PowerMeter for my bicycle. After testing and analyzing various locations, I determined the optimal location to measure Power was between the axle and chainrings. Torque was measured with the help of strain gauge measuring the deflection of bending elements between the axle and chainrings. Cadence was measured with reed switches, and the signal from the turning crank was transmitted to the frame inductively. This enabled me to measure the total Power (Angular velocity x Torque) of both legs without loss. The bigger challenge for me after this was to have a device on the bike that displays and stores this data. In addition, the heart rate, cadence and speed needed to be in a format that allowed a later evaluation on a personal computer.

In 1988, I finally had a bike computer ready that allowed me to display and store all the relevant data while training outdoors. I named this computer the PowerControl. In 1990 I had the privilege of working with the German Federation, whereby I was responsible for collecting training data for their endurance track athletes, analyzing and interpreting the data to develop and monitor their training. As an engineer, the feedback I received at this time was priceless. I was working with the world’s best athletes, trying to make the best training tool for them, and in exchange, I got very good feedback. Not so long after this, the positive benefits of using a PowerMeter as a serious training tool spread among cycling professionals who believed in serious training. Some of the first well-known users of the PowerMeter were Greg Lemond, Chris Boardman, Gianni Bugno, Team Telekom and many national cycling federations.

Currently, there are many rival companies that produce power meters, however, I am very fortunate to possess more than 27 years of knowledge and experience. It is these assets, along with my passion, that led me to create the very first PowerMeter, are the basis upon which each new product is developed. Now, if a cyclist is serious about training and optimizing performance, achieving one’s best without a PowerMeter is not possible.

Dr Mario Zorzoli (Union Cycliste Internationale (UCI), Aigle, Switzerland)  

**Riders’ health protection programme**  
**Thursday 3rd July**  
**Lecture Theatre A: 9.30-10.00**

Health protection of athletes has been a priority for the Union Cycliste Internationale (UCI). Its actions in this regard have relied on three main pillars: prevention, education and fight against doping. Already in 1997, UCI and cycling stake-holders have decided to introduce two innovative preventive measures to protect riders’ health: the health blood tests and the medical monitoring program.

The former consisted in collecting blood samples on the morning of a race day, analyzing them on site and preventing form competing those riders whose blood parameters were beyond the established limits. From 2008, this program has been replaced by the Athlete Biological Passport. The latter, which is still in force and concerns the professional road riders and the top athletes of the Olympic disciplines, is based on annual health checks, with cardiac and biological evaluations. UCI is also going to publish in 2015 new medical rules that will special emphasis will be put on the medical assistance to provide in competition.

In terms of education, the efforts have continued in informing athletes on the risks of taking nutritional supplements and injections of iron, when it was realized that riders abused of it and showed extremely high values of ferritine. Another significant educative measure has been the introduction of the No-needle Policy in 2011. Finally, concerned by the large use of Tramadol by some athletes, in 2011 UCI had requested WADA to add this substance to the Prohibited List. As a consequence of this, WADA agreed to add Tramadol to the 2012 Monitoring List.

CONTINUED OVERLEAF
Inigo Mujika (University of the Basque Country, Spain)
A scientific approach to training and tapering for road cycling events
Thursday 3rd July
Lecture Theatre A: 13.30-14.00

Road cyclists use various periodized training approaches to achieve fitness and performance peaks. Traditional periodization imposes the impossibility to achieve multiple performance peaks. Alternative periodization models such as integrated macrocycles and block periodization can be used, but generic training methodologies may not be appropriate for road cyclists and a sensitive and responsive learning systems should be implemented to optimize performance.

High training volumes and a polarized intensity distribution contribute to success in road cycling, but optimal performances are usually attained by intertwining lengthy phases of intensive training and shorter phases of tapered training before a major race. The taper should diminish residual fatigue induced by intensive training and maximize physiological adaptations and performance. Performance is usually maximized by a taper lasting two weeks, where the training volume is exponentially decreased by 41-60%, but training intensity and frequency are maintained, but sport specific and individual variability exist.

Mathematical models of the effects of training on performance have contributed to establish the optimal taper duration and the suitability of progressive versus step tapers, and to assess optimal taper characteristics, predict performance outcomes of functional overreaching prior to the taper and design innovative tapering strategies. Tapering-induced performance gains, attributed to increased muscular force and power, improvements in neuromuscular, hematological, and hormonal function, and psychological status of the athletes, are usually in the range of 0.5-6.0% for competition performance measures. Nutrition and environmental factors like travel across time zones, heat and altitude may interfere with an athlete’s taper in preparation for international level competition.

David Martin (Australian Institute of Sport)
Winning the Tour de France: Does it need a sport science perspective?
Thursday 3rd July
Lecture Theatre A: 17.00-17.30

Numerous scientific papers have addressed important aspects of “elite cycling performance”. Popular questions underpinning practice tend to address topics such as demands of competition, environmental physiology, ergogenic aids, recovery and resistance training. Creating an environment where professional cyclists and their directors believe winning is inevitable is not an easy job, especially when elite cyclists are required to frequently cope with significant losses. Many cycling teams believe that employing sport scientists is a pre-requisite for success. As sport scientists work to establish program direction and training methodology that is considered “state-of-the-art”and “evidence-based”interesting aspects of this relatively new profession (elite sport advisor) are being discussed. For those scientists lucky enough to work with a Tour de France champion it can be useful to reflect on relationships, emotions and belief as well as the technical aspects of training composition and cycling equipment choices. Our laboratory has presented physiological data from a Tour de France Champion documenting that peak oxygen uptake and corresponding power output expressed per kg body mass were exceptional in this cyclist. However, absolute oxygen uptake (L.min⁻¹), corresponding power output in Watts and cycling efficiency were not unique compared to other national team cyclists. When compared to another popular 7-time winner of the Tour de France, neither gross efficiency (%) or delta efficiency (%) improved from age 18-24yr.

Implementing scientifically supported strategies may be most effective when financial status, political support and team culture are considered. Interestingly, good coaches often display many of the attributes of a good scientist as they work in an environment where understanding what is required to win is highly valued.
The limits to exercise tolerance: mind or muscle?

SM Marcora & M Burnley
Endurance Research Group, School of Sport and Exercise Sciences, University of Kent, UK.

Wednesday 2nd July
Lecture Theatre A: 10.30-11.30
Sponsored by University of Kent.

The ability to sustain aerobic exercise for prolonged periods of time (exercise tolerance) is an important determinant of performance in cycling and other endurance sports. For over a century, physiologists have tried to understand what limits exercise tolerance. However, no single physiological factor has yet been identified as the cardinal “exercise stopper” in healthy humans [Gandevia, 2001: Physiological Reviews, 81(4), 1725-1789].

Mark Burnley will argue that during voluntary exercise in humans, no single limitation to exercise tolerance can be identified. He will demonstrate that muscle energy supply and utilization plays a major role in determining the relationship between power output and tolerable exercise duration in a variety of exercise models. Exhaustion, or more specifically task failure, can occur because the neuromuscular system fails to provide the required power output even though the subject is motivated to continue the task.

Samuele Marcora will argue that neuromuscular fatigue does not cause exhaustion during aerobic exercise in humans, and that there is a single factor limiting exercise tolerance in highly motivated individuals (Marcora & Staiano, 2010: European Journal of Applied Physiology, 109(4), 763-770). This factor is perception of effort and it has been overlooked by physiologists because of its psychological nature. This new theoretical model of exercise tolerance based on perception of effort has important practical implications for training and performance of cyclists and other endurance athletes. This symposium and the ensuing debate will provide sport scientists, coaches and cyclists with the latest thinking on what limits and determines exercise tolerance and endurance performance.

Are Tour de France champions born or trained?

CP Earnest,1 CN Moran,2 Yannis P Pitsiladis3
1 Department for Health, University of Bath, Bath, UK.
2 School of Sport, University of Stirling; Stirling, UK.
3 School of Sport and Service Management, University of Brighton, Eastbourne, UK.

Wednesday 2nd July
Lecture Theatre C: 10.30-11.30

It is commonly held that ~50% the variance in performance measures can be explained by genetics. However, research into common genetic variants only explains a fraction of that belief. Thus, a gap in our understanding of the relationship between genetics and performance still exists.

In this symposium, Dr Colin Moran will examine the heritability of endurance performance based on twin studies examining the variance in performance that can be explained by genetics. He will also discuss how different genes are responsible for training response from ones native baseline ability and how natural talent is in fact your baseline genetics. His discussion will be supported by epigenetic work showing how microRNA profiles differ between athletes and non-athletes and how these profiles could aid coaches in identifying which athletes will respond to training and those who will not. Dr Moran will also discuss data on rare variants, with large effects, to help fill the gap between heritability and performance response.

Professor Yannis Pitsiladis researches the importance of lifestyle and genetics in human health and performance and will summarise the genetic literature surrounding elite athletic cohorts. He will propose that apart from the alpha actinin-3 (ACTN3) R577X and angiotensin-converting enzyme (ACE) insertion/deletion (I/D), the majority of the candidate genes identified for sport performance may be false positives, thus having limited utility. Based on his research in world-class athletes (ie Genathlete, Russian, Spanish, Japanese, USA and Jamaican cohorts) he will further discuss preliminary research findings from whole genome technology studies in these unique athlete cohorts.

Current Perspectives on Anti-doping in Cycling

YO Schumacher1 & Yannis P Pitsiladis2
1 Aspetar Orthopedic & Sports Medicine Hospital, Doha, Qatar.
2 School of Sport and Service Management, University of Brighton, Eastbourne, UK.

Wednesday 2nd July
Lecture Theatre A: 13.00-14.00

Like no other sport, cycling has been affected by doping and its consequences in the public image involving changes in media and sponsorship interest.

The session will attempt to explain some of the most advanced methods used for the fight against doping in cycling and also try to give a perspective on future developments in the area.

The first topic will be the athlete’s biological passport (ABP), a longitudinal monitoring tool of selected biomarkers that are influenced by doping and where the athlete is compared to himself to unmask suspicious variations. This technique has been introduced in 2008 and since has made its proof both as a sanctioning instrument (more than 40 athletes have been suspended) and a targeting tool improving the efficiency of conventional doping tests (the number of athletes found positive for erythropoietic stimulating agents in normal doping tests has increased by 300% since the introduction of the ABP).

In the second part, new state-of-the-art molecular (called “omics”) – based solutions are being developed that have the potential to improve the analytical performance of the ABP. In particular, studies to identify a “molecular signature” of recombinant Epo (rHrEpo) doping show promising preliminary results. The identification of a blood “molecular signature” of rHrEpo administration is the strongest evidence to date that gene biomarkers have the potential to substantially improve the analytical performance of current anti-doping methods such as the ABP. With these new analytical methods providing multiple, indirect pieces of evidence for doping offences, anti-doping will progressively adopt a forensic approach, where the direct detection of the substance becomes obsolete.
Pacing in a broader perspective: How can current views on pacing and decision-making in sports sciences assist athletes in making the right decisions in advance and during the race?

FJ Hettinga1; E Otten2; L Mauger3
1 University of Essex, School of Biological Sciences, Centre of Sport and Exercise Science, UK.
2 Faculty of Medical Sciences, University of Groningen, The Netherlands.
3 Endurance Research Group, School of Sport and Exercise Sciences, University of Kent, UK.

Wednesday 2nd July
Lecture Theatre C: 13.00-14.00

In literature, research on the complex skill of pacing has expanded over the last decades. The first studies were applied and practically relevant, aiming to determine the fastest final time associated with different strategies. Besides these experimental studies, optimal pacing was also further explored using modelling techniques, such as by using an energy flow model. Both experimental and modelling studies have led to an increased understanding of performance determining factors in pacing, relevant for performance. In addition, pacing has also been of interest from a theoretical point of view and its occurrence stresses the importance of the brain in sports. Recently, underlying mechanisms have been explored in psychology, neurophysiology and decision-making contexts, placing pacing in the broader perspective of decision making.

For this World Conference of Cycling Science, it is of course important how these theoretical contributions feed into practice. Therefore, the present symposium will aim to place pacing in a broader perspective, and answer the question: How can current views on pacing and decision-making in sports sciences assist athletes in making the right decisions in advance and during the race? Focus will lie on how modelling can be assistive for cyclists and the decisions they make in advance of the race, and on the importance of bodily sensations (such as pain) and their effect on pacing and fatigue during the race.

Anti-Doping and Cycling – Where from here?
YO Schumacher1, R Tucker2, C Wegelius3, M Pinotti4, M Hutchinson5, M Zorzoli6
1 Aspetar Orthopedic & Sports Medicine Hospital, Doha, Qatar.
2 Institute of Sports Science, University of Cape Town, South Africa.
3 Garmin-Sharp Pro Cycling Team.
4 BMC Pro Cycling Team.
5 Cycling Journalist.
6 Union Cycliste Internationale (UCI), Aigle, Switzerland.

Wednesday 2nd July
Lecture Theatre A: 14.00-15.00

In the past decades, cycling has had a number of large doping scandals which have sustainably damaged the image of the sport and affected its credibility for the public, the media and sponsors. In order to regain the lost credits, many stakeholders in the sport have developed different approaches. This symposium brings together representatives from the major players in the sport to discuss about current and future challenges and opportunities of anti-doping in cycling. Under the moderation of Ross Tucker, former professional riders and Sports directors (C Wegelius and M Pinotti), experts from the media (M Hutchinson), experts in Anti-Doping (YO Schumacher) and representatives from the governing body (M Zorzoli) will discuss various anti-doping topics such as the role of pro-teams, the athlete’s biological passport, the role of performance monitoring, sanctioning and others. The round table will also provide the audience the opportunity to interact and actively participate in the discussion.

Muscle activity and pedal forces: do they matter in cycling performance?
F Grappe1,2, W Bertucci2, S Duc2
1 Département Santé et APS, Equipe Culture Sport Santé Société, UFR UFR-Sports, Besançon, France.
2 Faculty of Sciences, Université de Reims, Champagne-Adrénne, Reims, France.
3 Professional Cycling Team FDJ.

Wednesday 2nd July
Lecture Theatre A: 15.30-16.30

Dr Duc will discuss the use of muscular activity during cycling and how it is generally assessed by surface electromyography recordings. Many factors related to the body position, the road cycling conditions and the characteristics of the chainring have been reported to change the muscular recruitment and therefore potentially could alter cycling performance. Moreover, recent works have shown that the pedalling muscular coordination depend on the level of cycling experience and the pedalling technique. The aim of this short talk is to perform a review of the main recent studies and to purpose new perspectives for future EMG works in cycling.

Dr Bertucci will discuss the effect of cyclists’ regular exposure to vibrations, which are generated by the road profile (not only on the road with cobbles). This vibration exposure can play a role in the onset of the fatigue and have several effects for the cyclists for example on the energy expenditure, on the gross efficiency, on the muscular activation, on the articular strain and on the rate of perceived exertion. These alterations can decrease significantly the performance. The vibration exposure depends on several mechanical and biomechanical variables. This exposure can be measured in the laboratory and in the field conditions. It can be modified and possibly minimised using specific frames or components of the bicycle, using specific tyre types and inflated pressure, with modification of the handlebar, and optimizing the posture.
Training and physiological assessment in cycling: the Mapei Sport experience
A Morelli, A Bosio, P Artuso
Mapei Sport, Olgiate Olona, Varese, Italy.

Dr Bosio will discuss seasonal variation of total haemoglobin mass in professional cyclists. Seasonal variation of total haemoglobin mass and the influence that training load can have has been investigated in elite athletes from different sports (Eastwood et al., 2012: Med Sci Sports Exerc, (44), 725-732). Nevertheless, it is not clear whether a similar trend is valid for a specific group of professional cyclists who ride several thousands of kilometres during the season. 

The coefficient of variation for total haemoglobin mass measures (n=171) in 19 cyclists was 3.3% (90% confidence limits: 2.9-3.8%) with a maximal and minimal absolute variation of 153 and 1 g respectively. The coefficient of variation for haemoglobin mass, VO2max and performance capacity measures (n=70) in a sub sample of 15 cyclists were 3.5, 4.3, 63.1% respectively. Seasonal variation of haemoglobin mass in male professional cyclists seems to be similar to those found in elite athletes from different sports.

Interestingly, at an individual level very large changes are present. It has been suggested that training can affect haemoglobin mass variation throughout the season however the present data suggests that training impacts upon endurance capacity to a much greater extent than haemoglobin mass and VO2max.

Dr Artuso will discuss the effects of a very low versus high cadence interval training session on the physiological response to exercise and neuromuscular function. A particular kind of low cadence interval training has been developed over the last 25 years. Contrasting results are present in the literature regarding its effects on performance (Kristoffersen et al., 2014 534 Frontiers In Physiology; Nimmerichter et al.,2012: Eur J Appl Physiol, 112 (1), 69-78). To compare two different forms of training (that is low cadence versus high cadence) we looked at the physiological and perceptual responses (HR, VO2, Lactate, RPE, tissues oxygenation and de-oxygenation) to cycling exercise and monitored the post exercise acute effects on the neuromuscular functions. Both central and peripheral assays by trans-cutaneous electrical stimulations. A group of cyclists performed, in two separate occasions, either a low (35 rpm, SFR) cadence or high (115 rpm, HC) cadence interval training (IT) sessions consisting of 8x4 min with 2 min of recovery. The two training sessions were completed at the same relative workload (W). SFR determined lower (p<0.05) physiological responses to exercise than HC but with the similar RPE. However, despite the neuromuscular function elicited by the two conditions being similar, few parameters regarding the peripheral neuromuscular properties did not fully recover 20 min after the end of the exercise in SFR. In particular the peak torque of the evoked single twitch remained lower at 20 min post training. In conclusion the SFR training induce lower physiological stress of HC but SFR may cause more neuromuscular fatigue than HC.

CONTINUED OVERLEAF
Contemporary sports nutrition in elite cycling
K Currell1, J Morton2, A Philp3, N Mitchell4
1 English Institute of Sport.
2 Liverpool John Moores University.
3 University of Birmingham.
4 Team Sky/British Cycling.

Thursday 3rd July
Lecture Theatre C: 10.00-11.00

The symposium will aim to discuss the molecular adaptation to endurance training, and how nutrients interact with the training response at a molecular level to enhance adaptation. An overview of the nutrient training interaction for endurance athletes. Traditional nutritional approaches for endurance training have typically promoted high CHO availability before, during and after training sessions to ensure adequate muscle substrate to meet the demands of high daily training intensities and volumes. However, during the past decade, it has been demonstrated that deliberately training in conditions of reduced CHO availability can promote training-induced adaptations of human skeletal muscle (ie, increased maximal mitochondrial enzyme activities and/or mitochondrial content, increased rates of lipid oxidation and in some instances, improved exercise capacity). Such data have led to the concept of ‘training-low, but competing-high’ whereby selected training sessions are completed in conditions of reduced CHO availability (so as to promote training adaptation) but CHO reserves are restored immediately prior to competition. The Tour de France is considered one of the most physically demanding of sporting events, it can be considered sequential multi day day ultra endurance event. Not only do athletes need to contend with racing unto seven hours there is long transfers between stages as well. Effective diet and nutrition are essential for the optimum performance of the riders.

Using power meters to improve training and performance
L Passfield1, M Zabala2, D Friel3
1 Endurance Research Group, School of Sport and Exercise Sciences, University of Kent, UK.
2 University of Granada, Spain & Movistar Pro Cycling Team.
3 TrainingPeaks, Denver, USA.

Thursday 3rd July
Lecture Theatre A: 11.30-12.30

In the last decade the cycling power meter has become a ubiquitous training and competition tool. The continued development of new power meters and their falling cost brings this technology within the reach of most serious cyclists. In turn the proliferation of cycling power meters and their related data provides significant challenges to the rider, coach and professional team management. At the same time, informed use of power meter data provides the opportunity to develop competitive advantages. Recent developments in website and software design mean that the management and analysis of power meter data can be performed simply and yet with more detail and sophistication than ever before.

In training the power meter is used to plan, monitor and evaluate riders’ progress and preparation for competition. Additionally, professional cycling teams and serious riders regularly use power meters to develop and evaluate racing and training strategies as well as equipment and clothing selection.

This symposium is lead by three of the world’s most experienced practitioners in working with cycling power meter data. Their three different perspectives provide examples of best practice in the use of power meters. The examples focus on the use and analysis of power meter data for training and competition for both the individual rider and in a professional cycling team setting.

Nutrition for elite cycling: from the lab to the musette
D M Bailey1, LM Burke2
1 Performance Nutrition, Nestle Research Centre, Lausanne, Switzerland.
2 Sports Nutrition, Australian Institute of Sport, Belconnen, Australia.

Thursday 3rd July
Lecture Theatre C: 11.30-12.30
Sponsored by PowerBar

Considerable scientific evidence exists that underlines the importance of effective sports nutrition to maximise elite cycling performance. The challenge for elite cyclists and their sports nutrition practitioners is to translate this body of scientific research into strategies that: i) are based on sound scientific concepts demonstrated in well designed clinical investigations, ii) can be practically achieved during training and competition, and iii) impact on performance in combination with other “non-nutritional” factors. In order to achieve this cyclist and their support teams should consider the accumulated evidence for any given nutritional strategy, to practice it during training prior to competition and acknowledge the aggregation of any performance gains from the combination of nutritional strategies alongside other technical, tactical and psychological interventions. Thus, the support teams working with elite cyclists can achieve optimal performance by assembling the equivalents of “Science + Practice + Performance effect” into nutrition strategies.

A selection of nutritional strategies based on established as well as emerging scientific research will be discussed. Specifically, the application of current recommendations for pre- and during competition energy provision with carbohydrate supplementation. Namely, the practicality of achieving intake rates >80g/h during elite cycling events by drawing on current scientific understanding of gut adaptability to as well as alternative methods to facilitate high carbohydrate intakes during competition without impairing performance. The periodization of strategies to manipulate carbohydrate availability within the training program requires a careful understanding of the physiology and psychology involved with these practices. The application of the
recently well documented ergogenic properties of carbohydrate mouth rinsing provides another example where a scientific findings can be implemented in different settings (e.g. late feeding in a long road stage, or “hands free feeding” during a shorter time-trial). An evidence-based approach to the layered use of various ergogenic aids for a specific event and according to the responsiveness of the individual rider is also important. Finally, the importance of post-event nutritional strategies to maximise recovery during multi-day stage races will be reviewed with a focus on protein type, amount and timing.

To emphasise the transition of nutritional strategies from original scientific research to applied practice, the journey from the research laboratory to the competition venue will be told from the perspective of individuals responsible for each aspect of this fundamental process.

Aerodynamics in Professional Cycling
R Ketchell¹, A Froncioni², M Patton¹, A Woolees³
1 Garmin-Sharp Pro Cycling Team.
2 Alphamantis Technologies Inc, Montreal, Canada.
3 Cycling Canada, Ottawa, Canada.

Thursday 3rd July
Lecture Theatre A: 14.00-15.00

Aerodynamics in cycling has been studied in both laboratory settings and in the field. Robby Ketchell will discuss how recently, equipment decisions in races such as the Tour de France have been up for debate due to the conflicting view on the influence of wind resistance. An on-board device called The BAT Box has been proposed to measure in field wind speed and direction as well as other techniques such as weather forecasting and data mining. In addition, the plethora of power, heart rate, and GPS data acquired during the professional racing season have shown the contributing factors in bicycle racing under different circumstances. This presentation will list the influential factors in bicycle racing and how they differ among athlete and environment, the role of aerodynamics, and the methods of making in field aerodynamic measurements.

Andy Froncioni will then present a short history on the development of a Track Aerodynamic System (TAS), and how the symbiosis of a private R&D company and a national sports organization has worked. He will present the TAS, with specific attention to the physics of velodrome bicycle dynamics and real-world measurement techniques. The system is used to measure the aerodynamic drag area of cyclists individually and in teams. A comparison of aero testing methods is presented. Sample data from a team pursuit team will be used to demonstrate the more complex abilities of the system. This will be followed by a discussion about our experiences integrating scientific test protocols and information into the daily training environment of an Olympic cycling team. Lessons learned (timing, personalities, buy-in from leadership, potential for harm, potential for benefit). How aero testing can be the key to discovering and unlocking other performance potential in athletes (i.e. bike maintenance, position).

British Cycling: Developing a winning culture
VP Webb, A Kirkland, D Readle
British Cycling, Manchester, UK.

Thursday 3rd July
Lecture Theatre C: 14.00-15.00
Sponsored by British Cycling

This symposium consists of two presentations “The Dichotomy Between Applied Sport Science and Coaching Practice” and “A Behavioural Approach to Winning” to consider how we can develop a winning culture within cycle sport in the UK. There is a common perception in coaching that there is dichotomy between applied sport science and coaching practice. While both disciplines have a common aim, to enhance sporting performance, there is a tendency to move in mutually exclusive directions. Many coaches are interested in ‘the why’s’ of sporting performance, but questions such as ‘does it work in the real world?’ and ‘how do I apply this theory to my coaching practice?’ are far more important. For sports scientists to answer such questions, they must consider adoption of models such as the Applied Research Model for Sport Sciences (Bishop, D, 2008. Sports Medicine, 38(3) 253-263). Barriers to uptake and consideration of how findings could be implemented in a sporting setting should be considered when defining the research problem. This should be done, not only through review of literature, but by engaging with expert coaches. This type of approach may challenge the perception that research findings rarely impact on coaching practice. Therefore, it is recommended that applied sports science researchers and coaches engage with each other to prioritise research questions, while considering how the answers may result in changed practice and performance enhancement.

The efficacy of any performance programme is ultimately judged on the performance of its athletes. In this regard, the Great Britain Cycling Team has delivered one of the most successful programmes in sport. At the London 2012 Olympics and Paralympics, the team won a total of 27 medals. Riders supported by the Great Britain Cycling Team have also won several Grand Tours and numerous medals at world championships. Success on such
an unprecedented scale is only possible when leaders have a clear understanding of human behaviour and behaviour management within both a team environment and on an individual basis. It requires a clear vision of ‘what the dream is’ and then brings science and coaching together to deliver it. Developing such a winning culture requires all members of the team to ‘share the dream’, in which a detailed understanding of what it takes to win is required. Interventions that benefit rather than detract from performance are considered. The dream is underpinned by an adoption of the core principles of commitment; ownership; responsibility and excellence. Psychological support within the Great Britain Cycling Team is provided by performance psychologists, using a behavioural model developed by Prof Steve Peters. This model is underpinned by science emanating from neurology, psychiatry and psychology. Whilst very complex, the success of the model is likely to be the result of theory and interventions being presented to team members in an easily understandable way, using memorable analogies. This facilitates adoption of psychological interventions that are easily adopted within day-to-day life and when performing at the very highest level in sport.

The role of strength training within endurance cycling
I Mujika¹, B Rønnestad², DT Martin³
1 University of the Basque Country, Spain.
2 Lillehammer University College, Norway.
3 Australian Institute of Sport.
Thursday 3rd July
Lecture Theatre A: 15.00-16.00

The interest of strength training for endurance cycling performance is the subject of debate among athletes, coaches and sport scientists. It is likely that resistance training for the endurance cyclist can be tolerated, promotes desired adaptations that support training and can directly improve performance. Lower body heavy strength training programmes performed in addition to endurance cycling training have been shown to improve both short-term and long-term endurance performance. Possible mechanisms for improved long-term performance include postponed activation of less efficient type II muscle fibres and improved blood flow in working muscles. Importantly, strength maintenance training is essential to maintain strength gains during the competition season. Recent studies show that competitive female cyclists with greater lower body lean mass (LBLM) tend to have higher maximum mean power (MMP) over durations ranging from 1 s to 10 min (1 kg LBLM = ~9% increase in MMP1s and ~4% increase for MMP10min). These relationships enable optimal body composition to be modelled. Eccentric cycling may also represent an effective technique for promoting cycling specific skeletal muscle remodeling, and ergometers that promote this stimulus are becoming easier to access. Single-leg cycling with a counter weight can facilitate “normal”cycling biomechanics and promotes adaptations in cycling-specific muscles with a reduced cardiovascular load. Resistance training off the bike may be particularly useful for modifying LBLM. Unique training interventions on the bike may then be used to ensure the cyclist enjoys full functionality of available muscle mass.

Respiratory muscle training for endurance cycling: past, present and future
P Brown¹, JW Dickinson²
1 English Institute of Sport, Loughborough, UK.
2 Endurance Research Group, School of Sport and Exercise Sciences, University of Kent, UK.
Thursday 3rd July
Lecture Theatre C: 15.00-16.00
Sponsored by PowerBreathe

Respiratory muscle training (RMT) has been used in some form or another since the 1960s although its adoption by mainstream endurance cyclists is far more recent due to significant advances in commercial technologies. Over the past 25 years the respiratory muscles have demonstrated a considerable influence over our exercise tolerance through their signaling of the perceptions of breathing and whole body discomfort and also through respiratory muscle fatigue. Both of these effects are attenuated following short periods of RMT (typically 4 to 6+ weeks) due to the structural and functional adaptations in this muscle group. Importantly, there is now a large body of evidence that this improves endurance exercise performance. This presentation will address the historical context of RMT, the current state of play for the application of RMT with endurance athletes and where the future lies for this ergogenic training mode.
### ORAL PRESENTATION SCHEDULE

#### Physiology 1
**Wednesday 2nd July 16.30-17.45**
Lecture Theatre A

**16.30-16.45**
Reliability of power meter calibration by mathematical modelling of treadmill cycling.
T Maier, T Steiner, S Trösch, B Müller, JP Wahlrin.
Section for Elite Sports, Swiss Federal Institute of Sport, Magglingen, Switzerland.

**16.45-17.00**
Increased physical effort overrides the potentially deleterious effects of resource depletion following self-control
C Fullerton, AM Lane, TJ Devonport.
University of Wolverhampton.

**17.00-17.15**
Differences in power output between national and club level cyclists during a new variable power cycling test
A Sharma1,2, A Sparks3, LR McNaughton2, AV Fullerton, DJ Bentley2.
1 Human Exercise Performance Laboratory, School of Medical Sciences, University of Adelaide, SA, Australia.
2 Discipline of Physiology, Australian Institute of Sport.
3 Dept of Sport and Exercise Science, University of Wolverhampton.

**17.15-17.30**
Effects of induced changes in acid-base balance on mitochondrial adaptation to six-weeks of high-intensity cycle training
E Hawke1, D Hammarström1, K Sahlin2, M Tonkonogi, L Dauwe.
1 Dalarna University (Falun, Sweden), 2 Ghent University, F aculty of Engineering and Architecture, Department of Electrical energy, systems and automation, Zwijnaarde, Belgium.

**17.30-17.45**
Gross efficiency is improved in standing position with an increase of the power output
A Bouillo1, J Pinot2, A Valade2, J Carrassi1, G Costa Romero1, F Grappe2.
1 EA4660, CISS Health – Sport Department, Sports University, Besançon, France.
2 Professional Cycling Team FDJ.fr.

#### Physiology 2
**Wednesday 2nd July 16.30-17.45**
Lecture Theatre B

**16.30-16.45**
Comparison of physiological and perceptual responses to a maximal exhaustive test performed on the SRM and the Cyclus2 ergometer
B Karsten, A Peterson, M Champion.
Centre for Sports Science and Human Performances, University of Greenwich, Chatham Maritime, UK.

**16.45-17.00**
Potentiation of sprint cycling performance: the effects of a high-inertia ergometer warm-up
L Munro, S Stannard, P Fink, A Foskett.
School of Sport and Exercise, Massey University, Palmerston North, New Zealand.

**17.00-17.15**
Oxygen uptake kinetics during uphill and flat cycling in laboratory and field conditions
A Nimmerichter, K Haselsberger, B Prinz.
Department of Sport and Exercise Sciences, University of Applied Sciences Wiener Neustadt, Austria.

**17.15-17.30**
Two-parameter power analysis of the performances of grand tour winners
C Dauwe.
Dept of Physics and Astronomy, Ghent University, Gent, Belgium.

**17.30-17.45**
Comparing time-trial and time to exhaustion performance
L Passfield, S Coakley.
Endurance Research Group, School of Sport and Exercise Sciences, University of Kent, UK.

#### Biomechanics 1
**Wednesday 2nd July 16.30-17.45**
Lecture Theatre C

**16.30-16.45**
Field tests with an instrumented bicycle for comfort measurements
J Vanwaalbergen1, I De Baere1, M Loccufler2, W Van Paepegem3.
1 Ghent University, Faculty of Engineering and Architecture, Department of Electrical energy, systems and automation, Zwijnaarde, Belgium.
2 Ghent University, Faculty of Engineering and Architecture, Department of Electrical energy, systems and automation, Zwijnaarde, Belgium.

**16.45-17.00**
Application to cycling of a bioenergetic model: Towards a multi-level biomechanical model for global cyclist performance analysis
A Zignoli1, A Savoldelli1, F Biraili2, B Pellegrini2, F Scheuer2.
1 CerROM (Research Centre of Mountain Sport and Health) University of Verona, Verona, Italy.
2 Department of Industrial Engineering, University of Trento, Trento, Italy.

**17.00-17.15**
Multisensor monitoring cycle ergometer
H Lugo, N Chakravorti, LK Phillipot.
PP Conway, AA West.
1 Wolfson School of Mechanical and Manufacturing Engineering, Loughborough University, Loughborough, UK.

**17.15-17.30**
Incorporating internal mechanical power into performance models in cycling
H Giorgi1,2, M Andrews1, A Gray1, M Osborne1,2.
1 The University of Queensland, School of Human Movement Studies, Brisbane, Queensland, Australia.
2 Queensland Academy of Sport, Brisbane, Queensland, Australia.
3 University of New England, School of Science and Technology, Armidale, New South Wales, Australia.
4 Winner Track Co, Ltd, Fo Tan, New Territories, Hong Kong.

**17.30-17.45**
Acute effects of small changes in crank length on gross efficiency and pedaling technique during submaximal cycling
V Ferrer-Roca1, V Rivero Paloma1, A Oguta-Aiday1, JA Rodriguez-Marrero1, J Garcia-Lopez2.
1 Faculty of Physical Activity and Sports Sciences, Department of Physical Education, Institute of Biomedicine, University of León, Spain.
2 High Performance Sport Centre (CAR), Sant Cugat del Vallés, Barcelona, Spain.

CONTINUED OVERLEAF
## ORAL PRESENTATION SCHEDULE (CONT)

### Training
**Wednesday 2nd July 16.30-17.45**
Room 412

**16.30-17.00**
**Measures of training stress in cyclists do not usefully predict maximum mean power in competitions**
HA Ferguson¹, CD Paton², WG Hopkins¹.
1. Auckland Institute of Technology, Auckland, New Zealand.
2. Eastern Institute of Technology, Napier, New Zealand.

**17.00-17.15**
**The effects of different strength training regimes on cycling performance**
A Smit¹,², CW Hameetman¹, T Peters³, GWM Heijboer⁴, JJ Bastiaans⁶.
1. Elite Sports Unit, NOC*NSF, Arnhem, the Netherlands.
2. InnoSportLab Papendal, Arnhem, the Netherlands.
3. Vitesse, Arnhem, the Netherlands.
4. Belkin Pro Cycling Team, Amsterdam, the Netherlands.
5. KNWU, Nieuwegein, the Netherlands.

**17.15-17.30**
**Effects of different training protocols on the heart rate variability of trained cyclists**
F Reichert, L Picanço.
Post-Graduate Program in Physical Education – Federal University of Pelotas, Pelotas, Rio Grande do Sul, Brazil.

**17.30-17.45**
**Individualised training duration induces similar physiological and performance benefits at different intensities.**
S Coakley, L Passfield.
Endurance Research Group, School of Sport and Exercise Sciences, University of Kent, UK.

### Physiology 3
**Thursday 3rd July 16.00-17.00**
Lecture Theatre A

**16.00-16.15**
**Acute Cycling sport causes Upper Respiratory Tract infections and lung function loss among male recreational cyclists of different age groups**
KV Rajasekhar.
Centre for Physical Fitness and Sports Sciences, University of Hyderabad India.

**16.15-16.30**
**Power output and affective load change during time trial according to environmental conditions**
A Abel¹, F Grappe¹,².
1. C3S, EA4660, Health-Sport Department, University of Franche Comte, France.
2. Professional Cycling Team FDJ.fr.

**16.30-16.45**
**Quantification of vibrations during mountain biking**
P Macdermid, PW Fink, S Stannard.
School of Sport and Exercise, Massey University, Palmerston North, New Zealand.

**16.45-17.00**
**Do 3-min all-out test parameters accurately predict competitive cyclist performance in the severe intensity domain?**
A Niccoli, M Sacchetti.
Department of Movement, Human and Health Sciences, “Foro Italico”University, Rome, Italy.

### Physiology 4
**Thursday 3rd July 16.00-17.00**
Lecture Theatre B

**16.00-16.15**
**The physical, mental and hormonal responses to short-term intensified training in well-trained cyclists with a high carbohydrate nutritional intervention**
SC Killer¹, IS Svendsen¹, JM Carter², RK Randell³, AE Jeukendrup¹,², M Gleeson¹.
1. School of Sport, Exercise & Health Sciences. Loughborough University, Loughborough, UK.
2. Gatorade Sport Science Institute, Loughborough University, Loughborough, UK.

**16.15-16.30**
**The effect of exercise mode on salivary IgA secretion in high level triathletes**
S Barrett, A Storey, M Harrison.
Waterford Institute of Technology, Department of Health, Sport and Exercise Science. Ireland.

**16.30-16.45**
**Low dose fish oil increases the omega-3 index improving cycling efficiency and heart rate recovery**
L Hingley, M Macartney, M Brown, P McLennan, G Peoples.
School of Medicine, University of Wollongong, New South Wales, Australia.

**16.45-17.00**
**Within-individual haemoglobin variation and the athlete biological passport: a longitudinal investigation of 13,887 haemoglobin concentration readings in elite athletes.**
LM Lobigs¹, EJ Knight², YO Schumacher⁴, CJ Gore².
1. Aspetar Sports Medicine and Orthopedic Hospital, Doha, Qatar.
2. Australian Institute of Sport, Canberra, Australia.
Biomechanics 2
Thursday 3rd July 16.00-17.00
Lecture Theatre C

16.00-16.15
Wearable multi-sensor system for embedded body position and motion analysis during cycling.
A Valade¹, G Soto Romero¹, C Escriva¹, A Bouillod², J Pinot², J Cassirame², Jean-Yves Fourniols¹, F Grappe²,³.
¹ LAAS-CNRS, Toulouse, France.
² EA4660, C3S Health – Sport Department, Sports University, Besançon, France.
³ Professional Cycling Team FDJ.fr.

16.15-16.30
Development of a multi-directional rating test method for bicycle frame stiffness
J Vanwalleghem¹, I De Baere¹, M Loccuier², W Van Paepoegem¹.
¹ Faculty of Engineering and Architecture, Department Materials Science, Mechanics of Materials and Structures, Ghent University, Zwijnaarde, Belgium.
² Faculty of Engineering and Architecture, Department of Electrical energy, systems and automation, Ghent University, Zwijnaarde, Belgium.

16.30-16.45
Relationship between lower limb leg length and trunk orientation in cycling
A Brooker¹,².
¹ Bike Science Derby, Derby, UK.
² Nottingham Trent University, Clifton Campus, Clifton Lane, Nottingham, UK.

16.45-17.00
The influence of hamstring extensibility on preselected saddle height within experienced competitive cyclists
J Hynd, D Crowle, C Stephenson.
Sports and Exercise, Teesside University, Middlesbrough, UK.

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Biomechanics 3
Thursday 3rd July 16.00-17.00
Room 412

16.00-16.15
A depth camera-based system for estimating cyclist-bike projected frontal area
JS Wheat, S Clarkson, D Higham, S Choppin.
Centre for Sports Engineering Research, Sheffield Hallam University.

16.15-16.30
Effects of changing seat height on bike handling
B Fonda¹,², N. Sarabon², R Blacklock¹, F-X. Li¹.
¹ School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham, Birmingham, UK.
² S2P Laboratory for Motor Control and Motor Behaviour, Science to Practice, Ltd, Ljubljana, Slovenia.

16.30-16.45
Three ways of assessing the forces at the knee and ankle while cycling
EF Rios Soltero¹, HHCM Savelberg².
² Maastricht University, Maastricht, The Netherlands.

16.45-17.00
Efficiency index of a pedaling monitor system depend on load power, cadence and body weight.
T Kiwaki¹, T Tokuyasu², H Oka¹.
¹ Graduate School of Health Sciences, Okayama University, Shikata, Okayama, Japan.
² Faculty of Information Engineering, Fukuoka Institute of Technology, Fukuoka, Japan.
POSTER PRESENTATION SCHEDULE

Exhibition Area
Wednesday 2nd July

Board 1
Optimal pacing strategy for a race of two competing cyclists
T Dahmen, D Saupe
University of Konstanz, Konstanz, Germany.

Board 2
The relationship between vertical leg stiffness and gross mechanical efficiency in cyclists
JD Hughes, G Pitchers, SC How, M Cole
Exercise & Sport Research Centre, University of Gloucestershire, Gloucester, UK

Board 3
Treadmill-based cycling time trial better predicts seasonal cross-country mountain bike performance than traditional parameters in laboratory tests.
B Müller1,2, T Steiner1, T Maier1 & JP Wehrlin1.
1 Section for Elite Sports, Swiss Federal Institute of Sport, Magglingen, Switzerland.
2 Swiss Cycling Federation, Grenchen, Switzerland.

Board 4
Influence of positional biomechanics on gross efficiency within cycling.
J Bateman
University of Sunderland, UK.

Board 5
Laboratory predictors of uphill cycling time trial performance
AH Bessa1, P Lima1, J Hopker1, JRP Lima1, 2
1 Faculty of Physical Education and Sports, Federal University of Juiz de Fora, Juiz de Fora, Minas Gerais, Brazil.
2 School of Sport and Exercise Sciences, University of Kent, Chatham Maritime, Chatham, Kent, England.

Board 6
The effect of beetroot juice dosage on high intensity intermittent cycling performance.
G Byrne, B Wardrop, A Storey
Waterford Institute of Technology, Ireland.

Board 7
Differences in static and dynamic bike fit with 3d motion capture
M Corbett, J Bevis
Institute of Sport and Exercise Science, University of Worcester, UK.

Board 8
An online survey using social media investigating the use of kinesiology type tape and McConnell type tape with clinicians who treat cycling related knee pain.
G Theobald1, J Selfe2, J Richards2, H Roddam2.
1 The Body Rehab Injury Clinic, Staveley, Cumbria, UK.
2 School of Sport, Tourism & the Outdoors, UCLan, Preston, UK.

Board 9
A contiguous ramp and all-out exercise test to determine critical power in competitive cyclists
MS Wells1, G Atkinson2, HB Rossiter3, S Marwood1.
1 Sport and Exercise Sciences, Liverpool Hope University, UK.
2 Health and Social Care Institute, Teesside University, UK.
3 Los Angeles Biomedical Research Institute at Harbor-UCLA Medical Center, USA.

Board 10
The effect of wheel diameter on vertical and horizontal mountain bike position
S Phillips1, M Levy2, B Alumbaugh1, G Smith3, G Smith1.
1 Colorado Mesa University, Grand Junction, CO, USA.
2 University of Minnesota Duluth, Duluth, MN, USA.
3 Colorado School of Mines, Golden, CO, USA

Board 11
Muscular fatigue of the lower limb and subsequent joint angle adaptations during a 16.1km cycling time trial.
I Willitt, N Smith, P Hudson
Department of Sport and Exercise Sciences, University of Chichester, Chichester, UK.

Board 12
A new test battery to assess bike handling skills of experienced and inexperienced cyclists
B Fonda1,2, N. Sarabon2, F-X. Li1.
1 School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham, Birmingham, UK.
2 S2P Laboratory for Motor Control and Motor Behaviour, Science to Practice, Ltd., Ljubljana, Slovenia.

Board 13
Effect of hand cooling on body temperature, cardiovascular and perceptual responses during recumbent cycling in a hot environment
AD Ruddock1,2, K Chatziopoulos2, T Parkington2, GA Tew2, A Purvis2.
1 Centre for Sport and Exercise Science, Sheffield Hallam University, UK.
2 Department of Sport, Sheffield Hallam University, UK.
3 Department of Health Sciences, University of York, UK.
Exhibition Area
Thursday 3rd July

Board 1
Relation between lactic acid steady-state and muscle oxygenation in elite cyclists
M Mantovani1,2, M Bongi1, A Bandera1.
1 University of Insubria, Varese, Italy.
2 Team Colombia, Adro, Italy.

Board 2
Do core stabilization exercises enhance cycling efficiency?
EJ Weijmans, S van Berkel.
Department of Sports Medicine, Isala, Zwolle, the Netherlands.

Board 3
A multidisciplinary team immunity intervention and well-being monitoring with female track riders in preparation for the 2013/14 UCI world cup season
OC Busby, V Davies
Sport Wales, Cardiff, UK.

Board 4
An investigation of the biomechanical efficacy and clinical effectiveness of patello-femoral taping in elite and experienced cyclists
G Theobald1, J Selfe2, J Richards2, H Roddam3.
1 The Body Rehab Injury Clinic, Staveley, Cumbria, UK.
2 School of Sport, Tourism & the Outdoors, UCLan, Preston, UK.

Board 5
Comparison of power output demands for a top-10 ranking between Tour de France and Vuelta a Espana
J Pinot1,2, F Grappe1,2.
1 EA4660, CIG Health – Sport Department, University of Franche Comte, Besançon, France.
2 FDJ.fr Pro Cycling Team, Mousson le Vieux, France.

Board 6
The influence of aerobic fitness on the oxygen uptake kinetics of trained cyclists
G Rose.
School of Health, Sport & Professional Practice, University of South Wales, Newport, UK.

Board 7
The analysis & forecasting of British cycling time trial records
BTJ Dyer1, H Hossani2, M Shadi2.
1 Faculty of Science & Technology, Bournemouth University, UK.
2 The Business School, Bournemouth University, UK.

Board 8
Effect of environmental temperature on pacing during a simulated 16 km cycling time trial
S Bailey, C O’Hagan
Academy of Sport and Physical Activity, Sheffield Hallam University, UK.

Board 9
The Effect of IMT on Cycling Time-Trial Performance at ~16°C (Cool) and ~26°C (Hot) Temperatures.
C Sharp, M Faghy
Sport and Exercise Science, University of Derby, Derby, UK.

Board 10
Optimisation of cycling training
P Scarf1, M Shrahili1, SA Jobson2, L Passfield3.
1 Centre for Sports Business, Salford Business School, University of Salford, UK.
2 Department of Sports Studies, University of Winchester, UK.
3 School of Sport and Exercise Sciences, University of Kent, UK.

Board 11
Track Tales: A Narrative Exploration Of Within-career Transition In Sprint Cycling
W McCorn.
School of Sport & Exercise Sciences, Liverpool John Moores University, Liverpool, UK.

Board 12
The reliability and validity of the 3-minute critical power test
J Wright1, S Jobson1, S Bruce-Low1.
1 Health, Exercise and Sport Science, Southampton Solent University, UK.
2 Department of Sports Studies, University of Winchester, UK.

Board 13
Changes in whole body and local muscle oxygen consumption during prolonged cycling
C O’Grady, B Pageaux, JG Hopker.
Endurance Research Group, School of Sport and Exercise Sciences, University of Kent, UK.

Board 14
Modelling of Critical Power from Road Data
B Karsten1,2, S Jobson1, J Hopker2, L Stevens1, C Beeicle.
1 Centre for Sports Science and Human Performances, University of Greenwich, Chatham Maritime, UK.
2 Department of Sport Studies, University of Winchester, Winchester, UK.
3 School for Sport and Exercise Sciences, University of Kent, Chatham Maritime, UK.
4 Department of Sport and Exercise Science, ABER, Aberystwyth, UK.
## PROGRAMME DAY 1

**2nd July 2014**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>6.00-9.15</td>
<td><strong>Registration and refreshments</strong> – Foyer</td>
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<tr>
<td>9.15-9.30</td>
<td><strong>Welcome</strong> – Lecture A</td>
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<tr>
<td></td>
<td>Dr James Hopker, Roger Harrington (Leeds Council Cycling Ambassador), Brian Robinson</td>
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<tr>
<td>9.30-10.00</td>
<td>Charly Wegelius (Garmin-Sharp Sporting Director)</td>
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<td></td>
<td>“Can sports science help to make race-winning decisions?” – Lecture A</td>
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<tr>
<td>10.00-10.30</td>
<td>Dr Ross Tucker (University of Cape Town)</td>
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<td></td>
<td>“Fatigue and limitations to endurance cycling performance” – Lecture A</td>
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<tr>
<td>10.30-11.30</td>
<td><strong>Symposium</strong></td>
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<td>The limits to exercise tolerance: mind or muscle?</td>
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<td>Prof Samuele Marcora (University of Kent)</td>
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<td>Dr Mark Burnley (University of Kent)</td>
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<td>Sponsored by the University of Kent</td>
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<td>11.30-12.00</td>
<td>Peter Hespel (Omega Pharma Quick-Step)</td>
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<td>“Extreme Nutrition: Grand Tour Cycling” – Lecture A</td>
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<tr>
<td>12.00-13.00</td>
<td>Lunch/Posters/Exhibition – Foyer</td>
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<tr>
<td>13.00-14.00</td>
<td><strong>Symposium</strong></td>
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<td>Current Perspectives on Anti-Doping in Cycling</td>
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<td>“The Athlete’s Biological Passport – Past, Present, Future”</td>
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<td>Dr Olaf Schumacher (ASPETAR)</td>
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<td>“An Integrative ‘Omics’ Solution to the Detection of Recombinant Human Erythropoietin and Blood Doping”</td>
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<td>Prof Yannis Pitsalidis (University of Brighton)</td>
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<tr>
<td>14.00-15.00</td>
<td><strong>Symposium</strong></td>
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<td>Pacing strategies, perceived effort and cycling performance</td>
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<td>Dr F Hettinga (University of Essex)</td>
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<td>“Highly accurate computer simulations of individual time trials in competitive cycling”</td>
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<td>Prof Bert Otten (University of Groningen)</td>
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<td>“How to use pain to pace”</td>
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<td>Dr Lex Mauger (University of Kent)</td>
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<td>15.00-15.30</td>
<td>Refreshments/Posters/Exhibition – Foyer</td>
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<tr>
<td>15.30-16.30</td>
<td><strong>Symposium</strong></td>
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<td>Muscle activity and pedal forces: do they matter in cycling performance</td>
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<td>Dr Fred Grappe (FDJ)</td>
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<td>“Effects of vibration on the cycling biomechanics”</td>
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<td>Dr William Bertucci (University of Reims)</td>
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<td>“Interest of studying muscular activity to improve cycling performance”</td>
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<td>Dr Sébastien Duc (University of Reims)</td>
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<tr>
<td>16.30-17.45</td>
<td><strong>Open Short Communications</strong></td>
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<td>Lecture Theatre A, B, C, and room 412</td>
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<td><strong>Symposium</strong></td>
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<td>Cycling in the Extremes</td>
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<td>“Heat effects on cycling: physiology, perception, and performance”</td>
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<td>Prof Stephen Cheung (Brock University)</td>
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<td>“Can altitude training be recommended to elite athletes?”</td>
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<td>Dr Carsten Lundby (University of Zurich)</td>
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<tr>
<td>19.00-00</td>
<td>Conference Dinner – Rose Bowl</td>
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<td>Marco Pinotti, Michael Hutchinson, Tim Moore</td>
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**End of Day 1**
## PROGRAMME DAY 2

3rd July 2014

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>8.00-8.50</td>
<td>Registration and refreshments – Foyer</td>
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<tr>
<td>8.50-9.00</td>
<td>Welcome – Lecture A</td>
</tr>
<tr>
<td>9.00-9.30</td>
<td>Ulrich Schroberer (SRM), Nicolas Roche (Tinkoff-Saxo Professional Cycling Team) “The use of Power Meters in Professional Cycling” – Lecture A <strong>Sponsored by SRM</strong></td>
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<tr>
<td>9.30-10.00</td>
<td>Dr Mario Zorzoli (UCI Medical Director) “Maintaining rider health” – Lecture A</td>
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</table>
| 10.00-11.00| Symposium **Training and physiological assessment in cycling:**  
Dr Andrea Morelli “Seasonal variations of total haemoglobin mass and aerobic endurance capacities in professional road cyclists”  
Dr Andrea Bosio “Physiological and neuromuscular difference between training at low and high pedal frequencies”, Paolo Artuso **Sponsored by Mapei SportService**  
Lecture A  
Lecture C |
| 11.00-11.30| Refreshments/Posters/Exhibition – Foyer                               |
| 11.30-12.30| Symposium **Using power meters to improve training and performance:**  
Prof Louis Passfield (University of Kent)  
Dr Mikel Zabala (Movistar Pro Cycling Team)  
Dirk Friel (Training Peaks)  
**Sponsored by Powerbar**  
“Optimizing aerodynamics in road race cycling”  
“The development of a field-based platform for measuring aerodynamics in cycling: from hair dryers to Rio”  
Andy Fromioni (Alphamantis Technologies)  
Lecture A  
Symposium **Nutrition for elite cycling, from the lab to the musette:**  
Dr David Bailey (Nestlé Research Center)  
Dr Louise Burke (Australian Institute of Sport)  
**Sponsored by Powerbar** |
| 12.30-13.30| lunch/Posters/Exhibition – Foyer                                      |
| 13.30-14.00| Dr Irigo Mujika (University of the Basque Country) “A scientific approach to training and tapering for road cycling events”  
**Symposium** **British Cycling: Developing a winning culture:**  
Dr John Dickinson (University of Kent)  
Dr Peter Brown (English Institute of Sport)  
**Sponsored by Powerbreathe** |
| 14.00-15.00| Symposium **Aerodynamics in Professional Cycling:**  
Robby Ketchell (Garmin-Sharp Pro Cycling Team)  
“Optimizing aerodynamics in road race cycling”  
“The development of a field-based platform for measuring aerodynamics in cycling: from hair dryers to Rio”  
Andy Fromioni (Alphamantis Technologies)  
Lecture A  
Symposium **Inspiratory Muscle Training and Cycling Performance:**  
Dr John Dickinson (University of Kent)  
Dr Peter Brown (English Institute of Sport)  
**Sponsored by Powerbreathe** |
| 15.00-16.00| Symposium **The role of strength training within endurance cycling:**  
Dr Irigo Mujika (University of the Basque Country)  
Dr Bent Ronnestad (Lillehammer University)  
Dr David Martin (Australian Institute of Sport)  
Lecture A  
Symposium **End of Day 2** |
| 16.00-17.00| Open Short Communications  
Lecture Theatre A, B, C, and room 412  
**Symposium** **Winning the TdF: does it need a sport science perspective?** – Lecture A |
| 17.00-17.30| Dr David Martin (Australian Institute of Sport)  
**End of Day 2** |
| 19.00-21.00| Open Public Engagement Event – Rose Bowl  
Chair: Prof Louis Passfield  
Dirk Friel – The evolution of power measurement in professional cycling  
Prof Yannis Pitsiladis – TdF champions born or made?  
Dr Mikel Zabala & Marco Pinotti – Physiology of the TdF rider  
Dr Simon Choppin – Biomechanics aspects of professional cycling  
**Sponsored by TrainingPeaks** |