Maths Industry Meeting

Mathematics and movement in sports
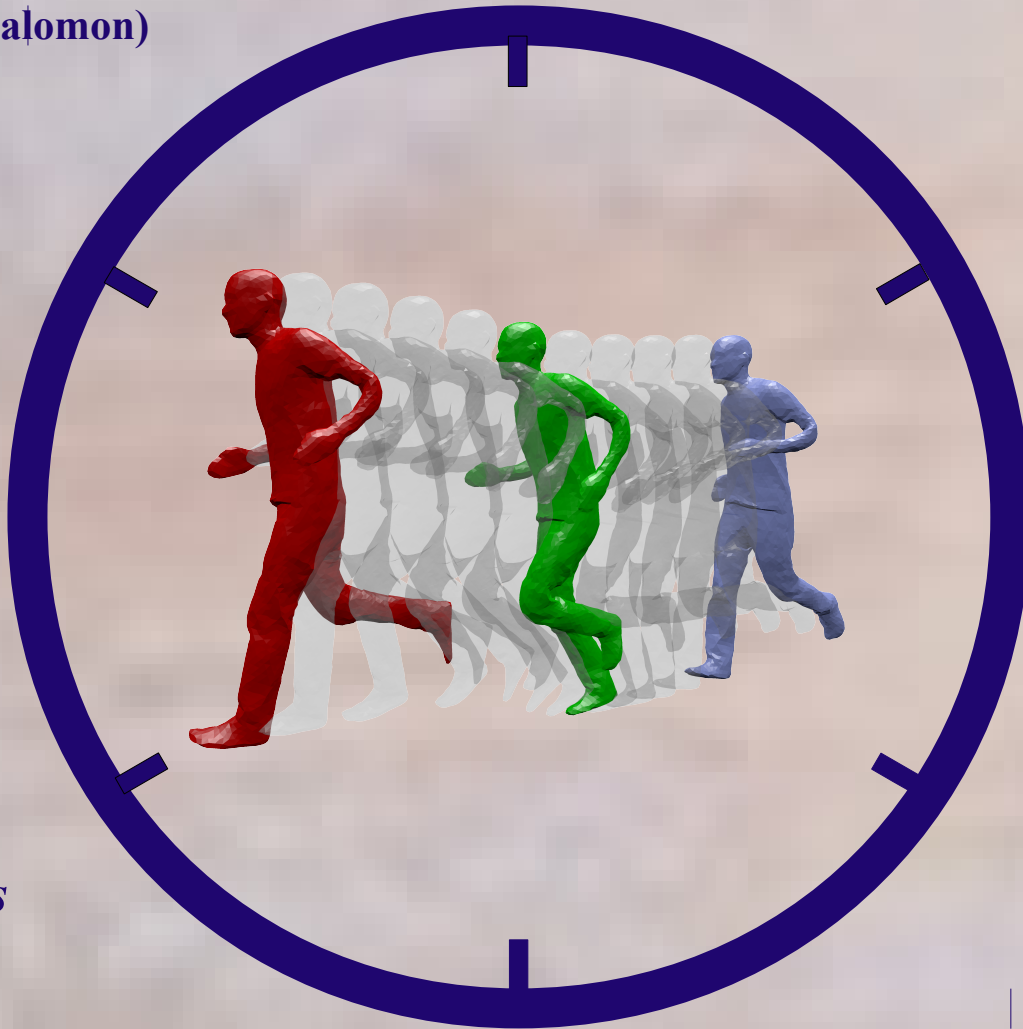
Tuesday March 13th 2018, 9:00-12:00
at Institut Henri Poincaré, Paris

Invited Speakers

Avner Ben-Har (CNAM Paris)
Edmond Boyer (Inria Rhône-Alpes)
Nicolas Horvais (Salomon)
Mark King (Loughborough Univ.)
Pierre Martinon (Inria Paris-Saclay)
Guillaume Rao (Aix-Marseille Univ.)
Lise Sissler (Salomon)

Round Table
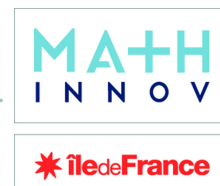
Can digital products help sports ?

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Organizers

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F. Richard

Live Brodcast on the IHP youtube channel
http://mathsetmvt-rmi.sciencesconf.org

Registration is free but mandatory

Conferences

9h00-9h20 Mark King (Loughborough, England)
Maths, movement and optimum performance in sport

Abstract. Applied mathematics can be used to quantity and investigate human movement in a variety of settings from both an experimental and theoretical perspective. This presentation will investigate human movement in sport including both the examination of actual performance and also using theoretical computer simulation models to investigate factors that limit optimal performance. A range of examples will be used including; gymnastics tumbling, one-handed backhand strokes in tennis and fast bowling in cricket. For all studies in biomechanics a strong theoretical understanding is essential so that results obtained can be understood and relationships or factors that are important to performance explained. For the theoretical analysis torque-driven forward dynamics subject-specific computer simulation models will be developed. Each simulation model is evaluated by comparing simulations with actual performances. Simulations and optimisations are then used to investigate specific questions for each activity. Using a subject-specific simulation model allows an ideal experiment to be run with one variable being perturbed at a time so that the effect of a specific variable can be established.

9H20-9h35 Edmond Boyer (INRIA Rhône Alpes)
Digital Models of Real Shapes in Motion

Abstract. Video based acquisition systems allow to fully perceive, in space and over time, shapes that move. The resulting 4D models, also called holograms, are of interest in a wide range of applications, from human motion analysis to virtual reality. In this talk I will give an overview of the field, both from a historical viewpoint and in terms of the current research challenges.

9h35-9h50 Avner Bar-Hen (Conservatoire National des Arts et Métiers, Paris)
How to measure collective effectiveness in the XV de France ?

Abstract. The aim of this study was to quantify the impact of selections and shared selections in the rugby union. The XV de France's collective effectiveness relies on a balance between stability and workforce renewal, which allows the building of specific position interactions and builds on experimented forwards packs. We show that selections and shared selections are serious collective performance parameters associated with performance.

9h50-10h05 Nicolas Horvais and Lise Sissler (Salomon, France)

From simple to complex applied mathematics to investigate human movement

Abstract. The goal of a sport brand is to provide to his consumer a product that will help him to get fully involved in his practice. To this end, we use applied mathematics in the development of our products to better address the "consumer need" of this product. This presentation will give some projects examples (in tennis and running) in which we can go from using very simple to more complex applied mathematics.We will go through a simple distance measurement, the measurement of the foot running technique directly in the field, the modelling of the downhill trail running performance, a measurement knee constraint during running, and we will end with finite element modelling.

10H05-10h20 Sébastien Pavailler (Salomon, France)

Modelling of the downhill trail running performance

Abstract. Running in the mountains, i.e. trail running is not the same thing as "traditional" road running. Indeed, trail running is a succession of uphill and downhill paths. Therefore, the performance models available in the literature for road running are not accurate for trail running. Some recent studies focused on modelling running performance during uphill sessions. However, based on race time analysis and athletes feedbacks, the ability of running downhill is more important than the ability of running uphill to win a race.
Therefore, the goal of this study was to determine the performance criteria during downhill trail running, whether it is from a technical, muscular, perceptual or psychological point of view.

10h20-10h35 Guillaume Rao (Institute of Movement Sciences, Aix-Marseille University)
How to estimate internal stress (without having to cut the subject's skin up) ?

Abstract. Muscle, ligaments and joint contact forces are needed to perform a movement. While several tools are available to measure the resulting movement, getting an estimate of its mechanical causes is less straightforward. I will present some mathematical issues that have been resolved either to estimate the muscle forces or to develop a numerical model used to estimate the internal stress and strain the foot segment experienced during running. These solutions numerical models have been used to design new running shoe prototypes and test their influences on the human body.

10h35-10h50 Pierre Martinon (Inria Paris-saclay)
Model and simulations for 2 runners

Abstract. We present a model describing the evolution of the velocity, the anaerobic energy, and the propulsive force of a runner as a function of the distance. We introduce the effect of running on a curve and the interaction between two close runners, in the framework of optimal control. Numerical simulations with the toolbox Bocop illustrate the effect of the centrifugal force and the psychological attraction to the runner in front, depending on the lane number.

10h50-11h15 Coffee Break

11h15-12h00 Round Table/Table ronde :

Can digital products help sports ? / Quelle est l'utilité d'un produit digital dans le monde du sport ?

Amandine Aftalion (DR CNRS EHESS) Moderator

Amandine Aftalion est directrice de recherche CNRS au Centre d'Analyse et de Mathématique Sociales de l'EHESS. Ancienne élève de l'Ecole normale supérieure, elle entre au CNRS en 1999 et poursuit ses recherches en mathématiques appliquées, dans le domaine des équations aux dérivées partielles et de leurs applications en physique et maintenant dans le domaine du sport. Elle travaille actuellement sur la modélisation mathématique de la course à pied. Dans la continuité de ses travaux sur les minimisations d'énergie, elle s'intéresse à l'énergie humaine. Elle est également impliquée dans la médiation et diffusion des mathématiques, notamment sous forme de vidéos.

Eric Guichard (ENSSIB)

Philosophe et anthropologue de l'internet, Éric Guichard est enseignant-chercheur à l'ENSSIB (École nationale supérieure des sciences de l'information et des bibliothèques) et responsable de l'équipe Réseaux, Savoirs & Territoires de l'ENS-Ulm. Il fut directeur de programme au Collège international de philosophie entre 2010 et 2016. Il a dirigé divers ouvrages, dont "Regards croisés sur l'internet" (Presses de l'Enssib, 2011), et "Écritures: sur les traces de Jack Goody" (Presses de l'Enssib, 2012). La majorité de ses derniers articles sont librement accessibles en ligne à partir de l'URL http://barthes.enssib.fr/articles.

Valentin Rapin (CEO of Arioneo)

Jeune entrepreneur passionné par l'équitation et les nouvelles technologies , il a joint l'utile à l'agréable en confondant avec Erwan Mellerio Arioneo. Arioneo est une startup spécialisée dans la conception solutions connectées permettant une analyse précise de la santé et de la performance des chevaux athlètes. Véritable condensé des dernières avancées technologiques en suivi médical sportif, l'EQUIMETRE est un capteur connecté qui analyse en temps réel l'activité physique et physiologique des chevaux de course lors de leur entraînement quotidien. Young entrepreneur passionate about riding and new technologies, Valentin Rapin joined the useful to the pleasant by co-founding with Erwan Mellerio the start-up Arioneo. The startup is specialized in the design of connected solutions for accurate analysis of the health and performance of athlete horses. A genuine technological powerhouse in sports medical monitoring, EQUIMETRE is a connected sensor that analyzes in real time the physical and physiological activity of racehorses during their daily training.

Web . http://www.arioneo.com/

Fernando Romao (PIQ Sport Intellignece)

Fernando Romao est directeur technique chez PIQ Sport Intelligence depuis sa création en 2014. Avant cela, il a été directeur du développement chez Archos, pionnier dans les tablettes Android, les lecteurs audio et vidéo portables, après une carrière de plus de vingt an chez Sagem. Pendant son séjour à Sagem, Fernando a enseigné au CNAM en Master dans le domaine de la télécommunication et de la théorie de l'information. Titulaire d'un diplôme d'ingénieur de SUPELEC et de l'ENSAM, Fernando a réalisé une soixantaine de brevets internationaux dans différents domaines.

Stefan Valentin (R&D Huawei FRANCE)
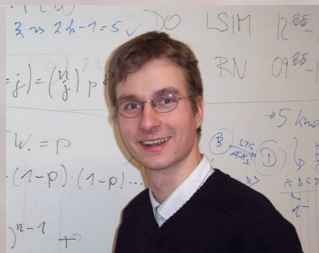
Stefan Valentin is a Principal Researcher at Huawei's Mathematical and Algorithmic Sciences Lab in Paris. He is currently leading the Context Aware Optimization team, which designs AI-driven algorithms and models for localization, tracking, and user classification. Stefan received his Doctorate in computer science with summa cum laude from the University of Paderborn, Germany in 2010. In the same year, he joined Bell Labs in Stuttgart, Germany where he worked on optimization algorithms for 4G and 5G until starting at Huawei in 2015. Stefan filed 30+ patent applications, co-authored 90+ research papers, and received 8 awards from the IEEE, from the Klaus Tschira Foundation and from various companies. His algorithms are deployed in cellular networks around the world and his team created the data set behind the #HuaweiBigDataChallenge at CentraleSupélec.

Web : http://www.shl-dataset.org/ http://huaweienfrance.fr/rd/