15ème Journée de l'ED 463

Ecole Doctorale des Sciences du Mouvement Humain

Le 7 Juin 2019 – Marseille

« La Multidisciplinarité en Sciences du Mouvement Humain »

Bienvenue à la JED 2019

Au nom du Comité d'organisation de la JED et de l'Association DocSMH, nous vous souhaitons la bienvenue à la 15ème édition de la journée de l'Ecole Doctorale des Sciences du Mouvement Humain.

Cette année la JED se déroule à Marseille et a pour thématique « la multidisciplinarité en Sciences du Mouvement Humain ». Les tables rondes prévues le matin permettront de débattre autour de la multidisciplinarité dans la démarche de l'innovation en Sciences du Mouvement mais également sur les atouts que la multidisciplinarité apporte dans la carrière professionnelle.

L'après-midi, les doctorants de 2ème et 3ème année vous présenteront leurs travaux respectivement sous la forme de communications affichées et de communications orales. Vous trouverez dans ce livret les abstracts associés à ces différentes communications.

Si l'événement se pérennise, c'est grâce à tous ceux qui jouent un rôle dans l'organisation de la JED : nos partenaires publics et privés sans qui la journée n'aurait pas lieu, la Faculté des Sciences du Sport de Marseille qui met ses locaux à notre disposition, l'Ecole Doctorale 463 et son directeur qui nous a épaulé pour l'organisation.

Nous tenons donc à les remercier pour la confiance qu'ils nous accordent chaque année.

« Ce qui est incompréhensible c'est que le monde soit compréhensible »
Albert Einstein

En vous souhaitant une bonne journée,

Le comité d'organisation de la JED 2019

Vous pouvez retrouver plus d'informations sur le déroulement de la journée ainsi que le livret au format électronique sur le site internet : https://jedsmh463.wixsite.com/edition2019

Lieu JED SMH 2019

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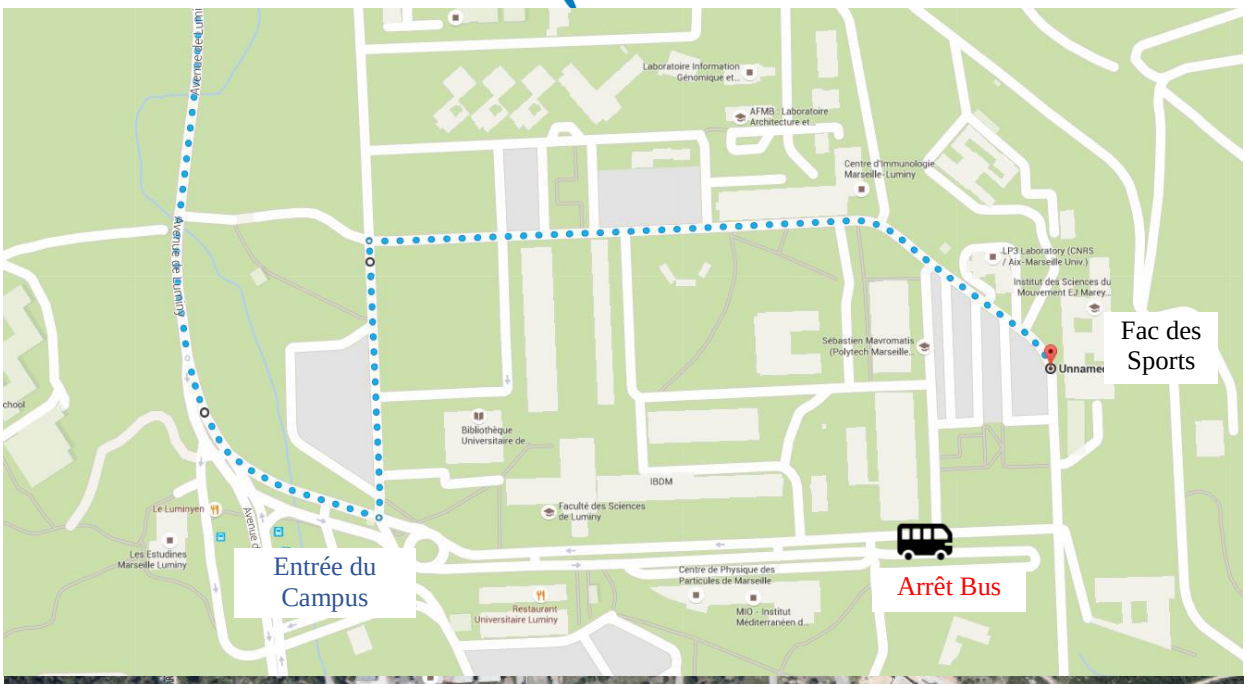

Lieu dîner & soirée

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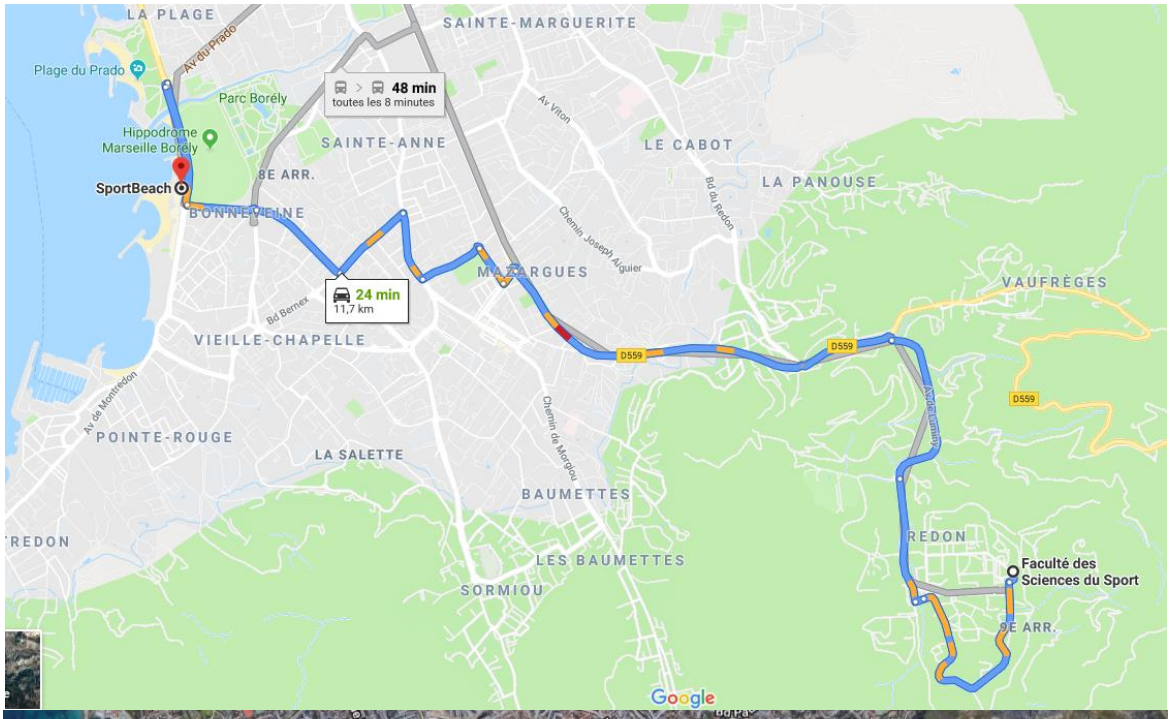

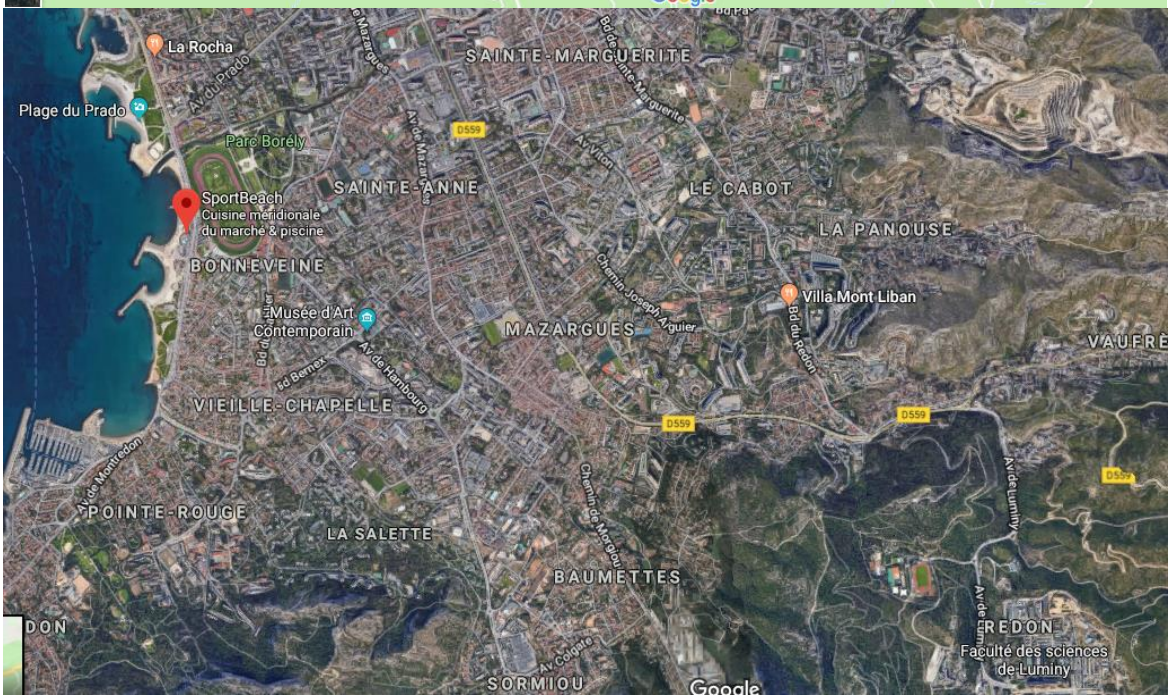

Programme

8h30 - Parvis FSS
Petit -déjeuner

9h00 - Amphi J.Paillard
Discours du directeur de l'ED

9h30 - Amphi J.Paillard
Table Ronde n°1
La multidisciplinarité dans la démarche de l'innovation

10h30 - Parvis FSS
Pause café

11h00 - Amphi J.Paillard
Table Ronde n°2
Les atouts de la multidisciplinarité dans la carrière professionnelle

12h00 - Foyer FSS
Buffet traiteur

13h00 - Terrasse FSS
Photo de groupe

13h30 - Amphi J.Paillard
Communications orales
Session 1

14h30 - Hall FSS
Communications affichées

16h00 - Amphi J.Paillard
Communications orales
Session 2

17h30 - Amphi J.Paillard
Remise des prix
Discours de clôture

18h00 - Foyer FSS
Cocktail de networking

19h00 - Technosport
Traditionnelle pétanque

20h30 - Diner et soirée
Sport Beach

Tables Rondes

Amphithéâtre J. Paillard

9h30 – 10h30

Table ronde 1 : « la multidisciplinarité dans la démarche de l'innovation »

Céline Souliers est directrice de **l'Incubateur Belle de Mai,** qui accompagne depuis déjà 20 ans des projets de création d'entreprises innovantes dans le domaine des Technologies de l'Information et de la Communication.

Guillaume Gouvernet, Docteur en Biomécanique, est aujourd'hui chargé de transfert technologique à la **SATT Sud-Est** où il assure les suivis technique, humain et financier des projets de valorisation. Auparavant, il a travaillé plusieurs années chez **Décathlon** et en particulier pour la marque Geonaute.

Jean-Jacques Temprado, Professeur des Universités en STAPS, est spécialisé dans l'étude des effets de l'activité physique sur la plasticité cérébrale, les capacités d'apprentissage et la cognition.
Il est avec nous aujourd'hui pour nous parler de son engagement dans le développement de **Walkoo**, une application pour smartphone qui associe l'exploration urbaine, la découverte culturelle et l'activité physique à des fins de santé et de bien-être.

Amine Metani, Docteur en biophysique, a su mettre ses compétences à profit pour fabriquer des neuroprothèses basées sur l'électrostimulation musculaire. Il s'intéresse aujourd'hui à la mise en place d'un programme de recherche visant à restaurer le mouvement chez des personnes atteintes de handicap.

Laurent Vigouroux, Maître de Conférences en STAPS, est spécialisé dans l'étude du fonctionnement biomécanique de la main. Allant de l'étude fondamentale des mécanismes associés à la préhension au développement ergonomique d'outils de travail et de matériel sportif.
Il nous fait l'honneur aujourd'hui de nous parler de **Smart Board**, un nouvel outil d'entrainement pour l'escalade dont il est l'inventeur.

11h00 – 12h00

Table ronde 2 : « les atouts de la multidisciplinarité dans la carrière professionnelle »

Stéphane Viollet est Directeur de Recherche au CNRS et également responsable de l'équipe **biorobotique** à l'Institut des Sciences du Mouvement. Il est spécialisé dans l'étude des réflexes sensori-moteurs chez la mouche, les capteurs optiques bio-inspirés et les stratégies de pilotage de robots inspirées de l'insecte.

Nicolas Mascret, Maître de Conférences à l'**ESPE** (École Supérieure du Professorat et de l'Éducation Aix-Marseille), est spécialisé dans l'étude des buts d'accomplissement, des théories implicites et du stress psychosocial en contextes sportif et scolaire. Auparavant Professeur Agrégé en EPS et auteur de « N'oublions pas les bons profs », il intervient activement dans la formation des futurs professeurs d'EPS.

Michael Huet, Docteur en Sciences du Mouvement Humain, est ingénieur facteurs humains à **Dassault Aviation** depuis 2013. Son domaine d'expertise, l'aéronautique, l'a suivi dans sa carrière à Altran où il occupait la place de consultant facteurs humains et ergonomie.

Clément Bougard est Ingénieur de Recherche, monitoring et santé/bien-être au sein du groupe **PSA**. Il est également responsable de l'OpenLab « Automotive Motion Lab ». Docteur en STAPS, il a auparavant travaillé comme chercheur biomédical en Neurosciences au Ministère des Armées.

Brice Isableu est Professeur des Universités en Psychologie Cognitive et Ergonomique et directeur du département Psychologie Cognitive et Expérimentale à Aix-Marseille Université. Anciennement, Maître des Conférences en STAPS à Paris X, il travaille aujourd'hui au **Centre de Recherche en Psychologie de la Connaissance, du Langage et de l'Emotion** (PSYCLE).

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Communications orales
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Session 1- 13h30

1. **13h30 : Arc-Chagnaud Coralie** - ESA Cocktail Study: Ineffectiveness of nutritional supplementation against human hypoactivity-induced skeletal muscle deconditioning

2. **13h45 : Fabre Marie** - Functional interplay between body sway and parieto-premotor network when standing

3. **14h00 : Bouvet Cécile** - Dynamic of bimanual coordination and auditory perception of (in)congruent accented sequences

4. **14h15 : Gatouillat Colin** - Sport Leaves Social Life: Understanding Drop-out From Sports Practice Among French Teenagers

Session 2 – 16h00

5. **16h00 : Brieg Lecoublet** - Neck Braces and Types of Powered-Two-Wheelers affect Head Mobility

6. **16h15 : Deshayes Maxime** - Effect of sex stereotype on cortical activity during a self-paced exercise: A motor-related cortical potential approach

7. **16h30 : Gemonet Elise** - Perceived workload in driving simulation compared to real car driving

8. **16h45 : Catteau Matthias** - In vitro electrostimulation reveals impaired exercise training-induced muscle adaptation of COPD patient myotubes

ESA Cocktail Study: Ineffectiveness of nutritional supplementation against human hypoactivity-induced skeletal muscle deconditioning

Arc-Chagnaud Coralie[1,2], Fovet Théo[1], Py Guillaume[1], Roumanille Rémi[1], Brioche Thomas[1], Chopard Angèle[1]

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Skeletal muscle deconditioning is a major consequence of various situations such as inactivity or microgravity. Understanding molecular pathways involved in the loss of muscle mass and function induced by muscle disuse is a crucial issue in the context of spaceflight as well as clinical field, and would help to develop efficient countermeasures. Recent studies reported the importance of redox balance dysregulation as a major mechanism leading to muscle wasting.
Our study aimed to evaluate the effects of an antioxidant supplementation in the prevention of muscle deconditioning induced by long-term inactivity. The study consisted of 60 days of hypoactivity using the well-known Head Down BedRest model (HDBR). Twenty healthy men were recruited, half of them received a daily antioxidant supplementation whereas the other half received a placebo. Muscle biopsies were collected from *vastus lateralis* muscles, before, after, and after 10 days of reloading.
After 2 months of HDBR, all subjects presented muscle deconditioning characterized at the functional level by a loss of muscle strength. At cellular level, our results show that supplementation did not prevented atrophy of muscle fibers. More particularly, in cocktail group, fast muscle fibers were more affected than the slow ones. Our results regarding oxidized proteins and 4-HNE levels in muscles traduced a potential protection of the cocktail against ROS-induced damage. Various parameters of mitochondrial content were analyzed and their evolution after HDBR attested of a rapid loss of oxidative metabolism efficacy in supplemented subjects. Finally, some markers of protein synthesis and degradation were evaluated to see the evolution of protein balance mechanisms after a long-term inactivity.
Our results underline the complexity of redox balance mechanisms and demonstrate that physiological amounts of ROS are essential to activate molecular pathways and preserve positive adaptations. It raises interrogations regarding appropriate nutritional interventions in order to fight against muscle deconditioning.

Keywords: muscle deconditioning, hypoactivity, oxidative stress, antioxidant

Acknowledgements: We thank all the staff working in the Institute of Space Medicine and Physiology (Medes-IMPS) in Toulouse for having organized and carried out these experiments. A special thanks to the subjects for their participation in this project.

Functional interplay between body sway and parieto-premotor network when standing

Marie Fabre[1], Marine Antoine[2,3], Mathieu Germain Robitaille[2], Edith Ribot-Ciscar[4], Rochelle Ackerley[4], Jean-Marc Aimonetti[4], Pascale Chavet[5], Jean Blouin[1], Martin Simoneau[CA,2,3], Laurence Mouchnino[CA,1*]

[CA] Co-last authorship: Martin Simoneau and Laurence Mouchnino contributed equally to the direction of this work

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When standing, activation of the foot sole mechanoreceptors largely depends on the speed and amplitude of the postural oscillations. Postural oscillations, or body sway, are characterized by continuous small oscillations and occasional large sways. If body sway is considered as the balance signature, we hypothesized that large sways could rather represent a functional response of the postural system to a decrease of transmission of cutaneous inputs from the feet. Indeed, a prolonged cutaneous compression while swaying within small foot area (i.e. small sways) may lead to a decrease in transmission of the cutaneous inputs to the cortex. Consequently, central mechanisms would trigger a large sway to gather plantar tactile information.

To test this hypothesis, we compared the amplitude of the $P_{50}N_{90}$ somatosensory cortical potentials evoked by electrical stimulation of the foot sole during either small or large sways in 16 young adults while in a natural standing position with the eyes closed.

Our results showed greater $P_{50}N_{90}$ SEP amplitude during large sways as compared to small sways, consistent with an increased sensory transmission in the former case. In accordance with the microneurographic recordings during a continuous pressure applied to the mechanoreceptors, the discharge of the tactile fibers adapted and was halved within a few seconds.

Our hypothesis that large sways during standing correspond to a self-generated functional behaviour to release skin compression is supported by both cortical source and EMG analyses showing respectively that large sways were preceded by the activation of cortical areas known to be engaged in motor planning and by specific activation of the ankle muscles.

The present findings provide evidence for an important sensory function of large body sways for maintaining balance.

Keywords: plantar sole afferents, microneurography, natural standing, EEG, balance control

Acknowledgements: This study was supported by the CNRS defiAuton program and by the Natural Sciences and Engineering Research Council of Canada, discovery program to MS.

Dynamic of bimanual coordination and auditory perception of (in)congruent accented sequences

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Auditory-motor synchronization is an interesting tool for the acquisition and improvement of bimanual movement patterns. Research suggests that simple accentuation patterns in an auditory sequence can facilitate the production of congruent movement patterns. Also, little is known about how the production of these movement patterns affects in turn the perception of the auditory sequence. Here we investigated the capacity to produce 1:2 and 1:3 bimanual coordination with an accented (in)congruent auditory sequence (unaccented, binary or ternary accented) as illustrated in Fig. 1, and the corresponding auditory perception. Auditory perception of the (in)congruent sequences was assessed using EEG during passive listening following movement production to disentangle perception and action related EEG responses. Participants' bimanual coordination performance benefited from congruent conditions, and suffered from incongruent ones. Moreover, (in)congruence affected the perception of the auditory sequence, as indicated by amplitude modulation of the EEG auditory responses. Congruence between the 1:3 movement pattern performed in synchrony with a ternary accented auditory stimulus, induced during passive listening a heightened EEG response to the accentuation-specific frequencies. These results reveal that congruent accentuation can facilitate both perception and production of polyrhythmic patterns, and more generally, close interactions between the perceptual and motor systems. These findings provide new insights into the processes underlying polyrhythmic auditory-motor synchronisation, with potential applications for facilitating motor learning and rehabilitation with accentuated auditory sequences.

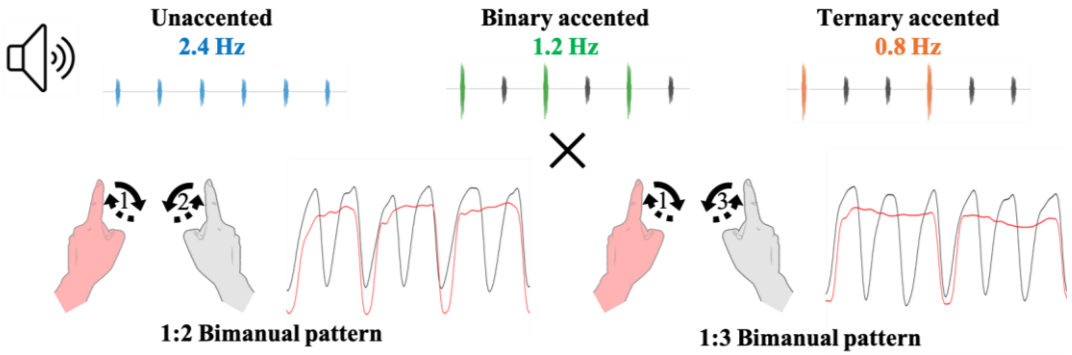

Fig. 1 Illustration of the six experimental conditions corresponding to the different possible (in)congruent combinations between auditory accented sequences and bimanual patterns.

Keywords: Auditory-motor synchronization, Bimanual, EEG, Auditory perception, Congruence

Sport leaves social life: Understanding drop-out from sports practice among French teenagers

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Sports practice is a way to be physically active. Despite public health efforts to support it, teenagers' sport participation is declining in some European countries. Little is known about the decreasing place of sport in their social lives. This study aimed to identify reasons given by teenagers about sports practice drop-out situated within their everyday lives, through 111 semi-structured interviews. Results made it possible to classify reasons for dropping-out into five domains of social life: friendship, body, family, school, and sport. The respondents mentioned one or several reasons. Depending on the moment of drop-out, some domains of social life played a preponderant role. The family seemed to be central in the decision to drop out during primary school, whereas the sports and school contexts were influential in middle and high schools respectively. The results regarding the prospect of a new engagement in sports practice are encouraging. But the results showed that the more recent the drop-out, the more the teenagers planned to resume sports practice. These data are relevant for health education policies. Drop-out needs to be identified as quickly as possible, before non-practice becomes durably established.

Keywords: sport; social life; drop-out; teenagers; public health.

Neck braces and types of powered-two-wheelers affect head mobility

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Objective: Cervical spine injuries are a major concern for motorcyclists in daily traffic accidents and racing competitions. The cervical range of motion is a decisive factor for the assessment of neck vulnerability as well as user comfort, but neck braces often impact head mobility. This study aims to quantify how different neck braces can modify head mobility for two different Powered Two Wheelers.

Methods: A motion analysis system was used to evaluate head mobility of motorcyclists depending on the driving posture and neck brace worn. Four neck braces and 2 different types of PTW were tested on 12 healthy volunteers to investigate the mobility restrictions induced by neck braces. Head axial rotation, lateral bending and flexion/extension were recorded, as well as translations (X, Y, Z axis), in order to quantify the maximum displacements of the head.

Results: The results showed that the driving posture induced by the type of PTW used has a significant influence on specific range of motion: axial rotation ($p=0.008$), Xaxis ($p=0.002$) translation and Zaxis translation ($p=0.002$). Wearing different neck braces using similar technologies changes significantly the head ROM, except for Z translation on the scooter and lateral bending on the racing motorbike.

Conclusion: The head mobility is reduced differently depending on the neck braces and driving posture. The motorcyclist's head restriction is changed depending of the neck brace's design. The type of PTW used by motorcyclists is an essential factor to consider for the evaluation of neck brace protection efficiency.

Keywords: Motorcyclist, Power-Two-Wheeler, Neck brace, Cervical Spine, Head Mobility

Effect of sex stereotype on cortical activity during a self-paced exercise: A motor-related cortical potential approach

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Previous research has shown that inducing a negative stereotype toward a group decreases motor performances (i.e., stereotype threat effect). Most of these studies focused on technical tasks that required coordination [1]. However, recent research has shown that when the task did not focus on technical aspects, inducing a negative stereotype toward one group led to a better performance of this group, as compared to when no stereotype was induced [2]. However, the mechanisms involved in such performance modifications are poorly understood. Therefore, the aim of the present study was to investigate the mechanisms involved in such performance increases.

Thirty-four participants were recruited and were assigned to one familiarization session followed by two experimental sessions. During these two last visits, participants were assigned to a 'negative stereotype toward women' condition and to a 'nullified-stereotype' condition in a randomized order and performed 80 intermittent isometric elbow contractions at a RPE 5 (i.e., effort « somewhat hard »). Strength development, motor-related cortical potentials (involved in preparatory processes in brain activity, MRCPs), and motivation were assessed.

Both men and women developed more strength when assigned to the 'negative stereotype toward women' condition, as compared to when assigned to the 'nullified-stereotype' condition. Women also reported that they were more motivated to outperform men in this same condition. Interestingly, the amplitude of readiness potential (one component of MRCPs) in the prefrontal cortex was higher for women when assigned to the 'negative stereotype toward women' condition.

The present research suggests that the prefrontal cortex plays an important role in the performance increases observed. As some studies have found a relationship between strength generated and amplitude of MRCPs [3], it may suggest that as women were more motivated, they planned to generate greater strength in the 'negative stereotype toward women' condition, resulting in the performance increases observed.

Keywords: sex stereotype, prefrontal cortex, stereotype lift, strength developed

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Perceived workload in driving simulation compared to real car driving

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Automobile manufacturers use driving simulators on a daily basis to test and validate their future technologies. However, a robust knowledge about the ecological validity of these tools is essential. Our goal is to complete this knowledge using real and simulated driving comparisons. We focused our approach on the driver's subjective feelings of workload [1], driving quality and ease [2]. Our study consists of a 40-minute drive on a city-type road, in a real car on a private circuit for one group and in a moving driving simulator for the other group. The participants rate their feeling of driving performance and driving ease on a scale of ten levels, before and after the drive concerning their own vehicle, and seven times during the drive on itself. At the end of the session, the drivers are asked to fill out the NASA-TLX questionnaire, which highlights their workload perception of the drive. The dimensions of Physical Demand, Temporal Demand, Effort, Frustration and the Total of this questionnaire are significantly higher for the simulation condition than for the real driving condition. Only the Mental Demand and the Performance are not significantly different between the two groups. With regards to the feeling of driving performance and ease, we found no significant difference between their own car and the real car condition. However, in the driving simulation condition, the drivers found that their driving performance and comfort level were lower, despite the increase of these scores during the drive. In conclusion, we can say that there is altogether a feeling that driving in a simulator is more difficult than in a real car.

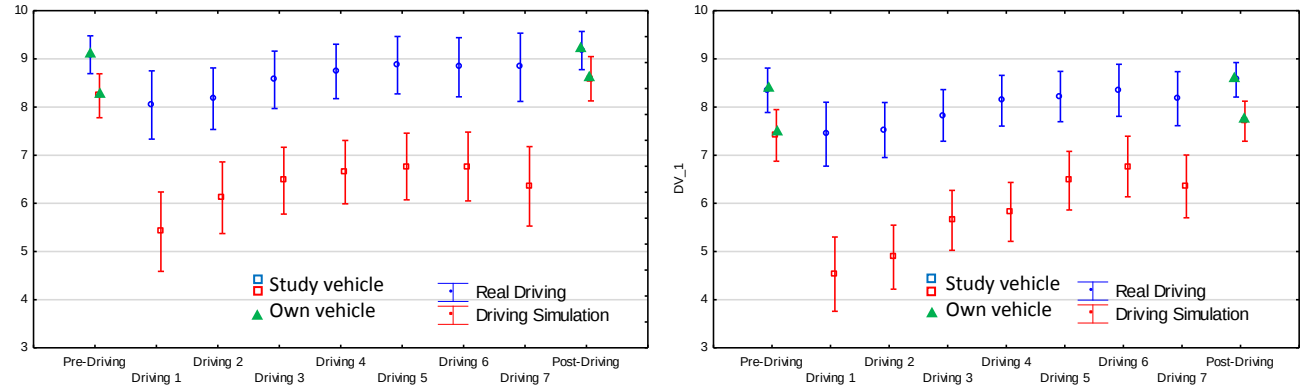

Fig. On the left, Question 1 about driving quality feeling. On the right, Question 2 about driving ease.

Keywords: Comparison Real and Simulated Driving, Driver Feeling, Workload, task difficulty.

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In vitro electrostimulation reveals impaired exercise training-induced muscle adaptation of COPD patient myotubes

Matthias Catteau*[1], Farès Gouzi[1,2], Léo Blervaque[1], Emilie Passerieux[1], Bronia Ayoub[1,2], Jacques Mercier[1,2], Maurice Hayot[1,2], Pascal Pomiès[1]

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Exercise training (ET) is the cornerstone of pulmonary rehabilitation for chronic obstructive pulmonary disease (COPD) patients[1]. However, COPD patients exhibit impaired ET-induced muscle adaptation that could limit the beneficial effects of ET[2–4].

Our objective was to compare the response of COPD and healthy myotubes subjected to an *in vitro* electrical pulse stimulation (EPS) mimicking ET.

Cultured myotubes from healthy subjects and COPD patients (n=9/group) were exposed to EPS during 24 hours. Morphological parameters as myotube diameter, fusion index and surface covered by myotubes were assessed with fluorescence microscopy. The fiber protein content (MHC1), and the protein synthesis (pAkt/Akt) and stress-related atrophic (pERK/ERK) pathways were assessed by *Western blotting.*

EPS trended to increase the diameter of healthy myotubes while it decreased the diameter of COPD myotubes (+3.8±9.4% vs -4.6±4.0%, Interaction: p=0.013). This was supported by a distribution frequency analysis showing a shift toward thinner myotubes in COPD condition (p=0.028), associated with a decreased fusion index (+4.7±6.7% vs -2.6±6.2%, Interaction: p=0.016) and surface covered by myotube (+4.5±8.2% vs -5.3±8.9%, Interaction: p=0.042). EPS had no effect on the pAKT/AKT ratio in both healthy and COPD myotubes. However, EPS enhanced the expression of MHC1 in healthy myotubes but not in COPD myotubes (+32±9% vs -4±11%, p=0.026), while EPS increased the pERK/ERK ratio in COPD myotubes with no effect in healthy myotubes (-4%±22% vs +30±34%, p=0.044).

While EPS trends to induce an hypertrophy of the healthy myotubes, it fails to reverse the atrophic phenotype of COPD myotubes. This impairment could be driven by an uncontrolled stress-related response suggesting that i*n vitro* EPS well reproduces the impaired ET-induced muscle adaptation occurring in COPD patients. This i*n vitro* model of ET represents a promising tool to investigate these issues.

Keywords: Chronic Obstructive Pulmonary Disease, Exercice-training, Muscle Adaptation, Electrostimulation, *In vitro*

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Communications affichées
Hall de la Faculté des Sciences du Sport
14h30 – 16h00

Aubin Lise - Unintentional rhythmical entrainment and attentional processes in HMI

Blervaque Léo - Efficiency of a pragmatic pulmonary rehabilitation maintenance program in patients with obstructive lung disease

Calabrese Carmela - A deeper look on motor coordination in human groups

Danthony Sarah - Test anxiety in physical education: the predictive role of the 3x2 achievement goal model

Denis Gauthier - Testing the role of cognitive inhibition in physical endurance using high-definition transcranial direct current stimulation over the prefrontal cortex

Faudot Barthélémy - Mechanical performance comparison of two types of wrist four-corner fusion plate

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Lantoine Pascaline - Effects of car seats on posture and discomfort during long-duration driving on a static simulator

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Lin Xi - ChromaTouch: Sensing the frictional state of a robotic skin via subtractive color mixing

Marsal Claire - Beliefs of physiotherapy and appreciation of the concept of movement in the new era of educational methods empowering patients with chronic disabilities, especially neurological, leading them to take possession of their rehabilitative activity

Pavlin Laura - eIF3f depletion impedes mouse embryonic development, reduces adult skeletal muscle mass and amplifies muscle loss during disuse

Rousseau Nicolas - Human osteoblast cell lines behaviour on titanium materials with various surface features: a correlation with fibronectin adsorption

Sudres Patrice - MR-based Geometrical Characterization of the Cervical Subarachnoid Space (CSS): Effects of Neck Flexion in Healthy Volunteers

Sysaykeo Delphine - Implementation of bio-inspired design for pivot mechanism in helicopter

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Vattikonda Anirudh Nihalani - Identifying spatio-temporal seizure propagation patterns using Bayesian Inference

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Willemet Laurence - Mind the spatiotemporal gap: Skin viscoelasticity limits our perception of discontinuous motion

Unintentional rhythmical entrainment and attentional processes in HMI

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To date, interpersonal coordination between humans has been extensively studied. We know that they have social functions such as synchrony and imitation. Moreover, an interesting aspect is their unintentional nature, in fact, entrainment effect during interactions is spontaneous, unavoidable and happens using preferential patterns [1]. However, interpersonal coordination in human-machine interactions (HMI) has hardly been investigated. The goal of this thesis is twofold: on one hand, study attentional process in HMI while investigating the non-intentional motor coordination between human and machine and on the other, develop a bio-inspired sensorimotor model using force control for an adaptative IHM allowing unintentional coordination in a most ecological task.

Therefore, a first experiment has been done to see how the unintentional entrainment phenomena impact our attention. To do so, we developed an interface video game-like requiring high attentional level and capable of synchronizing with subjects in real time. We have been recording reaction time (to different visual, audio and audio-visual alarms), eye tracker and motion capture data to address the following questions:

Does reaction time change if the interface synchronizes with people or not? Or does the frequency of the alarm can have an impact too? Results are still being processed.

On the other hand, our second objective is to develop a model of an arm able to achieve an ecological task that can be done in interaction with a human such as sorting objects. To do so, we first reproduced the force control model provided by E. Guigon, 2007 and tested it on a planar three joints arm simulated on Gazebo with three pairs of muscles, two mono-articular and one bi-articular and six degree of freedom. We are actually working on how to introduce rhythmical control to the model to allow synchronization by the use of dynamical systems theories.

Keywords: human-machine interactions, attentional processes, non-intentional motor coordination

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Efficiency of a pragmatic pulmonary rehabilitation maintenance program in patients with obstructive lung disease

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Despite an indisputable efficiency of pulmonary rehabilitation (PR) in management of obstructive lung disease (OLD), PR benefits decline rapidly and are often lost after 12 months [1]. Numerous maintenance strategies have been tested, but these programs appear often unpragmatic and their effects were only investigated for 3 years maximum. This study assed the stabilization of PR benefits over 7 years of a pragmatic maintenance program in patients with OLD.
Data from 289 OLD patients who followed a PR maintenance program lasting from 1 to 7 years were prospectively collected. One session/week of supervised exercise training and 8 sessions/year of therapeutic education were performed in self-help associations, within a healthcare network. Data were analyzed using mixed effect linear models.
No significant deterioration of quality of life (VQ11 score; $p=0.52$), dyspnea ($p=0.10$) was observed over the 7 years of follow-up. Conversely, we found a decline of 6MWD (%predic.; $p<0.01$) but observable only from the 60th month ($p<0.05$).
With this study, we bring first evidence that PR benefits can be preserved with a pragmatic maintenance program, until 5 years for exercise tolerance and 7 years for dyspnea and quality of life. These results showed an efficient and cost-effective way to avoid the benefit loss occurring one year after PR in OLD patients.

Keywords: Maintenance programs, obstructive lung disease, exercise tolerance.

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A deeper look on motor coordination in human groups.

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Perceptual motor synchronization in human groups is crucial to enhance team performance in musical ensembles or dancers' crews. Most of the existing studies focus on dyadic coordination [1], and the investigation of ensembles of three or more individuals remains preliminary [2]. In this research, we propose to study motor group synchronization across different experimental setups and conditions, so as to improve our understanding of the main factors leading to human coordination, specifically related to the presence of visual and acoustical coupling, the spatial organisation and the individual characteristics of the group's participants. To this aim, we built two flexible experimental setups allowing to implement the so-called *mirror game* [3], which is considered a paradigmatic coordination task in human groups: participants perform an oscillatory task and are asked to synchronize their motion. We show the results obtained across different groups of participants, characterized by homogeneous and heterogeneous natural frequencies, by expertise and inexperience in rhythmic activity and by presence and lack of social interaction. For each group, we considered 4 different experimental conditions in which the topology of the interaction varied from the most (complete graph) to the least connected topology (path graph). A common outcome of all experimental conditions was that when participants synchronized the oscillation frequency decreased compared to the mean individual frequency. Additionally, the way participants were visually coupled influenced more the degree of synchronization in the group than the homogeneity of their individual frequencies. In particular, a more robust phase synchronization emerged in the all-to-all and star graphs. Finally, we were able to quantify the group's ability to keep the quality of synchronization reached during the interaction almost constant- *social memory*- and how the group's composition influences it. The emerging outcomes complement different and sparse results in literature, providing a more comprehensive understanding of motor group synchronization.

Keywords: group motor synchronization, mirror game.

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Test anxiety in physical education: the predictive role of the 3x2 achievement goal model

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Based on five dimensions, a new scale has been recently developed (Danthony, Mascret, & Cury, in press) to assess test anxiety in physical education (PE). Four dimensions are negatively-toned: worry (thoughts related to failure), self-focus (what other say or think about my performance), bodily symptoms (specific physiological effects), and somatic tension (general autonomic arousal). The fifth dimension, positively-toned, is labeled perceived control (the capacity to cope and attain goals under stress). The present study examined test anxiety in the PE context in relation with the 3x2 achievement goal model, which was recently used in the general test anxiety literature (Flanagan, Putwain, & Caltabiano, 2015). This model distinguished three definitions (task, self, other) and two valences (approach, avoidance) of competence, leading to six achievement goals (Elliot, Murayama, & Pekrun, 2011). Therefore, the aim of the study was to investigate the predictive role of the 3x2 achievement goal model on test anxiety in the specific PE context.

486 French students (M_{age} = 15.83, *SD* = 1.20) voluntarily and anonymously filled out the RTAR-PE scale assessing test anxiety in PE (Danthony et al., in press) and the AGQ-S assessing the six achievement goals (Mascret, Elliot, & Cury, 2015). Hierarchical regression analyses highlighted that (1) worry was negatively predicted by task-approach goals and positively predicted by self-avoidance goals; (2) self-focus was negatively predicted by task-approach goals and positively predicted by task-avoidance goals; (3) bodily symptoms were negatively predicted by self-approach goals and positively predicted by self-avoidance goals; (4) somatic tension was negatively predicted by task- and self-approach goals and positively predicted by self-avoidance goals; (5) perceived control was positively predicted by task- and other-approach goals and negatively predicted by other-avoidance goals. A better understanding by PE teachers of the psychological characteristics of their students (such as achievement goals) may decrease test anxiety in PE.

Keywords: test anxiety, perceived control, achievement goals, physical education

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Testing the role of cognitive inhibition in physical endurance using high-definition transcranial direct current stimulation over the prefrontal cortex.

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The aim of this study was to clarify the role of the prefrontal cortex (PFC) in physical effort regulation. In line with previous work indicating a relationship between cognitive inhibitory control and the maintenance of physical effort (Cona et al., 2015; Ekkekakis, 2009; Perrey et al., 2016), we hypothesized that the PFC would be progressively involved in physical endurance through the engagement of cognitive inhibition, which would be necessary to maintain effort by inhibiting fatigue-related cues. This hypothesis was examined using a double-blind, sham-controlled, within-subjects study (N = 20) using high-definition (HD) transcranial direct current stimulation (tDCS) over the dorsolateral prefrontal cortex (dlPFC). Participants had to maintain a knee extensor contraction at 30% of their maximal force while simultaneously performing an Eriksen flanker task to evaluate their inhibition performance during the task. Anodal stimulation of the dlPFC influenced response to the cognitive task during exercise, as seen by slower response times and better accuracy. However, it did not lead to any measureable improvement in cognitive inhibition and did not influence endurance time. There was no correlation between cognitive inhibition and the maintenance of physical effort. This result could be explained by some methodological limitations of our protocol. We also provide alternative explanations for the contribution of the PFC in physical endurance through its involvement on decisional processes.

Keywords*:* physical endurance; transcranial direct current stimulation; dorsolateral prefrontal cortex; cognitive inhibition.

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Mechanical performance comparison of two types of wrist four-corner fusion plate

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Four-corner arthrodesis (lunate-capitate-hamate-triquetrum) with scaphoid excision is intended for patients suffering from radiocarpal arthritis or carpal instability. Nowadays, four-corner arthrodesis are performed through a dorsal approach and fixation achieved with a plating. A high number of non-unions and dorsal impingement [1] have been reported. A lateral plating approach has been recently developed by NewClip Technics company to decrease the complication rate. The aim of this study is to evaluate and to compare the mechanical performance of the two types of four-corner fusion plate using a finite element model of the wrist during classical hand grip positions.

An anatomically accurate three-dimensional finite element model of the healthy wrist was modelled representing bones, cartilage and ligaments. Physiological realistic loads were applied on the five metacarpal bones representing a maximal strength static grip action [2] with radius and ulna fixed (figure 1). The lateral (figure 1.A) and dorsal plate (figure 1.B) were positioned in the numerical model with respectively five and seven non-locking screws.

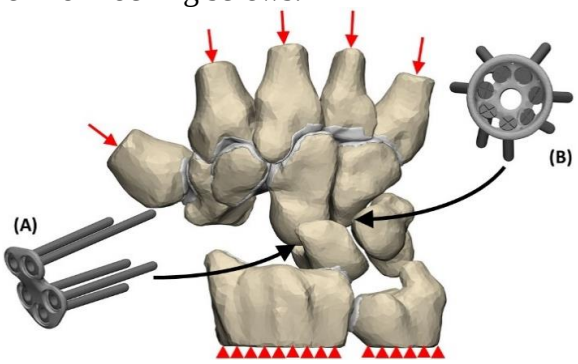

Figure 1: Finite element model of the wrist with the loads applied on the metacarpal bones, radius and ulna fixed. Four-corner arthrodesis with (A) a lateral plating approach and (B) a dorsal plating approach

The validation of the healthy wrist numerical model was carried out by comparing the load distribution on the joints with results from the literature [2]. Screws from dorsal plating approach were subjected to higher stress than screws from lateral plating approach with a stress concentration at the plate-screw interface. The relative displacement of bones in the lateral plating approach was lower than those from the dorsal plating approach. The lateral plating approach is a more stable construct because no pull-out forces are applied onto the screws. Therefore, the lateral plating approach is mechanically promising and could improve clinical outcomes.

Keywords: wrist arthrodesis; four corner fusion plate; finite element method; mechanical performance

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A novel single leg forward hurdle hop test: lower extremity stiffness and joint mechanical outputs

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Introduction

Lower-limb stiffness has been linked to athletic performance and injury[1].The contribution of joint stiffness to whole-body vertical (K_{vert}) and leg (K_{leg}) stiffness is task dependent. The purpose of this study was to investigate the relationship between sagittal plane ankle and knee joint mechanics with K_{leg}, K_{vert} and performance in a single leg horizontal plyometric task.

Methods

Ten male participants took part in two testing sessions fourteen days apart and completed 10 trials on each leg. Participants were required to perform two maximal-length hops over 15cm hurdles, rebounding quickly off a force platform in between, whilst ground reaction force and 3D motion capture data were recorded. Pearson correlation coefficient analysis was employed to determine the correlation between contact time, ankle (K_{ankle}) and knee (K_{knee}) joint stiffness, moments, powers and displacements; with hop distance, K_{vert} and K_{leg}. Joint stiffness, moments and powers were compared at the ankle, knee and hip respectively, using a one-way repeated measures ANOVA with significance ($p < 0.05$) and Cohen's d effect sizes calculated, and magnitude based inferences reported using Hopkins' thresholds[2].

Results

K_{knee} was greater than K_{ankle} ($p<0.05$). Higher mean values for peak joint moment were observed at the knee ($p<0.05$) and joint power at the ankle ($p<0.05$). K_{ankle} had the highest correlation with K_{vert} ($r=.52$) and K_{leg} ($r=.57$) respectively. Contact time had a very large effect on K_{vert} ($r=.71$) and K_{leg} ($r=.66$). Knee joint moment and ankle, knee and hip joint powers had a small effect on hop distance.

Conclusion

Horizontal plyometric exercises require higher stiffness at the knee, due to higher peak joint moments and less angular displacements. The higher joint powers observed at the ankle, and the correlation between ankle joint stiffness with vertical and leg stiffness; may indicate the potential use of this task to assess single leg horizontal plyometric performance.

Keywords: Stiffness, Hopping, Performance, Injury, Rehabilitation

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The effect of ultrasonic stimulation on inception slip

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Human can grasp, manipulate and explore in part because the soft and conformable skin that surrounds our fingertip exhibit high level of frictional resistance with a wide variety of materials. However the exact physics relating fingertip friction is not well understood. The fingertip is a non-homogeneous viscoelastic body which surface is textured and reveals interesting behavior.

In particular during incipient slippage --- i.e. the moment before the skin starts to slide --- exhibit a markedly decrease of the area of contact [1]. As the pattern of extinguishment is unique for various surface and depend mostly on the coefficient of friction, we have postulated that this behavior can be a dominant cues of the perception of various.

To test this hypothesis, we use ultrasonic friction modulation. Ultrasonic vibration creates an overpressure between the skin and a glass plate, which supports the load and reduction significantly of the real area of contact. A clear relationship between the area of contact and the amplitude of vibration has been demonstrated [2]. In this study we investigate the influence of ultrasonic vibration on inception slip [1].

Keywords: Ultrasonic vibration, static friction, area of real contact, fingertip, squeeze film

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Is skeletal muscle remodeling is associated with gut microbiota signature?

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Bacteria sheltered in gut impact on the physiology and function of several distant organs such as liver, adipose tissue or brain. Several published works, including our recent report, strongly suggest the existence of a functional crosstalk between gut microbiota and skeletal muscles. However, this gut microbiota-muscle axis requires further support. We investigated this cross-talk in mice with a specific muscle phenotype, the myostatin invalidated mice (KO mstn), a lean model presenting hypertrophic fatigable muscles. First, we defined their gut microbiota signature before and after a 4-weeks aerobic endurance training. Second, we studied the impact of a 3-months gut microbiota transfer from trained KO mstn mice to sedentary WT mice. We showed that KO mstn mice, display a specific microbiota signature characterized notably by a decrease of Firmicutes and Proteobacteria phyla. Interestingly, aerobic endurance training induced a normalization of gut microbiota signature of KO-mstn mice towards the WT profile. Furthermore, we highlighted an over-expression of an intestinal fat storage inhibitor (Fiaf) that could contribute to the lean phenotype of mstn KO mice. Remarkably, this Fiaf over-expression was also normalized by endurance training. Finally, we will present some preliminary data of gut microbiota transfer experiments from trained KO mice to sedentary WT mice focusing on muscle function and host metabolism. Characterizing the precise mechanisms of the cross-talk between gut microbiota and skeletal muscles combined with the beneficial effect of exercise could open promising therapeutic strategies for muscle-related disorders or other metabolism pathologies.

Keywords: treadmill**,** exercise**,** mitochondria, microbiome, intestin

Effects of car seats on posture and discomfort during long-duration driving on a static simulator

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Modern behaviors have made human beings sedentary. People spend nearly 10 hours sitting per day. It appears that sitting posture results in changes of spinal curvatures (decrease of lumbar lordosis) and on the pelvis orientation (tilts backwards) [1]. The persistence of those postural changes over time can cause a forward-bend of the trunk, an impairment of intervertebral disc nutrition, a modification of the back muscles stiffness and/or a local ischemia in the buttocks [2]. A prolonged sitting posture is therefore a risk factor for postural discomfort, as well as the appearance of pain, especially back pain (BP). In driving conditions, there is a higher risk of BP among professional drivers, and driving tasks can exacerbate painful symptoms amongst people who are already suffering from it. Multiple strategies helping the reduction of this discomfort are available, such as repositioning movements (RM) [3]. The RM's frequency increases with driving time, and more specifically for BP's group. Different patterns of such RM have been be identified such as shift and fidget movements [4]. Therefore, car seats have a major role in reducing these symptoms, but their efficiency depends on their design. This study aims to compare the effects of two different seats (seat A – and seat B – firm) on drivers' posture and their perception of discomfort during a long-time driving. For this purpose, twenty participants carried out two three-hours driving sessions with both seats on a static simulator. Every 20 minutes, they self-assessed the level of discomfort suffered over their whole-body and on each part of their body. Objective posture measurements (contact area (CA), mean pressure (MP), total pressure (TP), estimated load (EL), and repositioning movements (RM)) have been recorded for 3 hours thanks to two pressure maps positioned on cushions and backrests.

Keywords: seat design, long-duration driving, posture, discomfort

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Peripersonal space and the experienced perturbation of a new force-field: story of a contraction

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In daily life, we are surrounded by objects we can interact with. To reach an object of interest with the hand, we have to judge whether the object is within our peripersonal space or not. How this judgment is made represents a compelling question.
It has been suggested that such a seemingly perceptual task may imply a motor component. Indeed, experimental studies demonstrated an effect of sensorimotor adaptation to a biased visual feedback on both the proprioceptive estimate of the arm and the judgment of reachability. The changes in motor behavior observed in adaptation paradigms are thought to be related to the updating of internal models which impacts in parallel both the motor commands and the prediction of their sensory consequences. Adaptation can be observed in the context of changes in the geometrical properties of the body, or changes in the inertial, dynamic properties of the limb. However, the effect of adapting to new limb dynamics on the perception of reachability and the representation of peripersonal space has not been investigated so far.
In this context, our aim was to assess the effect of sensorimotor adaptation to a new force field environment inducing change of limb dynamics on the representation of peripersonal space. We asked two groups of participants to sit on-axis of a rotating platform. Each group performed successively a manual reaching task and a perceptual task consisting in judging the reachability of visual targets. The experiment was divided in PRE-, PER- and POST-rotation periods. Participants completed the motor task during PRE-, PER- (adaptative phase) and POST-rotation conditions, but the perceptual task only in PRE- and POST- rotation, that is just before and after adaptative phase. To precisely assess the effect of sensory-motor adaptation on reachability judgement, we submitted both groups to different mechanical perturbations. Indeed, one group rotated clockwise and the other counter-clockwise, resulting in in opposite motor perturbation and then to specific adaptive processes.
Results showed that peripersonal space representation was systematically reduced in the direction the mechanical perturbation. These findings clearly suggest that peripersonal space representation is linked to the changes of limb dynamics but is independent of the direction of the sensory-motor adaptation. This "non-specific" effect could suggest that the change in peripersonal space representation is more related to the detection of an initial movement error during rotation rather than to the process of sensorimotor adaptation per se. We speculate that such error detection triggers a default, non-specific reduction of the representation of peripersonal space because of its defensive properties.

Keywords: force-field adaptation, internal models, manual reaching, reachability judgement, peripersonal space

ChromaTouch: Sensing the frictional state of a robotic skin via subtractive color mixing

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The perception of the properties of a surface such as its shape and its friction is crucial to ensure that a hand-held object is stable. Nowadays, the contribution of tactile sensing to grasping and manipulation has been well recognized. Since cameras provide a fast and reliable way of transferring real-time data to a controller, many artificial fingertips using an off-the-shelf optical sensors to capture the information of the contact surface are developed, which help reducing the system complexity of electronic interconnections in piezo-resistive or capacitive sensor arrays.

Here, we demonstrate a soft tactile sensor based on a subtractive color mixing process. The sensor captures the mixing of two colors of two superimposed layers of markers with a high-resolution camera. From the variation of position as well as the chroma of the marker we are able to track the distributed 3-D deformation of the contact surface and infer the strain within the elastic substrate.

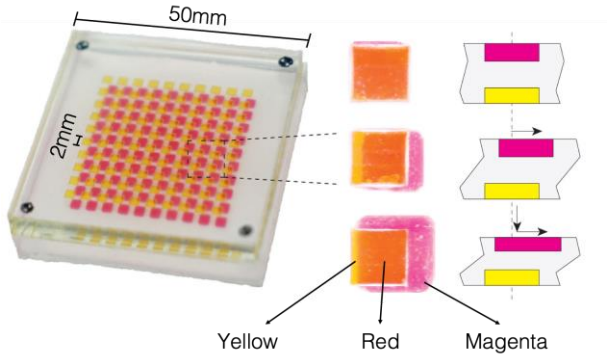

Fig.1. The tactile sensor and its sensing principle

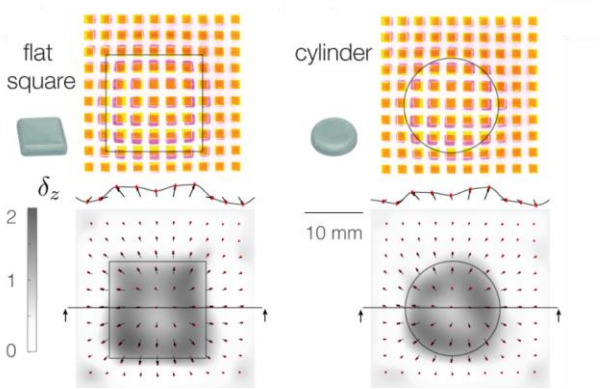

Fig.2. Reconstruction of 3D displacement field

The color pattern of each marker can be tracked with little computation and remains robust to external lighting. The ability to sense the 3-D deformation field can improve robotic perception of frictional properties that have applications in the fields of robotic control and human-robot interactions.

Beliefs of physiotherapy and appreciation of the concept of movement in the new era of educational methods empowering patients with chronic disabilities, especially neurological, leading them to take possession of their rehabilitative activity.

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The stroke is a sudden accident with long-term neurological functional limitations. The reeducative follow-up is insufficient, the patients and their family have a feeling of abandonment when they return home, with lack of medical support [1]. However, the patients, after a stroke, can improve thanks to exercises in amount and in sufficient intensity [2,3]. Our hypothesis is that few patients practice "self-education" because the actors (physician, physiotherapist) do not offer them. The latter do not put it in place because they do not yet work, for many of them, in a therapeutic education model. Difficulties such as physical, cognitive, and self-confidence deficits limit patient engagement in personal home self-exercise. The method was to ask questionnaires from the various actors = patients, physiotherapists, physicians on their representation of the setting up and the follow-up of Guided Self-Rehabilitation Contracts. The first study was with 248 physiotherapy students, 129 professionals and 65 physicians. The time needed for rehabilitation is underestimated, as is the functional recovery period [4,5]. The second study concerns 59 physiotherapists and occupational therapists surveyed at the beginning of the in-center continuing education on Guided Self-Rehabilitation Contracts. The autonomy and motivation of the patient are well identified, but little the intensity of the necessary rehabilitation. The third study, involving 200 patients, questions their commitment to practice self-exercises and the obstacles to the implementation of this new behavior. Fatigue is the first brake expressed, followed by lack of strength and fear of falling. A quarter of them do not feel like it. Self-management after stroke. Self-management after a stroke depends primarily on the willingness of the actors to undertake it [6].

Keywords: Stroke – Self-rehabilitation - Beliefs of rehabilitation - Surveys

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eIF3f depletion impedes mouse embryonic development, reduces adult skeletal muscle mass and amplifies muscle loss during disuse

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Eukaryotic translation initiation factor 3, subunit F (eIF3f), a component of eIF3 complex, plays an important role in protein synthesis regulation but its physiological functions are unknown. *In vitro*, eIF3f acts like a scaffold protein that interconnects MTORC1 complex to S6K1 in differentiated myotubes. Upon MTOR-dependent activation, S6K1 is released from eIF3f, phosphorylates its substrates, enhancing translational capacity that leads to muscular hypertrophy. Conversely, reduced eIF3f expression in muscle cells results in a decrease of MTORC1 substrates phosphorylation levels associated to myotubes atrophy.

In a knockout approach, we generated and analyzed mice carrying a null mutation in the *eIF3f* gene. We showed that homozygous eIF3f knockout fail to develop and that eIF3f$^{-/-}$ embryos die at an early stage of development but after preimplantation stage. However, disrupting one *eIF3f* allele does not affect growth, viability and fertility of heterozygous mice but reduces eIF3f mRNA and protein level in all tissues examined. Although heterozygous mice are phenotypically indistinguishable from wild-type mice, they present a diminished body weight and a lean mass reduction associated with normal body size.

Interestingly, skeletal muscles are mainly affected and display an altered cell size without modification of fiber number. Skeletal muscles of heterozygous mice show a deficiency in polysome content, a decrease in protein synthesis rate and an inhibition of the MTOR pathway. Then, we studied the effects of hindlimb immobilization that mimic muscle disuse on heterozygous mice to further explore eIF3f involvement in protein synthesis. We found that eIF3f partial depletion amplifies muscle atrophy compared to wild-type mice. Mass and cross-sectional area decreases were associated to reduced MTOR pathway activation and protein synthesis rate.

Taken together, our data indicate that eIF3f is essential for mice embryonic development and controls adult skeletal muscle mass through protein synthesis regulation in a MTOR-dependent manner.

Keywords: eIF3f knockout, MTOR, protein synthesis, skeletal muscle homeostasis

Human osteoblast cell lines behaviour on titanium materials with various surface features: a correlation with fibronectin adsorption.

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Protein adsorption on the surface of an endosseous implant is one of the first event following its insertion and contact with blood [1]. While many papers address proteins behaviour with respect to materials and topologies, such proteins/surface interactions remain very controversial [2,3]. The objective of this study is to compare the impact of different chemical titanium surface treatments on fibronectin adsorption, and to define the influence of such adsorption on the adhesion, proliferation and differentiation of osteoblast cell lines. Commercially pure titanium (grade 2) and extra low interstitial titanium alloy (Ti6Al4V ELI) are studied with four different surface topologies: Raw, anodized surfaces (only for Ti6Al4V surfaces), Starsurf® and nanotubular structured surfaces. Physico-chemical characterization of substrates is conducted to investigate surfaces crystallinity and chemistry, roughness properties, morphologies and hydrophilicity. Osteoblast cell lines will be grown until 6 days on the substrates, in a Dulbecco's Modified Eagles Medium (DMEM) supplemented with foetal bovine serum (FBS) and penicillin-streptomycin (P/S). Following incubation, cells adhesion, viability, alkaline phosphatase activity and the presence of osteocalcin will be investigated. Fibronectin adsorption is assessed with the same medium independently. Feasibility results on Ti6Al4V samples demonstrated the presence of anatase crystals on nanotubular surfaces only. Calcium and phosphorus have been found on all surfaces. Starsurf® and nanotubular structured surfaces have shown the presence of iron and the absence of aluminium and vanadium. Investigation with a greater sampling (850 samples) is currently conducted to assess the fibronectin and osteoblast cell lines behaviour on these substrates. Such investigation is intended to provide data for computational peri-implant bone healing models.

Keywords: Protein adsorption, biomaterials, chemical surface treatment, osteoconduction.

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MR-based geometrical characterization of the Cervical Subarachnoid Space (CSS): Effects of neck flexion in healthy volunteers

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Introduction

Kinematics MRI mostly aims at assessing sagittal changes of the cervical spine with degenerative diseases (myelopathy) and provide useful parameters, such as cross-sectional areas (CSA) which can be used in a clinical context [1]. The purpose of this study was to quantify the CSS CSA in both neutral/flexion positions by a new methodology based on a post-processing algorithm of 3D segmentations.

Methods

Eleven healthy subjects (5 f and 6 m, mean age : 30 +/- 6y) underwent cervical MRI (3T Siemens system, neck coil, sequence : T2 - 3D SPACE, voxel resolution : 1 mm, thickness : 1mm). The acquisitions were done in two steps : firstly in neutral supine position and in supine position with neck flexion insured by a dedicated device . The MR protocol was approved by the institutional ethics committee and all subjects signed the informed consents. The cohort was chosen excluding history or presence of cervical pathologies or deformations.
Firstly, the spinal cord (SC) was segmented in 3D by a semi-automatic approach from the Spinal Cord Toolbox [2] resulting in a smoothed surface mesh. Secondly, the smoothed surface mesh of the external border of the canal, assumed as the system dura/arachnoid mater, was assessed by a semi-automatic segmentation of the CSS from ITK-SNAP software [3].
Planes orthogonal to the centerline of the SC were defined from C1 odontoid to C7 inferior endplate. The boundaries of the SC and the SDAM are computed thanks to a surface mesh intersection algorithm [4], all the process used a homemade Matlab pipeline.

CSA_{CSS} is equal to :

$$CSA_{CSS} = CSA_{tot} - CSA_{SC} \quad (1)$$

Results & Discussion

The difference between neutral and flexion positions mean values decreases from 100 mm2 (C1-C2) to 0 mm2 (C3) and to 30 mm2 (C6-C7). Such behavior appears to be consistent in all the population. The upper cervical has a higher mobility than lower cervical part. That can explain the high CSA difference. These measures can be useful to validate the geometrical behavior of a finite element model with CSS.

Keywords : MRI, morphometry, cervical, subarachnoid space, flexion

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Implementation of bio-inspired design for pivot mechanism in helicopter

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CIFRE thesis with the team of Bio-inspired Design from ISM and Airbus Helicopters

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The aim of this thesis is to contribute to the design and validation of a new bio-inspired mechanical link suitable for dynamic systems of helicopter. We notice that the mechanical constructive principles remain the same for years and there is no more huge progress. The nature which is in continuous change could be an inspiration to new mechanical link design.

After study of the fixed scissor mechanism of a helicopter, troubles with the journal bearings were highlighted. We notice indeed that misalignment in the scissor mechanism induce overpressure at the endpoint of journal bearing, as shown figure 1.

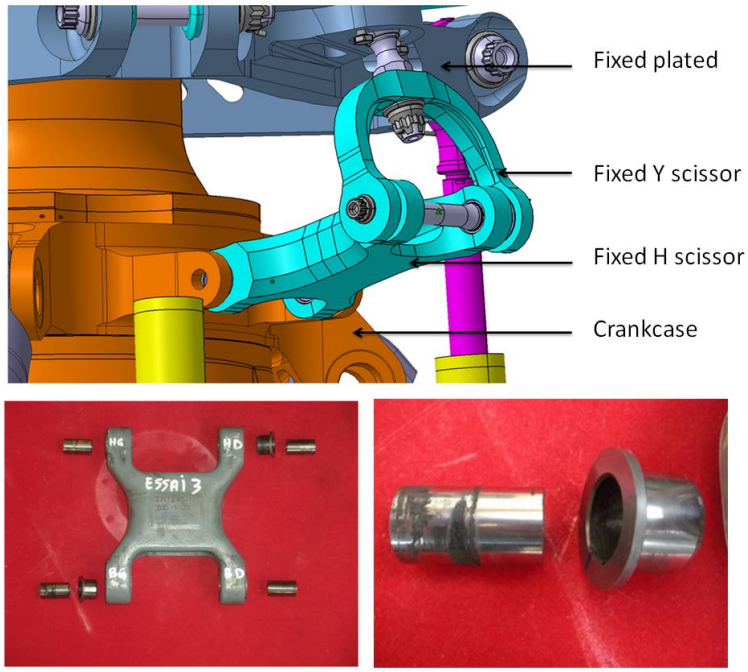

Figure 1: CAD of fixed scissor and photos of journal bearing and spacer after testing

In parallel, researches on biological joint of sheep were done, especially the geometric shape of elbow sheep. Thanks to 3D scan of the elbow bone, we analysed the contact surfaces. The surfaces are far from looking like surfaces that we use in mechanic. According to the different constraints of design and manufacture, a series of new geometric design of journal bearing was bio-inspired and drawn in CAD software. In order to evaluate the performance of the different designs and parameters, simulations with finite elements were performed. The simulations were pre-processed with the software NX and calculate with the solver Samcef. In our case, the objective is to have the best distribution of pressure and the lowest contact pressure.

Keywords: bio-inspired design, joint, contact, journal bearing, finite elements simulation

Sensorimotor adaptation transfers to the opposite limb despite a severed corpus callosum

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When humans adapt with one limb to a sensorimotor perturbation, this adaptation can generalize to a different workspace, or even to the opposite limb. Such generalization across limbs is known as interlimb transfer, and despite being well documented in the literature, there are still questions surrounding the underlying neural mechanisms [1]. For instance, several theoretical models highlight the corpus callosum as a potential key structure for mediating transfer [2][3], however, certain research indicates the involvement of ipsilateral projections [4]. To investigate the role of the corpus callosum in interlimb transfer, we implemented a prismatic adaptation protocol to test for transfer from dominant to non-dominant arm and from non-dominant to dominant arm in a range of patients with corpus callosum injuries. Based on the models indicating the corpus callosum as a key brain structure mediating interlimb transfer, it would be hypothesized that such patients should not show interlimb transfer. Our key finding was that an agenesis patient and two patients with recently acquired corpus callosum lesions demonstrated normal prismatic adaptation but also significant interlimb transfer from the dominant to non-dominant arm. Further, two of the patients also showed significant interlimb transfer from non-dominant to dominant arm. These results indicate that interlimb transfer of sensorimotor adaptation can be observed despite lesions or complete absence of the corpus callosum and thus suggests that interlimb transfer of sensorimotor adaptation is mediated by ipsilateral projections between the hemisphere and the arm [4], the cerebellum [5] or the basal ganglia [6].

Keywords: Sensorimotor Adaptation; Prismatic perturbation; Cross Education; Interlimb Transfer; Corpus callosum

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Identifying spatio-temporal seizure propagation patterns using Bayesian Inference

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Epilepsy is a common neurological disorder characterised by unpredictable seizures, affecting all age groups. There are various types of epileptic seizures varying from person to person. Focal seizures are a common class of epileptic seizures occurring in around 60% of epileptic patients. Focal seizures are classified as seizures originating in a particular region of the brain, usually referred to as epileptogenic zone, and may propagate to other regions. Currently, focal drug resistant epilepsy is treated by resecting the epileptogenic zone. However, identifying epileptogenic zone has been a challenging problem due to a) Sensitivity of non-invasive whole brain neuroimaging methods to any major movements during observation, making them infeasible for recording seizure data b) highly sparse observations made through invasive methods such as stereotactic electroencephelography(SEEG). We propose that the challenges with SEEG are addressable using a model based approach to fit important features of seizure dynamics. Specifically, we infer the spatio-temporal propagation pattern of seizures by inverting a dynamical model, Epileptor, to fit the SEEG power in a Bayesian framework. Epileptor is a dynamical model which was developed to capture critical features of seizure dynamics such as seizure onset, offset and logarithmic scaling of interspike intervals [1,2]. Using epileptor as a model for source dynamics and an estimation of projection matrix from source space to sensor space we developed a probabilistic model to predict log. SEEG power. We then infer the source dynamics and epileptor parameters, representing spatial distribution of epileptogenicity, using Bayesian inference techniques such as Hamiltonian Monte Carlo (HMC). HMC can however fail if the probabilistic model is not identifiable. In this work, we first demonstrate using simulated datasets of seizures that our probabilistic model is identifiable under some soft constraints. Finally, we compare the estimated epileptogenic zone with clinical hypothesis of a retrospective patient dataset.

Keywords: Epileptogenic zone, SEEG, Bayesian inference

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A study of aerial righting reflex in hoverflies *Episyrphus balteatus*

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Hoverflies feature stunning aerial capabilities allowing them to orient themselves in various positions and orientations. For example, when taking off from the ceiling, flies must reorient dorsoventrally and stabilize body rotations via active control of their flapping wings. Righting reflex has been shown to exist in mammalian and wingless insects but have never been studied so far in winged insects [1]. After being released upside-down and dropped in free fall, hoverflies systematically rotate their body in roll once the wingbeat triggered. For the first time, we show that body rotates first at maximum roll speed as fast as 8000°/s and then that head rotates after a time lag of 17ms (median value) at similar angular speed.

A dynamic model of the righting reflex accounts for that head-body response by implementing a closed-loop control of both head and body combined with a feedforward control of the head body angle. The feedforward control of the head orientation from the body angular speed, provided by the halteres, introduced a time lag between head and body, which was coherent with the fly's response. Our model suggests that a closed-loop control of both body angle and body speed, merged with a fast head stabilization reflex, are at work at an early stage during the righting process. These results highlight the strong coupling existing between the activation of the halteres and gaze stabilization reflex [2].

Keywords: *Syrphidae, hoverfies, Episyrphus balteatus*

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Mind the spatiotemporal gap: Skin viscoelasticity limits our perception of discontinuous motion

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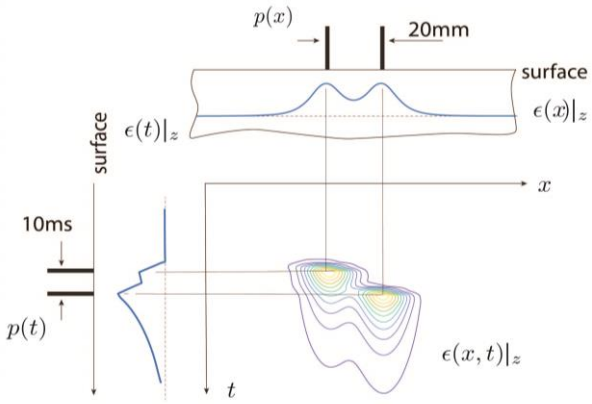
Our ability to perceive dynamic simulations on our skin is essential for interacting with our environment. The sense of touch, like vision and audition, is not a perfect sensor and exhibits perceptual thresholds that limit the resolution of both spatially distributed events, also known as the two-point threshold, and temporally distinct events, known as the gap-detection threshold. In the present study, we are interested in how these limits impact the perception of discrete moving stimuli that evolves both through time and space. We found that the spatiotemporal gap of stimulation can be masked, and the preliminary results match with the prediction of a viscoelastic model of the skin, hinting at the potential role of skin mechanics in the filtering process.



Keywords: Touch, Spatiotemporal, Motion, Viscoelasticity.

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Partenaires industriels

Decathlon est spécialisé dans la conception, la production, la distribution et la commercialisation de services et d'articles de sport et de loisir, ainsi que leurs composants. Partenaire fidèle depuis la création de la Journée de l'Ecole Doctorale.

L'Incubateur Belle de Mai accompagne et finance des projets de créations d'entreprises innovantes dans les technologies de l'information et de la communication. Un(e) représentant(e) de l'incubateur sera présent pour **la remise d'un prix de l'innovation.**

L'OpenLab « Automotive Motion Lab » est un laboratoire commun entre le groupe PSA et l'Institut des Sciences du Mouvement. L'objectif de cet OpenLab est d'étudier les facteurs humains en automobile.

Protisvalor est une filiale d'Aix-Marseille Université et est spécialisée dans l'accompagnement des chercheurs pour l'instruction, le montage et la gestion des contrats de recherche partenariaux et européens.

Le Grand Luminy Technopôle, partenaire fidèle de la JED, assure le rayonnement du parc Scientifique et Technologique de Luminy à travers différentes actions de communication et accompagne les porteurs de projet dans la création et le développement d'entreprise.

Partenaires institutionnels

La FSDIE (Fonds de Solidarité et de Développement des Initiatives Etudiantes) de Marseille et de Montpellier apportent leur aide aux projets étudiants.

Les 3 Unités de Formation et de Recherche (UFR) : l'Université côte d'Azur, l'Université de Montpellier et Aix-Marseille Université. Nous remercions particulièrement les **Facultés des Sciences du Sport d'Aix Marseille et de Nice.**

L'Institut des Sciences du Mouvement Etienne-Jules Marey a pour but d'étudier les déterminants mécaniques, physiologiques, neurologiques, psychologiques et sociologiques de la motricité des êtres vivants et de l'Homme en particulier.

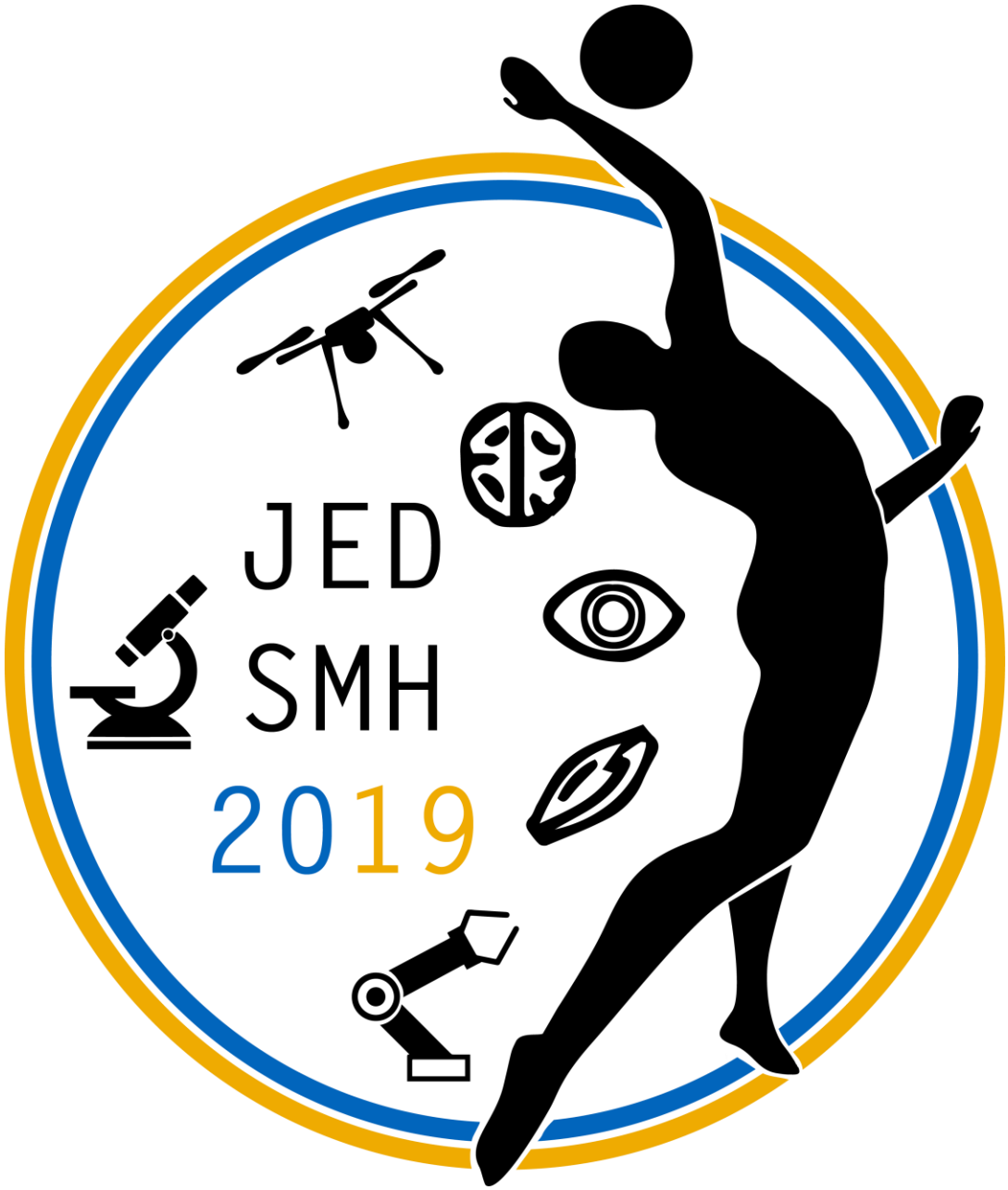
EuroMov a pour mission l'identification des signatures motrices de la santé : physiologiques, neuromusculaires, sensori-moteurs, etc.

L'Institut National de la Recherche Agronomique (INRA) est le premier institut de recherche agronomique en Europe, deuxième en sciences agricoles dans le monde et il mène des recherches au service d'enjeux de société majeurs.

L'Unité Dynamique Musculaire et Métabolisme (DMEM) mène des recherches fondamentales sur le développement et le maintien de la fonctionnalité de la masse musculaire chez les mammifères.

PhyMedExp développe des approches modernes pour conduire une recherche fondamentale d'excellence et déduire de celle-ci des retombées novatrices dans le domaine des pathologies musculaires.

Le Laboratoire d'Excellence (LabEx) - Solutions Numériques et Matérielles pour l'Environnement et le Vivant (NuMEV) a pour but de soutenir le développement des activités en sciences du numérique, de la physique ou de l'ingénieur du site de Montpellier dans leurs mouvements vers les interfaces avec les sciences de l'environnement et du vivant. Il remettra **un prix.**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