Perception
and Action
in Complex
Environments

Full description of the PhD research projects

The PACE network opens 15 PhD positions to complete a PhD research project in 3 years at one of the core partner site.

PhD Position	ESR-1
Host, location	Institut de Neurosciences de la Timone, Team InViBe, CNRS & Aix-Marseille Université, Marseille, France
Supervisor	Dr GS Masson, Dr A Montagnini, Dr L.Perrinet
PhD project	*Predicting sensory events and inference for visuomotor control:* The goal of the project is to explore the dynamics in visual motion integration and prediction. The fellow will conduct psychophysics, oculomotor recordings and modelling work on visuo-oculomotor control in healthy subjects in order to understand 1) how predictive information is stored and represented at multiple levels and time scales and 2) how the sensory and predictive information are integrated online.
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PhD Position	ESR-2
Host, Location	Institut de Neurosciences de la Timone, Team CoMCo, CNRS & Aix-Marseille Université, Marseille, France
Supervisor	Dr F Danion
PhD Project	*Predicting self-generated events: motor prediction in arm and eye movements, and their coordination:* The ability to predict sensory consequences of voluntary movements plays a central role in the generation of skilled movements such as object manipulation and eye movements. The leading hypothesis is that the brain is endowed of mechanisms that can simulate the dynamics of our body and of the object in conjunction with an efference copy of the on-going motor commands sent to our limbs. A first objective will be to investigate whether common or separate predictors are involved in the control of grip force and eye motion when manipulating objects. To address this issue we plan to monitor the adaptation of grip force and eye tracking performance when learning to manipulate object with complex dynamics. A second objective will be to identify the contribution of the primary motor cortex (M1) in the coordination of eye and hand movements through Transcranial Magnetic Stimulation over M1.
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PhD Position	ESR-3
Host, Location	Laboratoire des Systèmes Perceptifs, CNRS & Ecole Normale Supérieure, Paris, France
Supervisor	Dr. Pascal Mamassian
PhD Project	*Integration of multiple senses for the timing of an action:* An action driven by multiple senses is performed on average faster than when senses are taken individually, but the timing is more variable across trials. Current studies suffer from two pitfalls. Frist, signals from each sensory modality are arbitrary, whereas in natural environments, they are informative about a common dimension (e.g. location) and related to a single object. Second, accuracy in timing studies is overlooked because stimuli are supra-thresholds and performance close to perfect. ESR3 will fill these two important gaps using both manual (pointing) and saccadic eye movements
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PhD Position	ESR-4
Host, Location	Department of Human Movement Sciences, Free University, Amsterdam, Netherlands
Supervisor	Dr E Brenner, Dr J. Smeets
PhD Project	*Combining information from various modalities for rhythmic tapping: role of the task:* Tapping a rhythm with the finger on a table involves information from several senses: audition but also visual and kinaesthetic feedback about the finger's movement, and tactile feedback about the moment it hits the table. One open question is whether auditory (visual) feedback is weighted more heavily if the task is to synchronize one's actions to an auditory (visual) signal. Alternatively, all cues could always be combined 'optimally' to achieve the highest overall precision. ESR4 will study this and similar questions related to timing.
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PhD Position	ESR-5
Host, Location	Institut de Neurosciences de la Timone, Marseille, France & Département de Psychologie, Lille, France
Supervisor	Pr L.Madelain
PhD Project	*Adapting eye movements: Using information about saccadic latency:* Psychophysics, oculomotor recordings and choice modelling in dynamic foraging tasks in healthy subjects to probe 1) the extent of control of reinforcement contingencies on saccade latencies 2) the extent of knowledge the saccadic system has about its own latencies and 3) how organisms accumulate information about reward contingencies.
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PhD Position	ESR-6
Host, Location	Department of Basic Psychology, University of Barcelona, Barcelona, Spain
Supervisor	Dr Joan Lopez-Moliner
PhD Project	*Adapting movement to sensory delayed/conflicting feedback in interceptive timing:* An efficient sensorimotor control implies minimizing end-point cost functions, like the final spatiotemporal error in interception. Immersive systems imply conflicting context as to the timing of final feedback and it is essential to predict how human performance relies on this information. Actual final multisensory feedback (visual, auditory, haptic) and their predictions are crucial but it remains unclear how adaptation evolves when robust end-point time markers from other sensory modalities (haptic or auditory) conflict in precision and time with visual signals.
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PhD Position	ESR-7
Host, Location	Wellcome Trust Centre for Neuroimaging, University College of London, London, UK
Supervisor	Pr K Friston & Dr RA Adams
PhD Project	Building a unified active-inference framework for optimal naturalistic movements: The brain can be understood as a hierarchical probabilistic model of its environment that infers the causes of its sensory data by minimising prediction errors, or alternatively, maximising the Bayesian evidence for its model of the world by actively sampling sensory information. This framework can explain visual search behaviour (for a theoretical treatment of this idea see "Perceptions as hypotheses, saccades as experiments" – doi: 10.3389/fpsyg.2012.00151). This project will involve devising a paradigm to test these ideas in normal subjects, that can then be applied to explain the behaviour of psychiatric populations whose visual search behaviour is abnormal (e.g. those with diagnoses of schizophrenia or autism).
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PhD Position	ESR-8
Host, Location	Robotics, Brain & Cognition Italian Institute of Technology, Genova, Italy
Supervisor	Prof Gabriel Baud-Bovy, Prof Giulio Sandini
PhD Project	*The control and representation of articulated objects: insights from robots:* Because of their structural rigidity, most robots strain to manipulate kinematically-constrained objects without causing large interaction forces. While progresses in robotics, ranging from elastic actuators to new control schemes, are useful in the manipulation of such objects, the robotic ability to develop models of the objects they manipulate is limited. The project aims at developing a computational framework that might endow robots with such capacity and account for the unique capacity of humans to do so. The PhD candidate will need to be acquainted with current computational account of motor and sensory processes, such as optimal control theory, Recurrent Neural Networks, Active Inference framework. (ii) investigate how these paradigms might account for our capacity to identify and use kinematically constrained objects, (iii) leverage robot iCub's force and impedance control abilities to endow iCub with the capacity to interact physically with articulated objects, (iv) use iCub to test an implementation of the model.
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PhD Position	ESR-9
Host, Location	Robotics, Brain & Cognition, Italian Institute of Technology, Genova, Italy
Supervisor	Dr Monica Gori, Prof Gabriel Baud-Bovy
PhD Project	*Control and representation of articulated objects: human behaviour in sighted and blind adults and children:* Many actions, from opening a door to using scissors, involve kinematically constrained objects. It has long been recognized in robotics that kinematic constraints are particularly challenging as they require one to control the interaction at the kinematic and dynamical levels simultaneously. Despite its ubiquity in everyday action, only a few studies have investigated how humans manipulate kinematically constrained objects. The general objective of this PhD project is to study sensory and motor processes involved in the control of these objects. This project will in particular focus on how one develops a kinematic model of object from the visual observation of the movements of its parts and from the experience derived during its manipulation. Since good vision is necessary for a normal development of spatial cognition, we will study how congenital blindness impair the development of the representation and manipulation of articulated objects. During the PhD, the candidate will (i) probe psychophysically discrimination, identification or recognition of object geometry from visual and proprioceptive cues (ii) identify motor control strategies when manipulating kinematically constrained objects (iii) map how the capacity to manipulate such objects and perceived their kinematic properties develop from childhood to adulthood in sighted individuals and (v) tests blind children to assess how congenital blindness affect the manipulation and perception of these objects.
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PhD Position	ESR-10
Host, Location	Perceptual and Cognitive Systems/Life Style, TNO, Soesterberg/Leiden, Netherlands
Supervisor	Dr Anne-Marie Brower, Dr Petra Siemonsma
PhD Project	*Testing sensorimotor integration in aging:* An important age-related dysfunction is the decrease in the ability to perform daily tasks. Age-related dysfunction is generally explained by both a diminished function in multiple physiological domains (including muscle strength, neuromuscular coordination, balance and cardiovascular function), reduced physical reserves and a decline in the integration of the sensorimotor system. The aim of the project will be to develop an instrument to diagnose the underlying causes of beginning age-related dysfunction in order to advise on personalized rehabilitation or training.
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PhD Position	ESR-11
Host, Location	Department of Biomedical Engineering, Ben-Gourion University, Tel-Aviv, Israël
Supervisor	Pr Opher Donchin
PhD Project	*Cerebellum and aging: predicting behavioural deficits from patterns of neural degeneration in aging subjects:* Our recent research has uncovered a specific relationship between patterns of cerebellar loss and deficits in motor control. Using MRI anatomy and voxel-based morphometry, we relate behavioural deficits with loss of grey matter on a voxel-by-voxel basis. With a new template of the human cerebellum and using specific registration techniques for individual cerebella, we can localize sites associated with deficit to an accuracy of up to 1 mm3.
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PhD Position	ESR-12
Host, Location	Department of Psychology, UD, Durham, UK
Supervisor	Dr. Cristiana Cavina-Pratesi, Dr Jason Connolly
PhD Project	*Neural prosthetic advancement: identification of circuitry and decode optimization :* Brain computer interfaces support patients suffering from paralysis by extracting signals from precise groups of neurons and translating them using the optimal decoder. To date, the targeted network is defined from the intact brain. Since the organization of the motor pathways changes drastically in brain disease/injury, this choice raises questions. First, are real grasping actions performed by intact subjects or actions imagined by patients guiding the prosthetic devices informed by the same neural population(s)? Second, are the brain areas and their signals extracted similar in intact participants and those patients with brain injury?
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PhD Position	ESR-13
Host, Location	Institut de Neurosciences de la Timone, Team CoMCo, CNRS & Aix-Marseille Universté, Marseille, France
Supervisor	Dr Nicole Malfait
PhD Project	*Predicting Functional recovery in stroke patients:* Unilateral damage leads to both local and distributed changes and gives rise to a disruption of interhemispheric dynamics followed by reorganization. Our aim is to understand the relationship between changes in interhemispheric connectivity and functional recovery. We will work in collaboration with the Timone University Hospital. We will analyse three ensembles of potentially predictive data: behavioural (bilateral exosqueleton KINARM), electrophysiological (EEG) and neuroimaging (anat MRI, rs-fMRI, DTI).
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PhD Position	ESR-14
Host, Location	Center for Advanced Technologies in Rehabilitation, Sheba Med Center, Tel Hashomer, Israel
Supervisor	Prof Meir Plotnik
PhD Project	*Targeting advanced rehabilitation techniques for sensorimotor deficits:* Spinal cord, brainstem and cerebellum contribute in synergy to dynamic postural adjustments in static conditions and during locomotion. Postural control deficits are common consequence to different damages to the brain and the peripheral nervous system. Rehabilitating postural control is achieved following a motor learning protocol, during which the motor function is learnt, trained and consolidated. It should also take into account the most affected control level in a given pathology.
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PhD Position	ESR-15
Host, Location	Motek Medical, Amsterdam, NL
Supervisor	Dr Frans Steenbrink
PhD Project	*Real-time visual feedback on biomechanical parameters to improve gait in children with cerebral palsy:* For many patient populations who experience limited mobility, Clinical Gait Analysis (CGA) is used to inform the clinical decision making process for optimal treatment. Recently, parameters from CGA, that employ a biomechanical model of the musculoskeletal system, can be calculated in real-time from walking on an instrumented belt, which can be used to drive real-time feedback applications for training purposes. By feeding specific parameters back to the patient, e.g. using a Virtual Reality (VR) system, the patient can respond, by altering its gait pattern and eventually aiming to restore gait performance. However, to date is unclear how such feedback should be presented to the patient in order for them to effectively adjust their gait pattern.
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