PARSUK XPERIENCE 2021

Projectos / Projects

Período de candidatura / Application deadlines
Projetos / Project proposal: 14/02/2021 – 14/03/2021
Bolseiros / Scholarship holders: 28/03/2021 – 18/04/2021

Formulário de candidatura disponível no website da PARSUK / Application form available in PARSUK's website

PARSUK

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Project 1	
Name of the Advisor	Dr. Filipe Ferreira Future Leaders Fellow
Project title	Massive spatial parallelism in optical fibres
Name of the Host Institution	University College London
Name of the Group Leader	Dr. Filipe Ferreira
Abstract of the Research Project	This project aims to exploit massive spatial parallelism in optical fibres by merging spatial light modulation with machine learning. The 4-week internship will focus on how to establish multiple data pathways over multi-mode fibres by experimenting with liquid crystal on silicon spatial light modulators (LCoS-SLMs). The student will be integrated in the ongoing UKRI Future Leaders Fellowship “Beyond Exabit Optical Communications” that aims to transform optical fibre communications to go beyond current single-mode fibre technology limits with sustainable energy-consumption per bit“ arguably the greatest challenge in the field. Much wider conduits of information are fundamental to tackle the grand challenges faced by our society and economy: flexible & remote working and health monitoring & care with increasing quality and capabilities, accelerate artificial intelligence and data revolution, support communication among autonomous vehicles â€“ as well as other applications that cannot be currently anticipated. The project will be implemented in the Optical Networks Group at University College London: one of the world leading research centres in optical communications. We are looking for people with an interest in photonics, physics and computer science. The experience acquired during this internship will provide enhanced career opportunities in the field of photonics, high-speed communications, digital systems and advanced learning algorithms.
Project goals	During the 4-week internship the student will experiment with liquid crystal on silicon spatial light modulators (LCoS-SLMs) to achieve reconfigurable mode conversion from the fundamental mode in single-mode fibres to higher-order modes guided in multi-mode fibres. The student will be trained to understand the basics of our spatial modulation prototype platform, this will include training on the basics of: optical fibres, optical beam focusing and collimation, and computer-generated holograms. Then, the student will characterize the performance of the spatial modulator prototype for different multi-mode fibres, and explore the application of this technology for optical signal generation and amplification. Finally, the student will experiment with different hologram generation algorithms to improve performance. The student will gain hands-on lab experience with high-speed transmission rigs, optical and electrical high-speed test & measurement equipment and high-speed RF electronics. Moreover, being integrated in an international multi-disciplinary team will provide

	opportunities to develop transferrable skills in the areas of teamwork, communication and organisation.

Project 2	
Name of the Advisor	Dr. Andreia Albuquerque-Wendt Postdoctoral Research Associate
Project title	Defining the localisation of calcium transporter proteins in Leishmania mexicana parasites
Name of the Host Institution	University of Glasgow
Name of the Group Leader	Dr Eva Gluenz
Abstract of the Research Project	Leishmaniasis is a neglected tropical disease affecting millions worldwide and is caused by Leishmania parasites, which are transmitted by the bite of a female sandfly. In mammals, these parasites transform from the promastigote insect-stage to intracellular amastigote forms (host-stage), which replicate inside macrophages. Disease manifestations range from cutaneous lesions to visceral infection, which is fatal if untreated. The few available anti-leishmanial drugs present several drawbacks and resistance development is of concern. Successful treatment in the future requires a better understanding of drug action, resistance mechanisms and new target identification. Membrane transporters are key to drug action, mediating drug uptake and efflux, or as direct targets. In eukaryotes, calcium ions (Ca2+) are ubiquitous secondary signal messengers and diverse transporters control Ca2+ exchange across membranes to maintain low intracellular Ca2+ concentrations. Research on calcium signalling in the life cycles of trypanosomatid parasites has gained momentum since key proteins and pathways have been identified. The relatively recent development of new genetic tools for Leishmania opened up new opportunities for the genetic dissection of transporter function. I have generated a collection of CRISPR/Cas9 knock-out (KO) L. mexicana mutants, including 20 putative Ca2+ transporters, which are currently being characterised with regards to their growth profile in vitro (vector-stage), as well as in vivo (host-stage). To complement this exciting novel data set, I propose to supervise the selected student in utilising CRISPR/Cas9 to tag the proteins and use fluorescence microscopy to identify the sub-cellular localisation of these 20 proteins in the L. mexicana model. This will determine where in the cell these transporters act and contribute to their functional characterisation.
Project goals	This project aims to identify the sub-cellular localisation of 20 putative calcium transporter proteins of Leishmania mexicana parasites. Specifically, I will teach the student how to: 1) Prepare Leishmania culture medium and work solutions; 2) Cultivate promastigote and amastigote Leishmania parasites;

	3) Generate PCR donor cassettes expressing fluorescent proteins for genomic integration in Leishmania parasites; 4) Transfect and select fluorescently labelled parasites utilising different drugs; 5) Perform live imaging of fluorescently labelled parasite cell lines in the promastigote and amastigote forms. In the end of this internship the student will have gained high quality laboratory experience from an expert Parasitology rich environment and be able to transfer many of the skills across other (model) organisms and scientific questions. In addition to that, depending on the performance of the student it is expected that the students contribution is highlighted with co-authorship in subsequent manuscripts where his/her data are featured.

Project 3	
Name of the Advisor	Dr. Ana Sara Cordeiro Senior Lecturer in Pharmaceutical Sciences
Project title	Delayed burst release formulations for vaccine and antibody delivery
Name of the Host Institution	De Montfort University
Name of the Group Leader	Dr. Ana Sara Cordeiro
Abstract of the Research Project	Repeated dosing is an important hurdle in the implementation of treatment schemes and vaccination campaigns, reducing the potentially life-saving impact of these initiatives. A good example of such is the current COVID-19 vaccination campaign, which requires multiple dosing at different times to ensure effective immunisation. Under the current circumstances, manufacturing and distributing enough vaccine doses to provide coverage to a high number of individuals in this “two-dose scheme” is challenging, and may severely limit the effectiveness of the campaign itself, as well as the fight against the pandemic. Similarly, patients with chronic diseases or receiving immunotherapy, for example, are often required to schedule appointments at healthcare facilities every two or three weeks, to receive their treatment, commonly via injectable routes. To overcome these difficulties, this project proposes the development of delayed burst release formulations that allow the controlled release of vaccines and drugs at defined time points. This can be achieved through the design and optimisation of micro-containers made from degradable polymers, which can retain the active ingredient for an appropriate time and release that cargo upon degradation according to their physicochemical characteristics. These micro-containers can be designed in different shapes, including microneedle tips, to be administered through various non-invasive routes such as the transdermal one. Also, emerging technologies such as 3D printing will be applied to fine tune the characteristics of the containers and provide

	improved control over the drug/vaccine release properties. This will lead to the development of a simple manufacturing system that can easily be automated and scaled up to industrial level, while using low-cost biocompatible materials and therefore creating an inexpensive platform that can be useful for multiple applications.
Project goals	As described previously, the main aim of this project is to develop polymeric micro-containers loaded with model antigens/antibodies and prepared using biodegradable polymers which may be able to produce a delayed burst release profile. Since this antigen/antibody release would ideally continue beyond the duration of this project, the goal would be for the visiting student to perform the initial formulation screening steps and optimise the formulations to the most promising characteristics, including the data analysis for the initial time points in any release study performed. Later time points would be analysed by the supervisor beyond the duration of this project, with any formulation that provides promising results. For this reason, the specific objectives of this particular research project are: 1. To develop formulations with different biodegradable and biocompatible polymers and evaluate their degradation kinetics, to choose the preferred biodegradation profiles 2. To load the chosen formulations with a model antigen (ovalbumin) or a model antibody (recombinant anti-TNF alpha antibody) and explore loading capacity and antigen/antibody stability 3. To produce 3D printed implants and/or microarray patches with the optimised formulations and perform characterisation studies (imaging, mechanical strength, insertion, etc.) 4. To assess antigen/antibody release from the implants or microarray patches in relevant in vitro models

Project 4	
Name of the Advisor	Daniela Botnariuc PhD student
Project title	Determining optimal 3D-printable plastic materials for paediatric proton therapy
Name of the Host Institution	University College London
Name of the Group Leader	Dr. Catarina Veiga
Abstract of the Research Project	With advancing radiotherapy technologies, oncologic patients have better outcomes and three quarters of the paediatric patients survive for more than ten years. State-of-art modalities, such as proton therapy, are particularly beneficial for paediatric patients due to their potential to minimise the dose delivered to healthy tissues surrounding the tumour, compared to conventional approaches. Radiotherapy has been crucial in cancer treatment, however the increased

	population of cancer survivors is at risk of developing long-term side effects from radiation treatment, namely second cancers. Children are more sensitive to radiation due to the increased sensitivity of growing and maturing tissues. In fact, childhood cancer survivors present an excess of second tumours compared to the adult population of cancer survivors, independently of the primary cancer type. Proposed models used to predict the risk of radiation induced second cancers have limitations, one being the lack of complete and accurate full body dose information. A better understanding of the risk of developing second cancers after proton therapy is very relevant with a new centre opening soon in London, and is especially relevant for paediatric patients, as they will live for many years after treatment, allowing enough time for late effects to develop and impact their quality of life during adulthood. Clinically, the dose delivered to patients can only be computationally estimated. Since it is not possible to perform direct measurements in humans, tissue-equivalent phantoms have an important role in radiation dosimetry. To accurately determine radiation doses for individuals of different body sizes and anatomical structures, physical phantoms that reproduce these features must be fabricated. Commercially existing paediatric phantoms lack detail and are extremely expensive, leading to poor availability in clinical and research settings. As an alternative, we propose to develop novel 3D-printable plastic materials with radiological properties as a cheaper, more flexible and realistic solution.
Project goals	The aim of this project is to investigate the radiological properties of 3D-printable plastic materials for proton therapy against real paediatric tissues, using Monte Carlo simulations. This work will contribute to informing the design and optimisation of the materials to be used in the fabrication of paediatric phantoms. This project is suitable for a motivated and enthusiastic student interested in the use of Monte Carlo simulations for radiation transport in medical physics. During the four-week placement, the student is expected to achieve the following technical objectives: 1. Become familiar with the concepts of radiation therapy, dosimetry, childhood cancer treatments and interactions between radiation and matter. Understand the importance and the applicability of physical tissue-equivalent phantoms in radiotherapy settings. 2. Become familiar with GATE Monte Carlo simulations for protons beams and reproduce the experimental set-up appropriate for this work. Learn about the necessary elements to include in a GATE simulation such as phantom geometry, proton beam characteristics and physics implementations. Get

	inducted for high-performance computing usage and run example simulations on the cluster. 3. Plan and execute a set of Monte Carlo simulations to calculate radiological properties of biological tissues and 3D-printable plastics of varying elemental compositions and physical densities. This will include estimating relative stopping powers for proton beams and water equivalent thicknesses of the different plastics being investigated. 4. Compare the results of the investigated quantities obtained with Monte Carlo against those achieved using simpler analytical models. Identify the elemental composition of the plastics which best mimic real paediatric tissues for proton beams. 5. Prepare a short written report of the project in journal paper format. Deliver an oral presentation (15+5min) to the research group about the findings of the work.

Project 5	
Name of the Advisor	Ricardo Martins PhD Student
Project title	The Acute Effects of Simple vs Cognitively Demanding Physical Activity on Executive Functioning in Children
Name of the Host Institution	Coventry University
Name of the Group Leader	Dr. Emma Eyre
Abstract of the Research Project	Executive functions (EF) can be described as a collection of top-down control processes, characterised by inhibition, cognitive flexibility and working memory (Diamond 2013). A meta analyses investigating the acute effects of PA on EF including a wide age range (5-60+ years old) have suggested that PA bouts of over 10 minutes might enhance EF (Chang et al. 2012). However, walking, running and cycling have been the predominant activities in research, representing 90% of it (Pontifex et al. 2018). These activities can be easily undertaken, but recent research suggests that PA games which challenge the ability to respond to a situation and create situations where children have to choose one response in favour of another, may influence the neural expansion that creates the neural networks, responsible for the inhibition processes (Tomporowski, McCullick, and Pesce 2018). Given this, changes to the level of coordination complexity and cognitive demand were recommended (Tomporowski et al. 2015) and should include at least one of the following components: 1) cognitive interference: introducing random changes in the conditions under which the task is performed (an unpredictable component that requires cognitive engagement and forces adaptation). 2) trigger core executive functions: include a task/component that relies

	directly on a specific core executive functions. 3) promote exploration: this includes proposing activities that are not entirely defined and that encourage participants to find creative solutions. The incorporation of cognitive tasks stimulates multiple sensory systems, suggests that memory storage processes may be facilitated not only by PA-induced increases in physiological arousal, but also by the cognitive activation induced by cognitive exercise demands (Pesce et al. 2009). However, to date there is very limited research on the acute effects of CDPA and more research is required. Therefore, this study aims to investigate the influence of two types of field based PA bouts on young children EF (Inhibition), comparing two similar intensity protocols, one only requiring metabolic engagement and a similarly designed activity requiring cognitive tasks (CDPA) on EF in association with affect scales, rating of perceived exertion and arousal following an online approach.
Project goals	This project aims to understand the impact of a simple vs cognitively demanding physical activity bout on children's executive functions. Quantitatively, we aim to investigate the differences in reaction time and selective attention scores following the physical activity bouts (simple vs cognitively demanding) and the changes in affect and arousal (perception of pleasure and activation) before, during and after. A further consideration is that these activities are expected to improve the participant's cognitive performance significantly. Yet, following an eco-validity perspective, we aim to comprehend if these activities are pleasurable to the participants, in order to create adherence for future interventions. Qualitatively, we seek to understand how these activities can be modified for this age group. Focus groups will be used to discuss their views on how they perceived both activities (e.g. how enjoyable the activity was, what they liked or disliked, how they would change the activity?). This data will inform future research on how to design activities that are more enjoyable. The data collection will take place online via ZOOM, and the data analyses will be conducted on SPSS, Jamovi and Nvivo. Due to the pandemic, this project has been moved online, and all the safety is assured.