Research Position Registration Form for
Short Term Research Attachment (Summer)

Project Title	Synthesis and characterization of electronspun luminescent nanofibers using aggregation-induced emission luminogens
No. of Position	1
Proposed Duration (mths)	2-3 months
Supervisor / Mentor	Dr Franklin Anariba https://epd.sutd.edu.sg/people/faculty/franklin-anariba
Project Description	The project has three phases: **Phase 1:** Student will characterize the UV-Vis and luminescent properties of 6 organic luminogens under various organic solvents. Excitation wavelength will be 254 and 365 nm. **Phase 2:** Student will electrospin photoluminescent nanofibers in aligned and non-aligned manner, under various syntheses conditions and characterize their luminescent response to determine quantum yield. **Phase 3:** If time permits, student will use voltaic excitation to characterize the corresponding luminescence of the device.
Basic Requirement	1. A desire to carry out science experimental work and get trained. 2. A desire to make a difference while at Sutd. 3. Basic understanding of molecular absorbance and fluorescence spectroscopy.
Desired Requirement	1. Trained in the use of UV-Vis spectrometer. 2. Trained in the use of fluorescence spectrometer. 3. Trained in the use of electrospinning devices.
Reference / Link	https://www.hindawi.com/journals/jnm/2018/1980357/

Research Position Registration Form for
Short Term Research Attachment (Summer)

Project Title	Implementation of digital design and fabrication workflows
No. of Position	2
Proposed Duration (mths)	3 Months
Supervisor / Mentor	Dr Gowri Narasimha Boddeti
Co-Supervisor	Associate Professor Low Hong Yee https://epd.sutd.edu.sg/people/faculty/hong-yee-low
Project Description	The Digital Manufacturing and Design (DManD) Centre is constructing a cloud-based software platform, enabling the creation of digital workflows out of the program codes, design tools & software, and data that are being developed at DManD, to facilitate the use of these research outcomes by researchers, educators, and industry practitioners. In this project, the student will work together with a group of senior researchers to implement one example from their cutting-edge research results, e.g., 4D printing, design for additive manufacturing, as digital design and fabrication workflow on the platform under development. The student will gain hands-on experience in software development and get deep insights into the latest digital design and fabrication research.
Basic Requirement	Technical proficiency in at least one programming language (e.g., Python, Javascript, C/C++) Familiarity with cloud computing and web development in PHP
Desired Requirement	Experience in running Linux servers Experience in computational geometry and visualization, or computer-aided design and engineering software will be an advantage (e.g., MATLAB, VTK/ParaView, Rhino, Solidworks, FEM, etc.)
Reference / Link	

Research Position Registration Form for Short Term Research Attachment (Summer)

Project Title	Data-driven Methods in Digital Design and Fabrication
No. of Position	1
Proposed Duration (mths)	3 Months
Supervisor / Mentor	Dr Xiong Yi
Co-Supervisor	Associate Professor Low Hong Yee https://epd.sutd.edu.sg/people/faculty/hong-yee-low
Project Description	Recently, design for additive manufacturing (DfAM) methodology is proposed to develop products with optimal performance provided by the design freedom of additive manufacturing. Design decisions should be made in different domains and at different scales. To explore and exploit the design space, a multi-disciplinary and multi-scale decision-making problem needs to be formulated and cannot be solved with existing approaches. In this project, the student will apply data-driven methods on existing datasets to assist designers for obtaining optimal decisions in product design and fabrication. The student will gain hands-on experience with machine learning applications in engineering design and get deep insights into the latest digital design and fabrication research.
Basic Requirement	Technical proficiency in at least one programming language (e.g., Python, C/C++, Matlab)
Desired Requirement	Familiarity with machine learning algorithms and libraries Experience with digital design and fabrication workflow (e.g., CAD tools, 3D printers)
Reference / Link	

Research Position Registration Form for Short Term Research Attachment (Summer)

Project Title	Investigating Information Polarization and Distortion in Opinion Dynamics Model
No. of Position	Up to 2
Proposed Duration (mths)	3-4 months, depending on the student's summer programme
Supervisor / Mentor	Asst/Prof Cheong Kang Hao https://academics.sutd.edu.sg/faculty/faculty-science/cheong-kang-hao/
Project Description	The advent of social media and technologies augmenting social communication has dramatically amplified the role of rumour spreading in shaping society, via means of misinformation and fact distortion. Rumor is an important form of social communications, and spread of rumors plays a significant role in a variety of human affairs. There are two rumor models that are widely used, i.e. Daley and Kendall (DK) model and Maki-Thompson (MK) model. Particularly, we can view rumor spread as a stochastic process in social networks. In this project, we aim to review the existing rumour spreading models and to suggest improvements to these models. Interested students should also refer to papers [1-3] listed below and they will have the opportunity to extend these models.
Basic Requirement	Pro-active in learning attitude and competent in programming. Any programming language is fine.
Desired Requirement	
Reference / Link	[1] Chao Wang, Jin Ming Koh, **Kang Hao Cheong** and Neng-gang Xie. (2019) "Progressive Information Polarization in a Complex-Network Entropic Social Dynamics Model" IEEE Access, DOI: https://doi.org/10.1109/ACCESS.2019.2902400. [2] Zong Xuan Tan and **Kang Hao Cheong**. (2018). "Cross-issue solidarity and truth convergence in opinion dynamics". Journal of Physics A: Mathematical and Theoretical, 51(35)5101. [3] Chao Wang, Zong Xuan Tan, Ye Ye, Wang Lu, **Kang Hao Cheong** and Neng-gang Xie. (2017). "A rumor spreading model based on information entropy". Scientific Reports, 7, 9615.

Research Position Registration Form for
Short Term Research Attachment (Summer)

Project Title	Investigating the Parrondo Effect in the Financial Markets
No. of Position	Up to 2
Proposed Duration (mths)	3-4 months, depending on the student's summer programme
Supervisor / Mentor	Asst/Prof Cheong Kang Hao https://academics.sutd.edu.sg/faculty/faculty-science/cheong-kang-hao/
Project Description	This information science project attempts to investigate the Parrondo effect across financial markets. The Parrondo effect can be summarized as two losing games being combined in a random or periodic manner to achieve a winning outcome. We will discuss the concept of volatility pumping, rebalancing strategy, and 'buy and hold' strategy. Our approach will be three-pronged involving analytical derivations, computer simulations and validation using realworld data. Despite claims in [1-2], the project aims to investigate the extent of the Parrondo effect across financial markets and how it may aid in portfolio management and investments.
Basic Requirement	Pro-active in learning attitude and competent in programming. Any programming language is fine.
Desired Requirement	
Reference / Link	[1] Spurgin, Richard, and Maurry Tamarkin. "Switching investments can be a bad idea when Parrondo's paradox applies." The Journal of Behavioral Finance 6.1 (2005): 15-18. [2] Iyengar, Raghuram, and Rajeev Kohli. "Why Parrondo's paradox is irrelevant for utility theory, stock buying, and the emergence of life." Complexity 9.1 (2003): 23-27.

Research Position Registration Form for Short Term Research Attachment (Summer)

Project Title	Optimization techniques in improving Spectrometer Design
No. of Position	Up to 3
Proposed Duration (mths)	3-4 months, depending on the student's summer programme
Supervisor / Mentor	Asst/Prof Cheong Kang Hao https://academics.sutd.edu.sg/faculty/faculty-science/cheong-kang-hao/
Project Description	The potential advantages of multi-channel spectrometer design over conventional sequential detection are well known and are active areas of research both for electron energy spectroscopy and ion mass spectroscopy. Their inherent advantage of capturing the entire spectrum in parallel, promises at least an order of magnitude speed up in data acquisition times for analytical techniques such as Auger Electron Microscopy (AES) and Secondary Ion Mass Spectrometry (SIMS). Recently, a new set of multi-channel spectrometer designs have been proposed which involve the simultaneous adjustment of an array of electrode voltages/coil currents using computational simulation methods, departing from the traditional approach of using certain analytical field distributions or electrode shapes. The aim of this electronics engineering project is to critically evaluate these more complex multi-channel designs and further develop them, transforming them into realistic engineering designs from which prototype analysers can be made. **This will be a pure simulation project** whereby students can be involved in the different segments: (a) optimization techniques, (b) novel spectrometer design and (c) turning energy spectrometer design into mass spectrometer. Interested students should refer to refs [1-5] listed below to have a basic idea of spectrometer design.
Basic Requirement	Pro-active in learning attitude. Competent in programming and strong in physics. Any programming language is fine.
Desired Requirement	
Reference / Link	[1] Kang Hao Cheong, Jin Ming Koh. (2019) "A Hybrid Genetic-Levenberg Marquardt Algorithm for Automated Spectrometer Design Optimization" In press, Ultramicroscopy. [2] Jin Ming Koh, Kang Hao Cheong. (2018). "Automated electron-optical system optimization through switching Levenberg-Marquardt algorithms". Journal of Electron Spectroscopy and Related Phenomena, 227, 31-39.

	[3] Kang Hao Cheong, Weiding Han, Anjam Khursheed and Karuppiah Nelliyan. (2015). “A Parallel Radial Mirror Energy Analyzer Attachment for the Scanning Electron Microscope”. Microscopy and Microanalysis, 21(S4), 142-147. [4] K. H. Cheong and A. Khursheed. (2011). “A parallel magnetic sector mass analyzer design”. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 645(1), 221-226. [5] A. Khursheed, K. H. Cheong and H. Q. Hoang. (2010). “Design of a parallel mass spectrometer for focused ion beam columns”. Journal of Vacuum Science & Technology B, 28(6), C6F10-C6F14.

Research Position Registration Form for
Short Term Research Attachment (Summer)

Project Title	Flexible bus services
No. of Position	1
Proposed Duration (mths)	Two Months.
Supervisor / Mentor	Dr. Wang Xingyin
Co-Supervisor	Prof. Costas Courcoubetis https://esd.sutd.edu.sg/people/faculty/costas-courcoubetis
Project Description	Currently, public buses operate on fixed routes and schedules. A bus has to follow its assigned route exactly and, therefore, visits every stop even if there is no passenger waiting or getting off at the stop. In addition, buses depart from their terminals at predetermined schedules. The schedule depends on peak or non-peak hours and weekday or weekend, but not directly on the actual number of passengers waiting or to be waiting at the bus stops. We propose a flexible bus system. Buses do not have to follow fixed routes, but can skip stops and take short cuts. Further, they do not have to follow fixed departure times. These flexibilities take into account passenger arrivals or planned arrivals (this is achieved if passengers book the bus service in advance). The decisions of a bus controller include the time to dispatch the next bus and the route to follow. The times when these decisions are made depend on the exact model, especially the level of dynamism of passenger arrival times. These arrival times may be known completely a priori, or one hour before the actual arrival times, or upon passenger arrivals only. The performance of a bus system can be evaluated in two ways: one related to the operating cost and the other related to the service level. The operating cost can be measured in terms of the number of buses required, the total number of trips made, and the total distance traveled, etc. The service level can be measured in terms of the average passenger waiting time, the maximum passenger waiting time, the percentage of passengers waiting for more certain threshold time units, etc. Intuitively, the operating cost and the service level are competing objectives. We hope that with flexibilities in route and schedule, either we can lower the cost of operating the bus services without sacrificing service level or we can achieve higher service level without increasing the cost. The student's job is to design some simple heuristics to aid the route and schedule decisions. The intern is required to perform some theoretical and/or computational analyses on the heuristics.

Basic Requirement	Good analytic and programming skills.
Desired Requirement	Verbal skills.
Reference / Link	

Research Position Registration Form for
Short Term Research Attachment (Summer)

Project Title	Estimation of cognitive load using psychological readings
No. of Position	1
Proposed Duration (mths)	3
Supervisor / Mentor	Asst/Prof Tan U-Xuan https://epd.sutd.edu.sg/people/faculty/tan-u-xuan
Project Description	There has been an increasing demand for cognitive load level estimation in human-robots teaming for operation tasks like load distribution. Hence, the objective of this project to work on an approach to estimate operator cognitive load level through sensing psychological readings like pupil dilation. To achieve this, a study experimental setup consisting of an operator operating autonomous robots in a simulated environment has been designed. The student will be tasked to work with another researcher from SUTD to develop a program that can be used in real-time to estimate the cognitive load level of a person.
Basic Requirement	Machine learning; programming
Desired Requirement	Prior experience in handling sensors
Reference / Link	M. Reiner and T. M. Gelfeld, "Estimating mental workload through event-related fluctuations of pupil area during a task in a virtual world," *International Journal of Psychophysiology*, vol. 93, no. 1, pp. 38–44, 2014.

Research Position Registration Form for
Short Term Research Attachment (Summer)

Project Title	Rapid plant cell segmentation and centroid identification
No. of Position	1
Proposed Duration (mths)	3
Supervisor / Mentor	Asst/Prof Tan U-Xuan https://epd.sutd.edu.sg/people/faculty/tan-u-xuan
Project Description	There has been increasing needs to improve plant cell diagnosis and manipulation, to solve various problems such as controlling plant disease spread and improving vegetation yield rate. However, challenges remain in identifying plant cells under microscope automatically, particularly in terms of the time taken to identify all the plant cells within the field-of-view of the microscope. To achieve this, machine-learning can be incorporated in existing plant cell segmentation technique. The student will be tasked to work with another researcher from SUTD to develop a program that can reduce the latency of the plant cell segmentation technique, in achieving a real-time implementation for rapid deployment.
Basic Requirement	Machine learning; programming
Desired Requirement	Prior experience in handling microscopic specimens
Reference / Link	Z. H. Chau, I. Paranawithana, L. Yang, and U.-X. Tan, "Plant Cell Segmentation with Adaptive Thresholding," in 2018 25th International Conference on Mechatronics and Machine Vision in Practice (M2VIP), 2018, pp. 1-6: IEEE.

Research Position Registration Form for
Short Term Research Attachment (Summer)

Project Title	Assistive Technology in Mobility for Wearable Computing
No. of Position	2 (1 software/CS), 1 hardware (Industrial Design/Engineering)
Proposed Duration (mths)	3
Supervisor / Mentor	Asst/Prof Simon Tangi Perrault https://istd.sutd.edu.sg/people/faculty/simon-perrault
Project Description	The goal of this project is to explore new assistive technologies in mobile contexts. Most of the assistive technology available (e.g. for visually impaired people) only work in static contexts (sitting on a chair). However, most users spend a large part of their days on the go. In this project, we want to prototype, design and evaluate new assistive technology based on wearable devices. This includes: - determining possible scenarios/use cases - prototyping hardware prototypes - writing software applications - evaluating solutions - iterating on prototypes The final goal of the project is to come up with new technologies and potentially publish the results of the evaluation process in a decent venue
Basic Requirement	- Programming (Python or Java or C# or JS) - Machine Learning (optional) - Hardware (Arduino or other microcontroller) - Sensors - Front End Developpement (optional)
Desired Requirement	- Android Programming - Machine Learning - Advanced hardware/sensors knowledge - Front end dev
Reference / Link	https://istd.sutd.edu.sg/people/faculty/simon-perrault (website) http://alexandrudancu.com/wp-content/uploads/2016/05/movespace.pdf http://www.shengdongzhao.com/wp-content/uploads/p3572-carcedo.pdf (relevant papers)

Research Position Registration Form for Short Term Research Attachment (Summer)

Project Title	Biophotonics—detecting biomolecules using light
No. of Position	1
Proposed Duration (mths)	3
Supervisor / Mentor	Assistant Professor Robert E Simpson https://epd.sutd.edu.sg/people/faculty/robert-edward-simpson
Project Description	We have recently developed and in the process of patenting a new material, called “Black Silver” that has remarkable biosensing capabilities. The detection involves exciting surface plasmon resonances in the Black Silver material. The objective of this project is to build a set-up to excite surface plasmon resonances in Black Silver, and then to characterize the ability of the material to sense different biomarkers.
Basic Requirement	Knowledge of Engineering, optics, or physics
Desired Requirement	■ Ability to communicate verbally in English ■ Some knowledge of Python programming would an advantage ■ High GPA
Reference / Link	Sreekanth et al., Large area silver-stibnite nanoporous plasmonic films for label-free biosensing, Appl. Mater. Inter- faces 10 (2018), no. 41, 34991–34999.

Research Position Registration Form for Short Term Research Attachment (Summer)

Project Title	Simulating Cascading Failures in Power Grids with back-up Generators
No. of Position	2
Proposed Duration (mths)	3 months
Supervisor / Mentor	Dr. Stefano Galelli (ESD) Dr. Kandasamy Nandha Kumar (iTrust) Prof. dr. Robert Kooij (iTrust)
Project Description	Cascading failures in power grids can have an enormous impact. Upon an initial failure of a transmission link, due to the redistribution of power flows, additional links might trip, thus leading to a cascading of the initial failure. An infamous example is the 2003 North American black-out which affected 50 million people. Several studies have suggested the use of back-up generators to mitigate the risks of such cascading failures. Most studies assume that if a failure occurs, a back-up generator will become available instantaneously. In reality, back-up generators need time to synchronize with the generators that are already connected to the grid. In addition, the synchronization speed may be delayed significantly by means of a cyberattack that changes the appropriate control data being send to the back-up generator. The aim of this project is to build a program in Matlab/Simulink, which accurately simulates the dynamics of cascading failures in power grids with back-up generators. The simulations should take transient behavior related to synchronization between generators, into account. To build the program, real-life data from the iTrust EPIC (Electric Power Intelligent Control) testbed will be used.
Basic Requirement	Basic knowledge about power grids Programming experience
Desired Requirement	Experience with Matlab/Simulink
Reference / Link	https://itrust.sutd.edu.sg/testbeds/electric-power-intelligent-control-epic/ Hines, P., Apt, J., and Talukdar, S. (2009) Large blackouts in North America: historical trends and policy implications. Energy Policy 37, 5249–5259. Y. Koç, T. Verma, N. A. M. Araujo and M. Warnier, "MATCASC: A tool to analyse cascading line outages in power grids," *2013 IEEE International Workshop on Inteligent Energy Systems (IWIES)*, Vienna, 2013, pp. 143-148. Jun Yan, Yufei Tang, Haibo He and Yan Sun, Cascading Failure Analysis With DC Power Flow Model and Transient Stability Analysis, IEEE Trans. on Power Systems, Vol.30, No.1, Jan 2015.

Research Position Registration Form for Short Term Research Attachment (Summer)

Project Title	Optoelectronic, Photonic and Electrodynamic Applications of Dirac/Weyl Topological Semimetals
No. of Position	1
Proposed Duration (mths)	3 to 4 months
Supervisor / Mentor	Dr. ANG Yee Sin
Co-Supervisor	Prof. Ricky ANG https://epd.sutd.edu.sg/people/faculty/ang-lay-kee-ricky
Project Description	The discovery of topological semimetals [1], where topologically protected semi-metallic band resides in the bulk of the solid, represents one of the major milestones in modern condensed matter physics and material science. Despite intensive research efforts focusing on uncovering the fundamental physics and mathematics of the unusual topology, the prediction of realistic candidate crystals and the experimental detection of topological states, the device application aspects of topological semimetal remain largely unexplored. In this Project, we will explore the potential applications of Dirac/Weyl semimetals in optoelectronics, photonics and electromagnetic applications [2]. Based on theoretical analysis and simulation software, proof-of-concept design of novel devices will be studied, which includes metasurface, photonic crystals, plasmonic devices, optical switches, photodetector, energy converter and so on. This project will focus on both the feasibility and the figure-of-merit of various topological-semimetal-based devices. The outcome of this pilot study shall yield important insights on the device application potential of the ever-expanding family of topological materials.
Basic Requirement	Electromagnetism, introductory solid-state physics, introductory quantum mechanics, programming skill (such as Python, Matlab, etc).
Desired Requirement	Quantum transport, charge transport theory, nonlinear optics, first-principle electromagnetic simulation such as CST, and COMSOL.
Reference / Link	[1] Z. K. Liu et al, Science 343, 864 (2014); [2] K. J. A. Ooi, APL Photon. 4, 034402 (2019).

Research Position Registration Form for Short Term Research Attachment (Summer)

Project Title	Thermionic-field charge injection for 2D-materials based Schottky barrier
No. of Position	1
Proposed Duration (mths)	3 to 4 months
Supervisor / Mentor	Dr. ANG Yee Sin
Co-Supervisor	Prof. Ricky ANG https://epd.sutd.edu.sg/people/faculty/ang-lay-kee-ricky
Project Description	The junctions formed at the contact between metallic electrodes and semiconductor materials are crucial components of electronic and optoelectronic device. The junction is characterized by the Schottky barrier. The charge injection across the Schottky barrier is normally by thermionic over barrier injection and the transport is known as the Schottky diode equation. With the advances in making van der Waals (vdW) structure, the electrical contact or Schottky junction become complicated that the traditional model may not valid. Recently, we have developed a new model to address this question [1]. In this project, we intend to extend the model to include the effects of electric field where the “below” barrier tunneling process are included.
Basic Requirement	Electromagnetism, introductory solid-state physics, introductory quantum mechanics, programming skill (such as Python, Matlab, etc).
Desired Requirement	Solid-state physics, charge transport theory, semiconductor devices
Reference / Link	[1] Editor Suggestion: Y. S. Ang, H. Y. Yang, and L. K. Ang, Universal scaling in nanoscale lateral Schottky heterostructures, Phys. Rev. Lett. 121, 056802 (Aug 2018)