EST 1892 LSBU

The School of Engineering at London South Bank University is an ambitious and progressive centre of research strength, ranked 25th nationally for research power in the last Research Excellence Framework. We have a fabulous central London location and are looking for talented potential students interested in research to work with our academic faculty in areas of strength. We are offering a number of funded PhD scholarships below. These studentships are available to UK nationals & EU citizen's and overseas applicants*. Those in possession of their own funding (e.g. via a non-EU government scholarship) are also welcome to apply for a place of study.

PhD Scholarships in:

1) **Digital technologies for developing Responsive Roll to Roll manufacturing platform**
2) **Use of Artificial Intelligence to predict and fabricate novel piezo and thermoelectric sensors using molecular modelling and advanced coating processes**
3) **Establishing fundamental correlations between growth conditions and functional properties of piezoelectric thin films using atomic modelling and experiments**
4) **Modelling of lubricated contact loading processes**
5) **PhD project on development of a multiscale simulation algorithm to couple molecular dynamics and finite element analysis**
6) **PhD Scholarship in the Self-adaptive and Self-optimising Bio-intelligent Cyber-Physical Production Systems**
7) **PhD Scholarship in AI and biomedical image analysis in comparative neuroanatomy**
8) **PhD Scholarship in Multimodal gastroenterology imaging for IBD assessment and personalized medicine**

Further details on each PhD project as well as application information are provided via this link but all PhD scholarships benefit from the following:

- Training in advanced engineering topics
- Mentoring from industry on the application and context of research
- Bespoke technical training
- Enterprise and innovation skills training
- Transferable skills development opportunities to increase employability
- 3-year studentships of ~£15,000 per annum living stipend (tax free)
- Payment of all tuition fees*
- A school supported consumables and travel budget to support additional specialist research training courses, access to specialist equipment and travel to international conferences, seminars and workshops
- Industry sponsored* cutting-edge research projects
- Wide choice of PhD projects ranging from applied to blue-sky research
- State-of-the-art research facilities in the centre of London
- Opportunities for overseas secondments to industrial partners and universities
- Excellent career prospects on completion of the PhD

* for eligible students only

LSBU Research Centres Website: http://www.lsbu.ac.uk/research/centres-groups, please click on the link here to see the specific PhD posts available.

Closing date for applications: April 2020 **PhD Start:** October 2021

PROJECT #1

PhD project on using Digital technologies for developing 'Responsive Roll to Roll manufacturing platform'

Project description:

The Roll-to-Roll (R2R) technology (see figure 1) is at the heart of micro/nano scale production; it is used to fabricate a wide range of products that require high-precision, including wall coverings, lamination, heat exchanger fins, vacuum processing using a wide range of printing technologies such as screen printing, hot embossing, flexographic printing, gravure printing and winding machinery to name a few. The materials used on R2R platforms range from polymer PET or PMMA substrates for food and packaging purposes, extremely thin and expensive glass substrates such as Gorilla Glass 2 (Willow Glass) for flexible electronics and metals (titanium and aluminium foil for radiator fins).

Figure 1: Example of an R2R technology

Compared to other manufacturing methods where the substrate is stiff, R2R employs a flexible substrate and even the slightest change in the production conditions can lead to accelerated defects thereby increasing production waste. Responsiveness in a manufacturing system refers to its ability to tackle "unforeseen events" arising out of internal or external perturbances to avoid defects. The scope of this PhD project is to understand responsiveness in a manufacturing system by taking "web-tension" as a prime example. The project will build a sample R2R platform (as a demonstrator) with rollers and advanced electrical control and will make use of the most robust digital tools such as digital image correlation, Fibre Bragg and vision systems such as a Camera-based micro-coordinate metrology.

This project aims to develop a platform to showcase the capability of digital tools in tackling the problem of perturbating in the "web-tension" occurring during the processing. This is analogous to saying "monitoring of tension in the rope-pulley during the climb of an elevator".

On this project, the student will have a unique opportunity to gain familiarity with "high performance scientific computing on local and national facilities". The project will see increasing industrial collaborations with companies such as E&R, Gencoa and CPI and other Catapults as well as have a lot of travelling opportunities in the UK.

Supervisory Team: The successful applicant will be working Dr Saurav Goel who besides LSBU, also works at Cranfield University. He is involved in the running of two International Centres namely, the "EPSRC Centre for Doctoral Training in Ultra-Precision Engineering" and "EPSRC Networkplus in Digitalised Surface Manufacturing". As part of this project, you will be benefitted from a wide range of training tools. Informal enquiries should be directed to **Dr Saurav Goel** (GoeLs@LSBU.ac.uk). As a PhD student, you will join the London Centre of Energy Engineering and work alongside a range of new and experienced PhD students in a collaborative environment.

Requirements: Applicants must be of outstanding academic merit and should have (or be expected to gain) either a first class or an upper second-class Honours degree (or the international equivalent), or an MSc/MRes with distinction. Enthusiastic and self-motivated candidates from all countries with a background in either Engineering, Materials Science, Physics or Mathematics or a related discipline are encouraged to apply. Candidates should be able to demonstrate that they are highly motivated, have excellent communication skills and undertake challenging tasks using their own initiative.

PROJECT #2

PhD project on the Use of Artificial Intelligence to accelerate discovery of novel piezo and thermoelectric sensors using molecular modelling and advanced coating processes

Project description:

The project aims to develop Artificial intelligent algorithms, which can map multi-functional material properties with multi-objective search algorithm to accelerate the discovery of novel materials exhibiting desirable functional properties. Some of these desirable properties would be Piezoelectric or Thermoelectric properties which can be made use of in developing highly robust and miniaturised printable sensors.

Furthermore, such an AI model will be integrated with a suitable time integrator such as molecular dynamics to validate the AI properties to yield a complete property map which can be validated by experimental flexible printing using a Roll to Roll manufacturing platform or simple inkjet printing.

Additionally, the project aims at the autonomous discovery of chemical rules from large-scale data via semi-supervised learning and local descriptor search. Infusion of domain knowledge will be tried out to make the ML framework more data efficient.

To utilize data from multiple experimental and computational sources, databases such as Materials Genome Initiative with varying levels of fidelity, will be use with inclusion of first principal DFT/ab-initio calculations.

A lot of works with similar approaches are growing in the literature and some of these works will readily guide the methodology required in this project. In this regard, following references will serve as a good reference papers:

- **https://doi.org/10.1002/adma.202003206**
- **DOI: 10.1039/d0ta00690d**
- **DOI: 10.1126/sciadv.aaq1566**

Supervisory Team: The successful applicant will be working Dr Saurav Goel who besides LSBU, also works at Cranfield University. He is involved in the running of two International Centres namely, the "EPSRC Centre for Doctoral Training in Ultra-Precision Engineering" and "EPSRC Networkplus in Digitalised Surface Manufacturing". As part of this project, you will be benefitted from a wide range of training tools. Informal enquiries should be directed to **Dr Saurav Goel** (GoeLs@LSBU.ac.uk). As a PhD student, you will join the London Centre of Energy Engineering and work alongside a range of new and experienced PhD students in a collaborative environment.

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PROJECT #3

PhD project on Establishing fundamental correlations between growth conditions and functional properties of piezoelectric thin films using atomic modelling and experiments

Project description:

Piezoelectric thin film materials have unique properties of generating electricity when they are subjected to external deformation/pressure; and vice versa, they can perform actuation functions through geometrical changes when external electrical fields are applied. They have been widely applied in engineering applications such as resonators, energy harvester, sensors, smart actuators, lab-on-chips and acoustic wave devices. Piezoelectric materials are set to transform the next-generation of sensors for in-situ monitoring of a variety of processes thus empowering the UK's industrial strategy as well as the UK's Government drive to leverage the maximum benefits from the Digital Twin technology.

It has been observed from the past experimentation that the properties (especially their pressure vs voltage dependence properties) of the piezoelectric films are sensitive to the growth conditions and initial configuration of the substrate which includes for example, not only the processing parameters but also the substrate's crystal orientation, glancing angle, bombarding energy and so in. An initial indication of the variation in the resulting properties is not straightforward to be measured during the growth process but can be linked to the residual stress developing in the film throughout the growth process. In this state-of-the-art project, a molecular modelling led investigation will be coupled with the experimental effort to link these together for establishing a novel understanding of the growth conditions with the functional properties of the film. This will include simulating the growth process with varying orientations, at different substrate tilting orientations, and different growth parameters, and analyse the data to obtain the necessary correlations using simulated XRD and SAED data and linking these with the experiments. The analysis will also include factors such as shadowing effects, channelling effects, and bombardment and surface atom migrations and diffusion effects.

Thus, the project will provide fundamental understanding (1) on the texture generation and evolution with the film deposition on an inclined plane, (2) the nature of residual stress development and its origins to influence the film's functional property such as its piezoelectric properties; (3) how can predictive digital twins be developed based on this fundamental understanding to monitor functional properties of the thin films during the growth process.

The project will see increasing industrial collaborations with companies such as E&R, Gencoa and many others and will offer immense travelling opportunities in the UK.

Supervisory Team: The successful applicant will be working Dr Saurav Goel who besides LSBU, also works at Cranfield University. He is involved in the running of two International Centres namely, the "EPSRC Centre for Doctoral Training in Ultra-Precision Engineering" and "EPSRC Networkplus in Digitalised Surface Manufacturing". As part of this project, you will be benefitted from a wide range of training tools. Informal enquiries should be directed to **Dr Saurav Goel** (GoeLs@LSBU.ac.uk). As a PhD student, you will join the London Centre of Energy Engineering and work alongside a range of new and experienced PhD students in a collaborative environment. The project will be co-supervised by Prof Allan Matthews (University of Manchester) and Prof Richard Fu (Northumbria Uni).

Requirements: Applicants must be of outstanding academic merit and should have (or be expected to gain) either a first class or an upper second-class Honours degree (or the international equivalent), or an MSc/MRes with distinction. Enthusiastic and self-motivated candidates from all countries with a background in either Engineering, Materials Science, Physics or Mathematics or a related discipline are encouraged to apply. Candidates should be able to demonstrate that they are highly motivated, have excellent communication skills and undertake challenging tasks using their own initiative.

PROJECT #4

PhD project on Modelling of lubricated contact loading processes

Project description:

Lubricant plays an important role in influencing the way how friction is manifested during any contact loading process, including, cutting, milling, indentation, impact or drilling. For this reason, coolant during machining has been used for many centuries as it provides an important property of being a heat carrier to take the heat away from the cutting zone where heat is generated during plastic deformation of the workpiece material as it is sheared by the tool.

It has been known by now that even at smaller length scales such as during diamond machining or nanoscratching by an atomic force microscope, a coolant plays an important role. It was reported earlier that a water based coolant is particularly favourable to the diamond over an oil based coolant (https://doi.org/10.1016/j.wear.2006.05.022). Consequently, efforts in this direction have started to gain momentum particularly using computational modelling efforts – thanks to the power of current computation. (https://doi.org/10.1016/j.mtchem.2020.100356). While many aspects of ductile plasticity of silicon and diamond have now started to become clearer (https://doi.org/10.1103/PhysRevMaterials.2.083601), these efforts need more attention in light of the recent discoveries. One such discovery has been that the water lubricated diamond surfaces (https://doi.org/10.1103/PhysRevLett.119.096101) rubbing together showed newer regimes of friction. It was reported that while water starvation causes amorphization of the tribological interface, small traces of water are sufficient to preserve crystallinity. More efforts are required to understand how these fundamental discoveries can be translated to scalable computation models and to derive commercial benefits to the diamond

such as VMD, OVITO and LIGGGHTS to develop scalable computer models of lubricated contact mode processes using the UK's most powerful supercomputer ARCHER2. The main focus will be to link the simulations with the experiments performed on a state-of-the-art nanotribology instrument tooling industry.

This PhD project aims to continue these global efforts to unravel the unknown science of lubricated contact loading processes. Taking examples of nanoindentation and nanoscratching processes, the work will shed fresh insight on the origins of friction during the contact loading process in presence of a lubricant (gas or fluid) with a particular focus on identifying the ultra-low friction regimes to concatenate these efforts.

The project will make use of robust modelling techniques using either atomistics or CFD techniques to predict the influence of coolant during lubricated tribology between two contacting asperities.

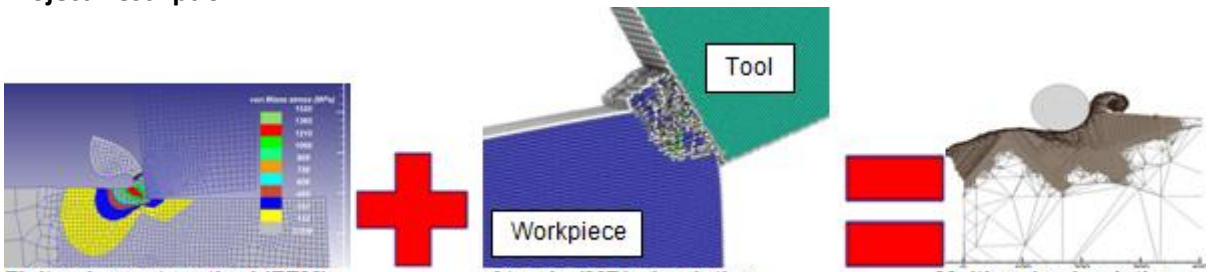
Supervisory Team: The successful applicant will be working Dr Saurav Goel who besides LSBU, also works at Cranfield University. He is involved in the running of two International Centres namely, the "EPSRC Centre for Doctoral Training in Ultra-Precision Engineering" and "EPSRC Networkplus in Digitalised Surface Manufacturing". As part of this project, you will be benefitted from a wide range of training tools. Informal enquiries should be directed to **Dr Saurav Goel** (GoeLs@LSBU.ac.uk).

Requirements: Applicants must be of outstanding academic merit and should have (or be expected to gain) either a first class or an upper second-class Honours degree (or the international equivalent), or an MSc/MRes with distinction. Enthusiastic and self-motivated candidates from all countries with a background in either Engineering, Materials Science, Physics or Mathematics or a related discipline are encouraged to apply. Candidates should be able to demonstrate that they are highly motivated, have excellent communication skills and undertake challenging tasks using their own initiative.

PROJECT #5

A Multiscale simulation based investigation to study nanoscale deformation of materials

Project Description:



The finite element method (FEM) is used by almost every engineering company to design and manufacture engineering components. The top left image shows an example of how one can study machining process of a component using FEM. One limitation of FEM is it fails at very small length scales. Therefore, FEM cannot be used to analyse various precision manufacturing processes (e.g. polishing of diamond) because material removal takes place at an atomic scale (of the order of a few nanometres) and cannot be simulated using FEM software. Molecular Dynamics (MD) is an alternative analysis method which can simulate behaviour at atomic scale (the middle part of the snapshot) that can capture fine details of material's microstructure. Its issue is that it is not possible to analyse entire components with MD simulation because the process becomes prohibitively expensive. The goal of this project is to overcome these limitations by simultaneously using the two techniques under one umbrella using a multiscale simulation algorithm called as Quasicontinuum (QC) method. This can be done using an open-source software available through this website: http://qcmethod.org/

The rationale of merging or coupling the two scales namely, continuum scale and atomic scale lies in harnessing the fidelity of an engineering analysis without compensating the computational power and hence developing a more robust analysis method. The developed algorithm will be used to study nanoindentation and nanoscratching problems on a wide range of materials and the results will be validated using the newly bought nanoindentor instrument stationing at London South Bank University.

The project will offer various internship and travelling opportunities and immense benefit will occur through direct industrial interactions linked with existing projects with companies like Airbus.

Skills in computational programming and understanding of the mechanics will be critical to this project.

Supervisory Team: The successful applicant will be working Dr Saurav Goel who besides LSBU, also works at Cranfield University. He is involved in the running of two International Centres namely, the "EPSRC Centre for Doctoral Training in Ultra-Precision Engineering" and "EPSRC Networkplus in Digitalised Surface Manufacturing". As part of this project, you will be benefitted from a wide range of training tools. Informal enquiries should be directed to **Dr Saurav Goel** (GoeLs@LSBU.ac.uk).

Requirements: Applicants must be of outstanding academic merit and should have (or be expected to gain) either a first class or an upper second-class Honours degree (or the international equivalent), or an MSc/MRes with distinction. Enthusiastic and self-motivated candidates from all countries with a background in either Engineering, Materials Science, Physics or Mathematics or a related discipline are encouraged to apply. Candidates should be able to demonstrate that they are highly motivated, have excellent communication skills and undertake challenging tasks using their own initiative.

PROJECT #6

PhD Scholarship in the Self-adaptive and Self-optimising Bio-intelligent Cyber-Physical Production Systems

Project description:

Bio-intelligent production is considered as an emerging area of Industry 4.0. The goal of production biologicalisation is not only to inspire production systems with biological principles or to integrate biological systems into technological systems but also to create sustainable growth via the interplay between biological and technical processes controlled through intelligent knowledge management systems. This PhD project aims to address the challenging goal of flexibility in Industry 4.0 systems via self-adaptation and self-optimisation by taking inspiration from the principles of evolutionary biology. Biological systems show successful problem-solving capabilities in complicated, complex, and unpredictable settings. They are especially useful for dealing with complex, ill-defined dynamic systems that do not have an empirical solution. Given this, the PhD student will work on design and development of novel cyber-physical system models whose components act as an independent biological entity adapting to the external disturbances and changes using bio-inspired computational intelligence. The student will have an opportunity to gain knowledge on evolutionary intelligence and swarm-based optimisation algorithms and develop a series of fully autonomous component models which will be analysed and verified using a series of agent-based computer simulations mimicking complex symbiotic production scenarios. Finally, the developed models will be deployed in a series of real-world industrial case studies derived from both manufacturing intra-plant logistics and smart agriculture domains for validation and generalisation purposes.

The outcomes of this project for the PhD candidate are listed below:

- Understand key issues related to the design and deployment of cyber-physical systems,
- Understand the key concepts of Industry 4.0 and digital manufacturing,
- Gain experience in component-based system modelling and agent-based simulations,
- Gain experience in artificial intelligence and swarm intelligence techniques,
- Gain experience in modelling of intelligent embedded systems,
- Implement the develop systems and methods in real-world cases,
- Present the findings of the PhD project in international conferences,
- Perform high-quality research and publish it as journal articles.

This will be a 3-year fully funded studentship for an EU/UK and overseas applicants who are keen to conduct research in smart manufacturing at LSBU in the School of Engineering.

Supervisory Team:

The successful applicant will be working with Dr Bugra Alkan. As a PhD student, you will join the Cognitive Research Centre and work alongside a range of new and experienced PhD students in a collaborative environment. Informal enquiries should be sent to **Dr Bugra Alkan** (alkanb@lsbu.ac.uk). Please send a copy of your CV with a covering letter to Dr Alkan before applying.

Requirements:

- First-class degree in Robotics/Mechanical/Cybernetics/Mechatronics/Computer Science or related scientific discipline,
- First rate analytical and numerical skills, with a well-rounded academic background,
- Expertise in relevant packages (Python and/or MATLAB),
- Background with artificial intelligence and evolutionary optimisation algorithms,
- A driven, professional, and self-dependent work attitude is essential,
- Experience of working within manufacturing will be an advantage,
- The ability to produce high quality presentations and written reports.

PROJECT #7

PhD Scholarship in AI and biomedical image analysis in comparative neuroanatomy

Neuroanatomical changes are of paramount importance for the assessment of brain alterations in many different diseases (e.g. neurodegenerative, auto-immune, and inflammatory), and for the understanding of brain adaptation to animal morphology, behaviour and environment.
The possibility of providing quantitative evaluation of cytoarchitecture of the brain from imaging data, obtained through microscopy imaging of NISSL-stained or immunohistochemical-stained slices, would results an invaluable tool for all the research community.
In order to provide this tool, the layers of different brain types (mostly mammals) and the types of cells present in each layer need to be identified, and then a quantitative morphological assessment of cells and layers need to obtained.
The PhD student will join an exciting multidisciplinary research including computer scientists and engineers at LSBU, statisticians, biologists and veterinarians at the University of Padova with access to unique data from a variety of mammals brain.
The PhD will develop new solutions to analyse and interpret the imaging data using AI, and to integrate the results to answer biological and evolutionary questions.
The outcomes of this project for the PhD candidate are listed below:

- understand digital histology imaging;
- gain experience in medical image analysis and processing techniques;
- learn state of the art AI/deep learning methods in digital pathology and apply them the specific problem;
- develop new methods for targeting the specific imaging challenges brain neuroanatomy;
- work with biologists and veterinarians to develop computer-aided imaging solutions;
- present the findings of the project in international conferences;
- perform high-quality research and publish it as journal articles.

This will be a 3-year fully funded studentship for an EU/UK and overseas applicants who are keen to conduct research in medical imaging at LSBU in the School of Engineering.

Supervisory Team: The successful applicant will be working Dr Enrico Grisan (https://scholar.google.it/citations?user=gJxnw0QAAAAJ&hl=en), and collaborating with Prof Antonella Peruffo at the University of Padova Veterinary Medicine (https://scholar.google.com/citations?hl=en&user=8US-oHAAAAAJ&view_op=list_works&sortby=pubdate).

As a PhD student, you will join the Bioengineering centre (http://www.lsbu.ac.uk/research/centres-groups/biomedical-engineering-communications-bimec) and work alongside a range of new and experienced PhD students in a collaborative environment.

Informal enquiries should be directed to Dr Enrico Grisan (enrico.grisan@lsbu.ac.uk). Please send a copy of your CV with a covering letter to Dr Grisan before applying.

Requirements: Applicants must be of outstanding academic merit and should have (or be expected to gain) either a first class or an upper second class Honours degree (or the international equivalent), or an MSc/MRes with distinction. Enthusiastic and self-motivated candidates from all countries with a background in either Computer Science, Engineering, Physics or Mathematics or a related discipline are encouraged to apply.

A good knowledge and experience in imaging, medical imaging, computer vision, machine learning/deep learning would be advantageous.

PROJECT #8

PhD Scholarship in Multimodal gastroenterology imaging for IBD assessment and personalized medicine

There are an estimated 620 000 patients with inflammatory bowel disease (IBD) in the UK. The rising incidence of IBD combined with its incurability has significant cost implications and quality of life impacts. IBD can develop at any age, but is most often diagnosed in people aged from 15 to 25 years old. The therapeutic options available to IBD patients and their health care providers are increasing rapidly. Deeper understanding of discriminative ultrastructural changes, molecular perspective of therapeutic responses and microbiome and its metabolite changes to different classes of drugs are essential for a more precise approach to therapeutic choices. Current choice of therapies and positioning are largely empirical and further integrated information is required to stratify patients and personalize therapeutic strategies.

In order to provide this personalization, quantitative information needs to be extracted from routine clinical imaging data and histopathological images, and integrate them with clinical information and -omics data to provide reliable understanding of a patient disease and effective therapies.

The PhD student will join an exciting multidisciplinary research including gastroenterology clinicians and bioinformaticians at the University of Birmingham, computer scientists and engineers at LSBU and University of Valencia, and they will have access to unique multimodal data (RNAseq, digital pathology, white light endoscopy video, confocal microendoscopy).

The PhD will develop new solutions to analyse and interpret the imaging data using AI, and to integrate the results to suggest personalized solutions for each patient.

The outcomes of this project for the PhD candidate are listed below:

- understand digital pathology and endoscopic imaging;
- gain experience in medical image analysis and processing techniques;
- learn state of the art AI/deep learning methods in digital pathology and endoscopic imaging and apply them the specific problem;
- develop new methods for targeting the specific imaging challenges in gastroenterology;
- work with clinicians to develop computer-aided imaging solutions;

- present the findings of the project in international conferences;
- perform high-quality research and publish it as journal articles.

This will be a 3-year fully funded studentship for an EU/UK and overseas applicants who are keen to conduct research in medical imaging at LSBU in the School of Engineering.

Supervisory Team: The successful applicant will be working Dr Enrico Grisan (https://scholar.google.it/citations?user=gJxnw0QAAAAJ&hl=en), and collaborating with Prof Valery Naranjo at the Polytechnic University of Valencia (http://www.cvblab.webs.upv.es/) and Prof. Marietta Iacucci at the University of Birmingham Hospital (https://www.birmingham.ac.uk/staff/profiles/immunology-immunotherapy/iacucci-marietta.aspx).

As a PhD student, you will join the Bioengineering centre (http://www.lsbu.ac.uk/research/centres-groups/biomedical-engineering-communications-bimec) and work alongside a range of new and experienced PhD students in a collaborative environment.

Informal enquiries should be directed to Dr Enrico Grisan (enrico.grisan@lsbu.ac.uk). Please send a copy of your CV with a covering letter to Dr Grisan before applying.

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A good knowledge and experience in imaging, medical imaging, computer vision, machine learning/deep learning would be advantageous.