

FUSE CDT

Centre for Doctoral Training Newsletter



Welcome

By Sandy Cochran & Tony Gachagan

Welcome to the 2020 Research Newsletter of the EPSRC Centre for Doctoral Training in Future Ultrasonic Engineering.

FUSE was established in mid-2019 as a partnership between the Centre for Medical and Industrial Ultrasonics at the University of Glasgow and the Centre for Ultrasonic Engineering at the University of Strathclyde, with more than 30 external organisations pledging support ranging from hosting of visits to sponsorship of Engineering Doctorates.

The funding of FUSE was a timely recognition by the UK Engineering and Physical Sciences Research Council that ultrasonics is a key technology in an enormous range of markets and that Glasgow as a city hosts perhaps the largest number of academic faculty worldwide focused on ultrasound and its applications.

With funding starting only in July 2019, last year was very much exploratory and I'm delighted to say that what has emerged is a strong and cohesive cohort of six PhD students now strongly engaged with their research projects with potential links, in every case, with at least one external partner.

With a longer period for recruitment this year, we have a larger cohort, with 13 students now engaged in the taught portion of their PhDs.

We've also recently been joined by Kirsten Laing, the inaugural FUSE Business Development Manager. With Kirsten joining Caryn Hughes, Rhona Nicholson and Amalya Cohen, I'm delighted to say we now have a full support team. I'd also like to acknowledge the support of our International Oversight Board, chaired by Glen McLaughlin and of the students themselves, who contribute to FUSE in many ways beyond their individual work.

Of course, this year has been particularly difficult because of the global pandemic, with teaching all on-line and various issues related to that. However, the students who have begun their research projects have access to our excellent research labs and, with the recently announced prospect of a vaccine, we anticipate that all the research projects starting in 2021 will work well too.

I hope you find the content of this Newsletter interesting and enjoyable. Please don't hesitate to contact us if you're interested in learning more about FUSE or joining our community.

Canon

CANON MEDICAL

Canon Medical

Studentship

Our first FUSE CDT EngD was launched in 2020, which saw our researcher, Alistair Lawley, enter into studentship with Canon Medical Research Europe. Alistair Lawley joined FUSE in Cohort 1, 2019 and has a background in clinical healthcare, with direct experience of ultrasound for diagnostic procedures. Previous to joining FUSE CDT, Alistair had transitioned to a computer science career.

His project will be spent with Canon Medical Research Europe Ltd, which is part of the Global Canon Group with a R&D Centre in Edinburgh focussing on software and technology development in Image Analysis, AI, Visualisation and software platforms for Canon Medical Systems.

Clinical ultrasound imaging is a cornerstone of Canon Medical's suite of medical imaging equipment. One of the advantages of ultrasound as a clinical imaging technique is that it does not use potentially harmful ionizing radiations, making it ideal for screening purposes. In this scenario, Canon Medical Research Europe has been investigating possible solutions for image-based automation and workflow improvements in abdominal ultrasound screening.

It is in the context of this investigation that CMRE has seen the benefits of collaborating with FUSE, to access a pool of expertise in the world of ultrasonics and help shape future directions in clinical ultrasound imaging.

We chose to start our collaboration via the supervision of an EngD student because we have previous experience of the advantages coming

from working with a researcher that is deeply embedded in the activities of the company. Our research tends to be very focused on our long-term product development plans, so our students benefit from feeling part of the company, and the projects are boosted by becoming part of the company R&D roadmap.

The project pitched by Canon offered Alistair the opportunity to build upon previously developed skills while still offering an exciting, challenging opportunity to work with an industrial partner on a project with potential for direct industrial impact. While a PhD offers excellent academic learning the EngD is an excellent opportunity for someone in a mid-career position to enhance their career relevant skills while continuing to work in industry relevant projects.



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Meet our Researchers

It is our pleasure to introduce FUSE CDT's researchers, who form the core of the doctoral training centre. Our first cohort of students, recruited in 2019, are now entering their substantive research phase. They have recently chosen their study pathway (PhD or EngD) and research topic, and are seeking further alignment with industry.

Cohort 1 - Research Phase



MAURA ALLAN

Towards Ultrasonic Autonomous Surgery

In recent years, there have been multiple advancements within the area of ultrasonic surgical devices and within robotically assisted surgery, with the da Vinci surgical system being the best known. However, many current robotically assisted surgeries take place at lower levels of autonomy such as telesurgery or robotic guidance and there is still work that can be done to allow for fully autonomous surgery, even with respect to simple procedures. My project would look towards a system that is able to carry out simple surgical procedures without human intervention.

Some aims would be to:

- consider if the feedback from the ultrasonic surgical device is suitable to provide the required weight on bit control for the robotic manipulator,
- develop a suitable control algorithm, or a suite of control algorithms associated with different procedures or devices, to allow the feedback from the ultrasonic surgical device to dictate the movements of the robot manipulator,
- consider the redesign of the robot manipulator to ensure that the use of the ultrasonic surgical device is being optimised,
- study the impact of different ultrasonic surgical devices on the control algorithms developed, test the developed system/s under clinical guidance.

This project brings together knowledge of ultrasonics, mechanical and electrical design, and control algorithm design, to allow the development of a system that will lay the foundation for ultrasonic autonomous surgery.

ABDUL HADI CHIBLI

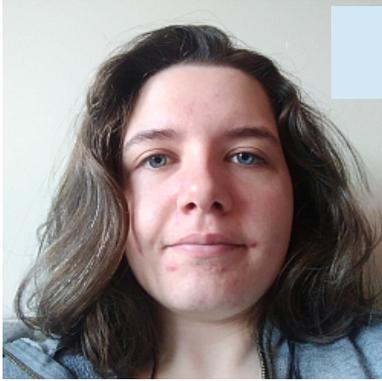
Combined Ultrasound Sensing and Therapeutic Tools for Robotic Surgery

I am a PhD student in the Future UltraSonic Engineering (FUSE) CDT working on ultrasonic dissecting and hybrid ultrasonic imaging tools for robotic surgery. Recently, Robot assisted surgery such as Da Vinci robot has been advancing through every aspect of hospital life, replacing both open and laparoscopic surgeries, due to its significant improvements in visibility and manipulation.

For this reason, My PhD project will focus in developing a tool for a robot assisted surgery. There is still work that can be done to allow advancing such a technology. Here I will focus in developing ultrasonic tool. That because as the ultrasonic Dissection, resection, and cauterization tool like the harmonic Ace which is compatible with Da Vinci assisted robot proved to be better than conventional tool in term of minimizing the blood loss. And on the same time, ultrasonic imaging system has been proved to be safer than the CT scan, because it avoids the body from radiation exposure and proved to work in real time and less bulky compared to MRI system. For this reason, my PhD will focus in developing a Combined Ultrasound Sensing and dissection Tools for robot assisted surgery. I am excited to move forward in this research



Meet our Researchers



ALICIA GARDINER

Acoustic Metamaterials for Ultrasonic Applications

My PhD will focus on the design of metamaterials that manipulate acoustic waves in the ultrasonic regime. Metamaterials can be defined as artificial materials capable of manipulating waveform media via their structure, rather than their innate material properties, allowing properties previously unobtainable in natural materials to be achieved. The desired application of these metamaterials involves the manufacture of ultrasonic transducer backing layers with superior sound absorption; in comparison to

standard backing materials (Epoxy layers with tungsten inclusions). Currently, my research has focused on developing mathematical models describing the acoustic behaviour of various Helmholtz resonator arrays, and thus, replicating these models using simulations (ANSYS/Onscale). My initial research also includes material calibration using 3D stereolithography (SLA) printers, with later experimentation to include printing and testing metamaterial prototypes.

BEN JACOBSON

Optimising Acoustic Cavitation Mediated Decontamination of Surgical Instrumentation



In the UK alone, over 4.7 million surgical procedures are performed each year. Each surgery requires the use of around 20 individual surgical instruments. These instruments are often expensive and complex, hence are reusable. It follows that each instrument must be decontaminated between procedures.

Decontamination requires each instrument to be completely cleaned of foreign material with subsequent disinfection and sterilisation. The cleaning stage is critical in avoiding patient exposure to infections carried on dirty instruments.

A principal tool in surgical instrument decontamination is ultrasonic cleaning. In this process Instruments are submerged in a liquid and energy is delivered to the surfaces of the instrument in the form of ultrasonic waves that create cavitation bubbles within the liquid volume. When these bubbles collapse, shockwaves are generated that remove contamination from adjacent surfaces.

In partnership with Aseptium, this project will investigate several perspectives of ultrasonic cleaning of complex surgical instruments in order to better understand the precise mechanisms by which bubbles clean, leading into further optimising the cleaning process to deliver the best decontamination procedure possible.

Both state of the art high-speed cameras and novel in-house acoustic detection devices will be utilised for imaging rapid acoustic cavitation bubble dynamics & interaction with the instrumentation, and monitoring & mapping of the acoustic signal, respectively.

Meet our Researchers



ALISTAIR LAWLEY

Automation for Patient Screening

Ultrasound is one of the most accessible and highly used clinical diagnostic modality currently available on the market today but much of its potential still remains untapped. This project focuses on getting the most out of ultrasound using advanced AI techniques to future proof ultrasound as a tool for the clinicians of tomorrow.

This collaboration between Canon and FUSE CDT, aims to investigate image-based solutions to diagnostic, automation, and workflow problems. Alistair will work closely from within the industry partner to achieve the intended goals with many exciting potential avenues to build upon as the collaboration progresses.

Being deeply embedded into the host company the student is able to quickly react to the needs of the project. For Alistair the opportunity to build upon existing skills while working with a highly regarded Industrial partner was too good to pass up. This project could potentially include machine learning/AI, computer vision, and automation all of which are highly in demand across scientific and industrial fields. Medical ultrasound allows for highly accurate real time medical imaging without the use of ionizing radiation leading to many potential uses in patient screening.

Ultrasound screening techniques are currently a hot topic of research with many potential clinical uses in the future. Having a student with clinical expertise backed up not only by the professional experience already within the host industrial sponsor but also within FUSE CDT itself has the potential to take advantages of these techniques as they are identified.

DARYA SHULAKOVA

Ultrasonic Drilling and Tunnelling Robot

Traditional drilling and penetration technologies involve mechanical, pneumatic, or hydraulic mechanisms, which utilise large forces and are power hungry. These technologies are large and often cause damage to the surrounding environment. Ultrasonic drilling technology has shown to be a promising alternative: it is more compact, less power consuming and produces less damage to its surroundings. Therefore, they can be more easily integrated into robotic systems for use in remote applications and extreme environments.

In ultrasonic drilling, waves are emitted from a transducer at frequencies above 20kHz. The waves then propagate to an amplifying horn, which subsequently produces vibrations into the surrounding material such as soil. This then enables the drill to proceed further into the soil. Studies have proven that ultrasonic drilling can reduce the forces and torques required during drilling by 30%, which consequently reduces power consumption.

The aim of my PhD is to miniaturise the ultrasonic drill for use in robotic tunneling applications. The project will involve optimization of the horn design using Solidworks, simulation of the design in Abaqus and field testing to study its effectiveness in different materials resembling the environment in which the drill is to be applied.



Institution of **MECHANICAL ENGINEERS**



RESEARCHER DEVELOPMENT DAY

On 19th June 2020, our first cohort participated in a Researcher Development Day focusing on personal and professional angles on improvement. Patrick Harkness led the day's events, which included presentations from guest speakers Margaret Ritchie (UofG), Sandra Mulligan (iMechE), Hannah Roberts (Skillfluence) and Elizabeth Adams (UofG).

The day included an overview of the motivational STEM Ambassador programme (Margaret Ritchie), that featured the benefits of science communication, and the iMechE chartership (Sandra Mulligan & Patrick Harkness). Students received feedback on their initial sixty-second STEM Ambassador introduction videos, and the day progressed on the theme of self-development with detailed advice on personal branding.

Marketing yourself through micro-blogging social media such as Twitter and LinkedIn was the main focus of the afternoon (Hannah Roberts), which was followed by a walk-through of a personal-development plan based on the five competencies of the iMechE Chartership (Elizabeth Adams).



IMECHE CHARTERSHIP

To further professionalise our researchers, FUSE CDT embarked on a bid for iMechE chartership in 2019. Led by Dr Patrick Harkness from our Researcher Development team, FUSE CDT successfully linked their training to the Monitored Professional Development Scheme (MPDS).

The scheme assesses and accredits graduate programmes to ensure appropriate opportunities, monitoring and feedback are available to ready engineers to apply for CEng or IEng. FUSE CDT researchers will be registered and will work towards accreditation through Continuing Professional Development (CPD) embedded in the CDT's activities.

Dr Harkness commented: 'Chartership is a gold standard of excellence across both industry and academia, and our clients and partners value it very highly. We are striving for that level of professionalism at FUSE. For me, and my colleagues, taking part on this level is a fresh challenge to add to our daily jobs. Enthusiasm and commitment are what makes a mentor, and these qualities are essential throughout your professional and engineering career.'

Cohort 2: First Year Training

Our second cohort joined FUSE CDT in September 2020 and are currently undertaking their First Year Training. As the students near the end of their foundational studies in spring 2021, they will be deciding between PhD and EngD pathways with their project selection. Below they offer a summary of their backgrounds and insight into their future ultrasonic interests.

Should you be considering a project for mid-2021 and would like to find out more about studentship opportunities, please contact Kirsten Laing, Business Development Manager (kirsten.laing@strath.ac.uk) for an initial discussion.



MOHAMMED ABDALLA

My previous studies as an electronics engineer allowed me to build a practical experience that is focused on mathematics and building programs. My Master's project was centered on generating Ultra-Wide Band Signal Using FPGA. Also, my third-year project was focused on RFID (Radio Frequency Identification Device) where I had responsibility to design RFID Tags (antenna with the calculation) and Reader Modules (antenna with the calculation) to identify the tags. I strongly feel that FUSE will give me the chance to support my analytical skills as an engineer and use it to get into the industry and academic field. I am intrigued to implement research work to real life problems (e.g., in the case study subject: A Sub-mm³ Ultrasonic Free-floating Implant for Multi-mote Neural Recording).

DENNIS ABRAHAM

I'm Dennis Abraham, a graduate from the University of Glasgow in BSc Aeronautical engineering. I am sure that Fuse CDT programme is a highly valuable opportunity that will greatly aid me to develop strong working relationships with my fellow researchers, academics and industrial partners. Further, I am hopeful and confident that from my time at Fuse and the PhD experience, will allow me to push boundaries in the fields of Non-destructive testing and medical imaging in ultrasound. I eagerly look forward to working alongside Industry to proactively carryout research providing innovative and valuable solutions in field of ultrasound.



HAARIS AZHAR

I am in my first year of the FUSE-CDT programme and I am excited to have started my training in ultrasonics. I look forward to gaining experience in the field, especially relating to NDT and ultrasound's applications in the aerospace, automotive, naval, and oil & gas industries. I gained my Masters degree in Mechanical and Aerospace Engineering from the University of Strathclyde in 2019 with a 2:1, completing my final year abroad in the city of Bologna Italy. I have worked extensively with SCADA and HMI systems, along with industrial automation software.



DION BLACKBURN

My name is Dion Blackburn and I am currently in in my first year as a FUSE PhD student. I graduated from the University of the West of Scotland in 2019 with a BSc (Hons) in Physics before continuing my studies at the University of Glasgow and obtained an MSc in Theoretical physics. I am looking forward to learn about the latest developments in the world of ultrasound and with the breadth that this field encompasses I am keeping an open mind as to possible projects.





MATTHEW DOWHAN

My name is Matthew, and I am a PhD student with FUSE. I have a master's degree in Biofluid mechanics from the university of Strathclyde and a background in physics, computational fluid dynamics (CFD), piezoelectric materials and deposition systems. My masters project involved designing, meshing and simulating a simplified aortic valve in order to measure the jet velocity and pressure flowing through the valve at different stages of closure to functionally mimic stenosis. This was done by utilizing a variety of software including ANSA and ANSYS Fluent. My current area of interest is in cardiac imaging through ultrasound and smart stent technology. My focus in my FUSE future is on smart stent technology, either in helping add or create an affordable biological stent, or in a stent capable of monitoring the dynamics within its vessel.

PANOS KAMINTZIS

I obtained my Masters of Engineering (MEng) in Electronics and Electrical Engineering from the University of Glasgow. As a first-year researcher in the FUSE CDT program, I could not be more excited for what lies ahead. I strongly believe that the work we are doing here in Glasgow will have a huge impact on the future of industrial ultrasonics as well as research. I am particularly interested in pursuing an engineering doctorate (EngD) in the sector of ultrasonic testing (NDT) or medical ultrasonics.



EMILY KERR



Hi, I'm Emily and I am currently in my first year of FUSE CDT program. I graduated from the University of Strathclyde with a Masters degree in Product Design Engineering. My masters project focused on redesigning a safety mechanism for equine Eventing to create a smart system to prevent rotational falls. Throughout my time at university, I have spent three consecutive years interning with Eaton Aerospace where I was able to apply my university knowledge on exciting projects and help with testing and validation of engine fuel pumps. Out of university I am a STEM ambassador and a member of WES (Women in Engineering Society) - a charity which promotes and supports women in STEM. I am looking forward to expanding my knowledge and experience in ultrasonic engineering and learning about the latest technological developments in the field of ultrasonics. I currently have a keen interest in the industrial side of ultrasonics, but I am also keeping my mind open for the project topics.

STEWART KEY

I graduated from The University of Strathclyde in 2016 with a BSc (Hons) in Computer Science. Following a successful internship at JPMorgan I joined their Software Engineer Programme which culminated in my promotion to Associate in 2019. During my tenure there I led initiatives automating processes, became our in-team expert on security, worked on cloud migration and upgrading our technology stack. I worked as a STEM ambassador, mentored graduates, and assisted in charity projects. With a lot to learn ahead of me I'm looking at all FUSE projects with an open mind, but am particularly interested in the medical field, projects involving machine learning are my current focus.





LOUISE MACDONALD

My name is Louise Macdonald, and I am a first year FUSE PhD student. I graduated from the University of Strathclyde in 2019 with a BSc (Hons) in physics and achieved distinction in my MSc in Nuclear Technology at the University of Glasgow in 2020. My project for my undergraduate degree was using laser plasma Wakefield acceleration to see if it was feasible to produce Lead-212 from a Radium-226 source and my MSc project was on evaluating the neutron dose from proton therapy using Bonner spheres. I am interested in the medical applications of ultrasound and would be interested in doing either a PhD or an EngD.

HILDE METZGER

I came to the FUSE CDT after completing an MSc in Acoustical Engineering at the University of Southampton and a BSc (Hons) in Physics and Music at the University of Edinburgh. I knew before starting higher education that I wanted to study a form of acoustics and then during my masters I discovered the use of ultrasound & microbubbles in a biomedical setting. I immediately fell in love and decided that I wanted to further my technical expertise in this field by doing a PhD and use that opportunity to develop technology that can improve people's quality of life. I also love science outreach in the community and schools, especially to encourage girls into the world of science.

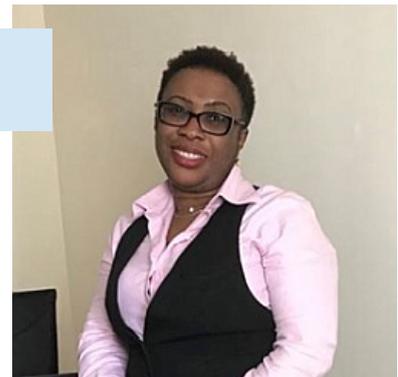


LYNE MKOH

My name is Lyne Mkoh, I graduated in 2020 from Glasgow Caledonian University with a master (MEng) in Mechanical Electronic System Engineering. I am currently a first year FUSE student. I have joined the FUSE program because of how broad ultrasonic can be applied in different areas of life especially in the medical sector where my interest lies. EngD oriented, I am looking forward to working along industries and bring my contribution in the field of Ultrasonic.

OLUBUNMI ONANUGA

Having worked in project support and operational roles in the healthcare, financial services and private sectors, I desired to live a more fulfilling life and decided on a career change. I journeyed through college, then university where I obtained a Master of Engineering (MEng) degree in Mechanical Electronic Systems Engineering from the Glasgow Caledonian University. The FUSE program piqued my interest because of the wide-reaching range of the applications of ultrasonics in different spheres of life. I look forward to learning, honing my research skills and contributing my knowledge to the application of ultrasound in the processing industry and industrial waste management/cleaning application.



JAYDEN TOMKINSON

Hi, my name is Jayden Tomkinson and I'm part of the second cohort of FUSE! I have a bachelor's degree in mathematics from Coventry University and have a love of learning. I wrote my undergraduate dissertation about inverted pendulums and the creation of a device to maintain its equilibrium, this was more of a Physics concept but loved pushing myself and challenging my understanding from a mathematics perspective. That is why I applied for FUSE in the first place is to expand my knowledge and keep challenging myself. I love working within my cohort on different projects and discussions as well as organising study session and exchanging knowledge.



PRINCE2 Project Management

One of the main aims of FUSE CDT's doctoral training programme is to develop our researchers into work-ready graduates. Accordingly, our first cohort of students are currently tackling the Prince2 Foundation certificate in project management.

Ben Jacobson reflects on his experience:

"Upon completion of the PRINCE2 Foundation module I feel better equipped with the tools and techniques required to plan and implement a successful project. Learning of the principles, themes and processes described in PRINCE2 has allowed me to attain a clearer understanding of exactly how I should execute future projects from the planning stage to the closing stage, no matter the size of the project. I feel that the full benefits gained from PRINCE2 will be realised post-PhD, in an industrial/commercial setting, where this qualification will help me stand out from the crowd. However, the inherent flexibility of PRINCE2 will certainly allow me to tailor the methodology to deliver improved aspects of my PhD project from documenting work to maintaining better communication channels. I would recommend the course to future researchers who are interested in learning more about the management side of a project."

KIRSTEN LAING - BUSINESS DEVELOPMENT MANAGER

It is our pleasure to introduce Kirsten Laing, who has recently joined the FUSE CDT team as our Business Development Manager.

Working for a variety of organisations from Government to Industry over her 25-year career, although each role has been different, there have always been significant Business Development activities in each of them. Kirsten returned to Scotland earlier this summer having lived in Nova Scotia for the last 4 years where she latterly worked as a Program Coordinator for an ocean science Graduate Research School based at Dalhousie University. Her BD skills were also utilised while working with one of the Program Codirectors as they developed an initiative to build on the strong ocean science and research links established in Cabo Verde as a mechanism for commercial ocean tech companies to service and support the vast ocean related requirements of West Africa.

Kirsten's key activities within FUSE CDT is to manage all aspects of internal and external engagement including developing strong industry and partner relationships to compliment ultrasound R&D strategies through supported PhD and EngD studentships and developing a growing ecosystem of knowledge and support for the ultrasound community.

Kirsten is available at kirsten.laing@strath.ac.uk for any queries related to external partner engagement.



SUMMER INTERNSHIPS

promoting ultrasound research amongst undergraduates

Despite the challenges faced over the summer with quarantine measures, we went ahead with our first intake of undergraduate engineering students into our summer internship programme. The internship is championed by our Equality and Diversity team to widen access into FUSE CDT by encouraging interest in ultrasound research specifically, and providing lab experience to up-and-coming researchers to strengthen their CVs. Our two 2019 interns worked at a distance under Dr. Teti Stratoudaki and Mr David Lines at the University of Strathclyde to refine their MATLAB skills, gain experience in Phased Array Ultrasonic Testing scan types and FMC/TFM, and to understand the benefits of data storage structures and optimisation.

The interns work under these difficult circumstances was highly praised by the wider 'Advanced Welding Equipment System for Inspection and Monitoring' (AWESIM) in Cavendish Nuclear, Doosan Babcock, the Advanced Nuclear Research Centre (ANRC) and the University of Strathclyde. They highlighted the 'hard work' and 'determination' of the interns to deliver on their tasks within a tight 5-week timescale, which will provide the mechanism for future data analysis in the project.



VASSIL ATANASSOV

My name is Vassil Atanassov and I'm currently a 4th year Mechanical Engineering student at the University of Glasgow. My main academic interests lie in the fields of robotics, thermal engineering and fluid mechanics. I find being part of a cutting-edge research team exciting and hope to learn a lot about more ultrasonics, non-destructive testing and all the various software that is utilized in industry and research (such as MATLAB, LabVIEW and C/C++). I believe this opportunity is a great fit for my academic interests and will provide me with an amazing first-hand research experience

AWAIS ALI

Hi, I'm Awais Ali, I'm currently a 4th Year Mechanical Engineering with Aeronautics student at The University of Glasgow. My current academic interests include Material sciences as well as Thermofield engineering. I believe this internship opportunity at CDT FUSE will allow me to further expand upon my interest in Material engineering allowing me to gain a more profound understanding for Ultrasonic testing, a key NDT (Non Destructive Testing) type desirable in industry as well as developing my own programming skills in software such as MATLAB, C and LabVIEW. I am grateful for the opportunity to learn from the highly experienced members of staff at CDT Fuse and am ecstatic to learn and develop my engineering skillset during this internship!



Get in Touch

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Newsletter created by FUSE CDT Admin team.

If you would like to learn more about any of the content, or contribute a news item, please contact Rhona Nicholson and Amalya Cohen at fuse-cdt@glasgow.ac.uk or the FUSE Coordinator, Dr. Caryn Hughes, at caryn.hughes@glasgow.ac.uk



FUSE Annual Meeting 2021

*Please add the dates of our next annual meeting on **15th and 16th June 2021** to your diaries. We look forward to seeing as many of you as possible!*