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INNOVATIVE

Marie Skłodowska-Curie Actions COFUND doctoral programme

2021

INNOVATIVE

The Systematic Integration of Novel Aerospace Technologies
Marie Skłodowska-Curie Actions COFUND doctoral programme

Delivering outstanding people and skills for the aerospace sector

The project is co-funded by the European Union

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Introduction

INNOVATIVE: Integration of Novel Aerospace Technologies, is an EU Marie Skłodowska-Curie Actions programme. It is run with the ambitious aim to train, nurture and develop aerospace researchers of the future, exploring game-changing and disruptive technologies, materials, methods and processes for the aerospace sector. INNOVATIVE is co-funded with the University of Nottingham and run by the Institute for Aerospace Technology (IAT).

The IAT is a major centre for aerospace research, where specialists from global aerospace companies and aviation leaders have joined forces with researchers and academics at the University of Nottingham to create an extraordinary future for aerospace technology. The IAT has more than 70 externally funded projects, valued at over £80 million, with an inspirational team of 400 scientists and engineers focusing on five key areas of research: Future propulsion, Aerospace electrification, Aerospace manufacturing, Aerospace materials and structures, and Aerospace operations.

The INNOVATIVE programme was established back in 2016 as the next step following the INNOVATE programme, which started in 2013. The development and implementation of disruptive ideas in these and other related areas, are the key enablers in achieving ambitious targets of greener, environmentally friendly aviation as set by FlightPath2050. They will also contribute to the development of decarbonised and carbon-neutral aircraft of the future. INNOVATIVE has provided a comprehensive doctoral training programme for Early Stage Researchers (ESR) in aerospace technologies. It has considered their interactions and interdependencies, empowering their young talents with a multidisciplinary skill set including the tools, techniques and methods required for future aerospace leaders.

This INNOVATIVE cohort comprises 23 researchers from around the globe – with representatives from 15 countries, spanning four continents from Ecuador to Indonesia, Inner Mongolia to Tanzania. They have conducted their research in a range of forward-looking training projects, articulated along four core research areas, including Innovative Design, New Technologies, Advanced Manufacturing, and Exploitation and Operations. With the broad expertise of the team, ranging from electrical and mechanical engineering to computer science and human factors, each ESR was placed in one of the many research groups across the Faculty of Engineering and Faculty of Science at the University of Nottingham where they pursued their individual PhD projects. Tailored aerospace training also included industrial placements that took place across our key partners including Rolls-Royce, Cummins, Aeromechs, Thales and SKF. The ESRs have also had the opportunity to attend numerous international conferences and events (like Farnborough International Airshow and Paris Airshow) to share and disseminate their findings, enhancing their network and sector knowledge. The programme has also supported the ESRs through specialised training courses to build their skill set and knowledge required to successfully address aerospace sector challenges at the highest professional level. The excellent quality of conducted research is confirmed by the significant number of publications – 35 papers in top-ranked international journals and 65 international conference presentations (at the time of publishing). In their research, the ESRs have pushed the boundaries of existing knowledge and current practices to make novel contributions to the aerospace sector, impacting the future of air transportation for people and goods.

The success of the INNOVATIVE programme can be attributed to the dedication of the ESRs who have developed amazing outcomes from their research; to the great support and encouragement of academic supervisors who came from different disciplines across the university to support these multidisciplinary research projects; to the IAT staff who have developed the initial vision, shaped and managed the programme and supported the researchers; and finally, to the financial support of the Marie Skłodowska-Curie Actions (MSCA) fund. INNOVATIVE has confirmed that such programmes are powerful tools for generating highly skilled researchers who are well-equipped and ready to solve the challenges of tomorrow. Its key objective – to develop and nurture the future leaders of the aerospace sector – has been successfully achieved. This brochure details and showcases the ESRs' work on the programme.

The INNOVATIVE cohort is now joining a community of experts who are capable of solving the acute challenges of aerospace. They are some of the brightest and most ambitious individuals working in aerospace today. We wish them the very best for their future careers and hope they achieve their ambitions. We will be following their careers and look forward to seeing them working for the world's most prestigious companies and collaborating with us on projects that will shape the aerospace industry of tomorrow.

Professor Serhiy Bozhko
INNOVATIVE Coordinator
Director, Institute for Aerospace Technology
Professor of Aircraft Electrical Power Systems

INNOVATIVE programme activity

2016

INNOVATIVE launch
March 2016

INNOVATIVE programme launched and positions for MSCA Early Stage Researchers (ESRs) are advertised internationally. We were searching for the brightest and most enthusiastic aerospace engineers and scientists of the future.

Cohort 1 arrive in Nottingham
October 2016

The INNOVATIVE programme, based in the Institute of Aerospace Technology (IAT) welcomes Cohort 1, consisting of nine ESRs.

PhD studies commence
October 2016

Cohort 1 enrol on their PhDs and start their research journey. Their disciplines range from Mathematical Science to Electrical Engineering.

2017

Cohort 1 teamwork: UAV Solar Challenge
Spring/Summer 2017

Cohort 1 work together to design, manufacture and fly a solar-powered, electric UAV. ESRs describe this experience as a highlight of the programme.

International Paris Air Show
June 2017

ESRs travel to Paris to disseminate their PhD work. ESRs learn about global aerospace companies and current trends, and are able to see prototype electric aircraft models first hand.

Cohort 2 arrive in Nottingham
October 2017

The IAT welcomes a further four ESRs onto the INNOVATIVE programme.

2018

EU mid-term review
March 2018

This is a great event bringing together the EU project officer, ESRs, their supervisors and the IAT to review the programme and hear presentations from all researchers.

Cohort 3 arrive in Nottingham
January/February 2018

The IAT welcomes a final 10 ESRs onto the INNOVATIVE programme. We now have 23 ESRs on the programme.

Publications record
December 2017

Team members in Cohort 1 present their work at international conferences throughout 2017. The programme now has three conference publications on its record.

IAT winter expo, University of Nottingham
December 2017

ESRs disseminate their PhD work to the Faculty of Engineering at a University of Nottingham aerospace exhibition held on University Park.

2019

Fly Your Idea – Airbus challenge 2019
Summer 2019

Working in small teams, members of Cohorts 2 and 3 take part in an international competition hosted by Airbus, challenging participants to solve real-world problems. One ESR team gets through to the second round.

Industry secondments ongoing
June 2019

Many ESRs have now been on secondment, spending time at companies across Europe including Cummins Generator Technologies, Rolls-Royce, Leonardo Helicopters, SKF and Aeromechs.

Publications record
December 2018

Cohort 1 team members make great progress with their PhD work – a total of 5 journal papers and 16 conference papers have now been published.

Industry secondments start
June 2018

These secondments enable ESRs to gain first-hand experience in industry. Victor Thierry is our first ESR out on secondment, going to CEA in France, The French Alternative Energies and Atomic Energy Commission.

2020

INNOVATIVE summer school
Summer 2019

The INNOVATIVE programme organises a six-day summer school. Highlights include talks from international members of the aerospace community representing industry and academia. ESRs also get to attend the Flying Legends airshow at Duxford, Cambridge.

Publications record
December 2019

All ESRs continue to publish in top scientific journals and conferences. The programme now holds 50 publications – 13 journal papers and 37 conference publications.

Industry visit to Airbus
February 2020

Another highlight of the programme, ESRs get to visit the Airbus factory in Broughton where commercial aircraft wings are manufactured and assembled. It's a fascinating trip.

2021

INNOVATIVE final project conference
December 2020

Our final, large-scale dissemination event, this two-day virtual conference brings all 23 ESRs together. We deliver 23 short technical presentations, have an insightful live Q&A and 4 brilliant panel sessions, reflecting on ESRs' experiences on the INNOVATIVE programme.

Final publications record
August 2021

Current tally stands at 100 publications – 35 journal papers and 65 conference publications.

Close of programme
August 2021

The INNOVATIVE programme has now closed. Many ESRs have started their post-doctoral journey, spread across academia and industry. Find out more about each ESR throughout the rest of the brochure.

Meet the team

Francesco Zangrossi
UG degree:
BEng Materials Engineering
Master's degree:
MEng Materials Engineering

Victor Thierry
Master's degree:
MEng Mechanical Engineering

Daniela Munalli
UG degree:
BSc Aerospace Engineering
1st Master's degree:
MSc Aeronautical Engineering
2nd Master's degree:
MEng Civil Aviation Management

Cosimo Spagnolo
UG degree:
BSc Electronic Engineering
Master's degree:
MSc Electrical Engineering

Vincenzo Madonna
UG degree:
BSc Electronic Engineering
Master's degree:
MSc Electrical Engineering

Angel Recalde
UG degree:
BEng Electrical Engineering and Industrial Automation
Master's degree:
MSc Electrical Engineering

Milos Lukic
UG degree:
BSc Electrical and Computer Engineering
Master's degree:
MSc EMMC Sustainable Transportation and Electrical Power Systems

Leonidas Gargalis
UG degree:
BEng Production and Management Engineering
1st Master's degree:
MEng Production and Management Engineering
2nd Master's degree:
MSc Space Studies

Ahmed Hebala
UG degree:
BSc Electrical and Control Engineering
Master's degree:
MSc Electrical and Control Engineering

Hery Mwenegoha
Master's degree:
MEng Aviation Engineering

Nurkanat Aimakov
Master's degree:
MSc Mechanics and Mathematical Modelling
2nd Master's degree:
BSc Mechanics

Dongdong Xu
UG degree:
BEng Mechanical Engineering
Master's degree:
MEng Mechanical Engineering

Xin Wang
UG degree:
BEng Electrical Engineering
Master's degree:
MEng Electrical Engineering

Jayakrishnan Harikumaran
UG degree:
BTech Electronics and Communication Engineering
Master's degree:
MSc Sustainable Energy Technology

Sarah Shabbir
UG degree:
BEng Mechanical Engineering

Mahnaz Sharafkhani
UG degree:
BSc Industrial Engineering (Planning and System Analysis)
Master's degree:
MSc Industrial Engineering (System Management and Productivity)

Julan Wu
UG degree:
BEng Civil Engineering
Master's degree:
MSc Civil Engineering

Xipeng Lyu
UG degree:
BEng Naval Architecture and Ocean Engineering
Master's degree:
MEng Naval Architecture and Ocean Engineering

Liang Ding
UG degree:
BEng Naval Architecture and Ocean Engineering
Master's degree:
MSc Mechanical Engineering

Shaohong Zhu
UG degree:
BEng Electrical Engineering

Mohammad Tanvir Chowdhury
Master's degree:
MEng Mechanical Engineering

Divish Rengasamy
UG degree:
BEng Electrical and Electronic Engineering

Ridwan Prasetyo
UG degree:
BPsych Psychology
Master's degree:
MSc Human Factors and Ergonomics

Aerospace electrification and propulsion

Vincenzo Madonna

Project: Physics of failure as a technology enabler for electrical machines in transportation: reliability-oriented design of low voltage insulation systems

Research group: Power Electronics, Machines and Control

PhD supervisors: Professor Michael Galea, Dr Paolo Giangrande, Professor Chris Gerada

Secondment: University of Nottingham, Ningbo, China / Yuyao Electrification Centre, China

Read my work here: V Madonna, P Giangrande, M Galea 'Electrical Power Generation in Aircraft: Review, Challenges, and Opportunities' IEEE Transactions on Transportation Electrification, vol 4, no 3, pp 646–659, Sept 2018

Awards: (1) Brian J Chalmers Best Paper Award, 23rd International Conference on Electrical Machines, 2018 (2) Best Student Paper Award of the IEEE Industrial Electronics Society, 2020

ORCID: https://orcid.org/0000-0003-4470-9735

Where did you grow up and study before Nottingham?

"I'm from Calabria in Southern Italy. I studied for my Bachelor's degree in Electronic Engineering at the University of Calabria and then attended the University of Bologna for my Master's degree, in Electrical Engineering."

What attracted you to Nottingham and the Marie Skłodowska-Curie Actions programme?

"I spent some time in Nottingham while working on my Master's dissertation, and while I was there I learned about the MSCA programme. I understood it's considered to be one of the most prestigious PhD programmes in Europe, perhaps even globally, and has a strong budget for research. It also puts great importance on attendance at conferences and events around the world, which made it a very attractive proposition for me."

What problem were you trying to solve?

"Making the transition from traditional aircraft models to electrified solutions is an industry-wide issue. The challenge of replacing conventional hydraulics with electro-mechanical actuators and introducing more electric power on board an aircraft is something that many engineers the world over are working on. For my PhD I was exploring the reliability of these systems, identifying safety-critical components and researching new methods for establishing electrical frameworks for future aircraft."

How has being at IAT helped your studies?

"Being at IAT has meant I've been able to work within a larger, multidisciplinary team and interact with colleagues from other faculties who are working on fuel and propulsion technologies. This has provided me with an overall view of aerospace research at the university, helping me to see how my project fits into an overall vision."

What's the best place you've been to as part of your studies?

"I attended the International Electric Machines and Drives conference in San Diego where I presented three of my papers. Delegates provided me with invaluable feedback which I've been able to apply to my future studies."

What's been your favourite INNOVATIVE team activity?

"The solar challenge. The brief required considerable electrical research and I was heavily involved in the design stage. It was a good exercise that enabled us to get to know each other and work as a team on a technically challenging project."

What interaction have you had with industry during your studies?

"I was fortunate to spend some time studying at the University of Nottingham Ningbo China during my PhD and while I was there I engaged with industry. I also attended the Paris Air Show where industry representatives were able to help guide our plans for the Machines Reliability Lab in Nottingham, explaining from a practical point of view what was needed."

National Air and Space Museum Washington DC 2018

If someone was going to read one of your papers, which would you recommend and why?

" 'Electrical Power Generation in Aircraft: Review, Challenges and Opportunities'. Whether you're an aerospace student or just interested in aviation, this paper provides an overview of electrical power systems in aircraft – in the past, the present and the future."

What have you enjoyed most while being in Nottingham?

"The university is very welcoming. It provides an excellent reception for students and makes you feel valued."

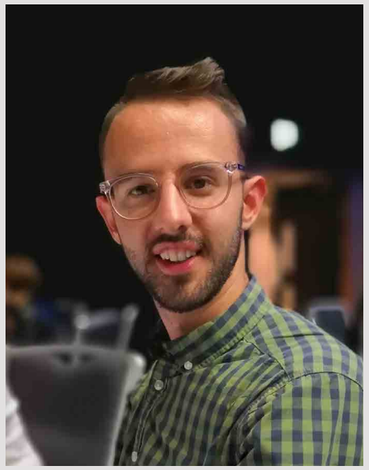
What are your plans for the future?

"I worked as a Research Associate and Post-Doctoral Fellow with the University of Nottingham until December 2020. In January 2021 I joined Leonardo Aircraft Division in Turin, Italy, where I work as a research fellow in the Electrification Research Unit of the Future Aircraft Technologies Lab. I plan to keep working in Research and Innovation for the foreseeable future."

What would you say to anyone considering the Marie Skłodowska-Curie programme?

"Marie Skłodowska-Curie is a flagship programme and I recommend applying if you have the opportunity."

"I was fortunate to spend some time studying at the University of Nottingham Ningbo, China during my PhD and while I was there, I engaged with industry."



Milos Lukic

Project: Energy recovery and storage from aircraft taxiing operations

Research group: Power Electronics, Machines and Control

PhD supervisors: Professor Michael Galea, Dr Christian Klumpner, Dr Paolo Giangrande

Secondment: University of Nottingham Ningbo China / Yuyao Electrification Centre, China

Read my work here: M Lukic, P Giangrande, A Hebala, S Nuzzo, M Galea 'Review, Challenges, and Future Developments of Electric Taxiing Systems' IEEE Transactions on Transportation Electrification, vol 5, no 4, pp 1441–1457, Dec 2019

ORCID: https://orcid.org/0000-0002-0146-0709

Please introduce yourself

"I grew up in Belgrade in Serbia and achieved my Bachelor's degree in Electrical Engineering at my home town university. I then went on to study the 'Sustainable Transportation and Electrical Power Systems' Master's course through the Erasmus programme at the University of Oviedo in Spain. Here I also had interactions with Sapienza University in Rome and the University of Nottingham."

Why did you want to join the Marie Skłodowska-Curie Actions programme?

"I was impressed by the training opportunities and industry connections it offered, which made it very different to any other PhD programme."

And why Nottingham and the INNOVATIVE programme?

"I'd made some friends at the university during my Master's course and was inspired by the facilities at Nottingham. I was keen to continue my studies there, so I found a suitable project and applied for a place."

What are you studying?

"I've been looking into green taxiing systems for aircraft and suitable batteries for these applications. When an aircraft is taxiing it's burning fuel and can be doing so for up to 30 minutes. I've been researching options for installing electric motors into aircraft wheels, so reducing fuel consumption and trying to establish which batteries would be most suitable for different taxiing scenarios."

What findings have you made?

"There's no right battery for everything! I've developed three or four scenarios using different battery types, trying to find the best option to assign to particular aircraft. It's something that requires a very precise specification, developed in conjunction with industry."

How has training helped you in your research?

"I attended a summer school in Italy which I found particularly useful as I met other students who were studying similar subject matter to me. I also attended a number of conferences and professional training courses. I remember the presentation skills course – I don't enjoy having to present but knew the training was necessary!

A highlight of the programme was my secondment at the Yuyao Electrification Centre in China. I continued my PhD studies while over there and was able to broaden my experimental research."

How have you interacted with industry during your studies?

"As a team we attended the Farnborough Airshow. I thoroughly enjoyed the experience as I was able to talk to companies who were developing electric taxiing systems and even spoke to a pilot who provided me with his insights into the opportunities for my research."

What are your plans for the future?

"In the future, I would like to use my research skills within an industrial environment that is more goal-oriented. I want to be engaged in a multidisciplinary role that would allow me to grow professionally and expand my knowledge simultaneously."

If someone was going to read one of your papers, which would you recommend and why?

"I collaborated with my INNOVATIVE colleague Ahmed Hebala on a paper called 'Review, Challenges, and Future Developments of Electrical Taxiing Systems'. It provides the reader with a thorough introduction to the systems I am exploring, summarising in-depth analysis and operation of electric taxiing."

What have you enjoyed most during your time at the University of Nottingham?

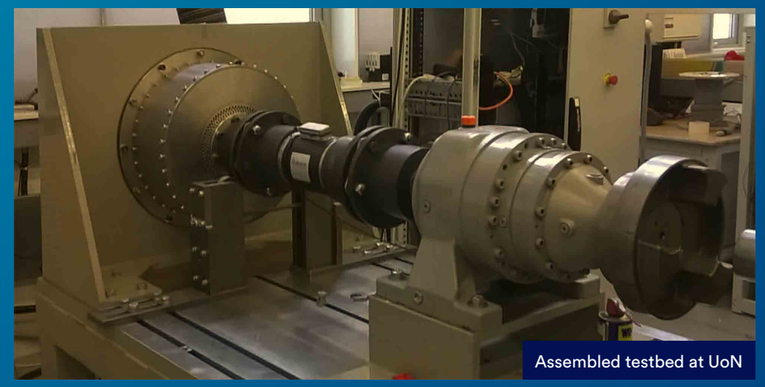
"The campus is very pleasant with plenty of green open space and libraries provide an excellent resource. The city itself is also a good size with plenty of student life, providing a lively atmosphere."

What would you say to anyone considering a Marie Skłodowska-Curie Actions programme?

"Compared to any other PhDs, this is a team effort. You're working as part of a group, all supporting each other, all problem solving together. That's what made this whole experience so enjoyable."

"I was impressed by the training opportunities and industry connections INNOVATIVE offered, which made it very different to any other PhD programme."

A showpiece of electric taxiing system at IAT



Assembled testbed at UoN

Ahmed Hebala

Project: High temperature integrated machine drives – the development of electrical machines for aerospace propulsion electrification

Research group: Power Electronics, Machines and Control

PhD supervisors: Professor Michael Galea, Dr Peter Connor, Dr Stefano Nuzzo, Dr Paolo Giangrande, Professor Chris Gerada, Professor Carol Eastwick

Secondment: Motor Design Ltd, UK

Read my work here: A Hebala et al 'Feasibility Design Study of High-Performance, High-Power-Density Propulsion Motor for Middle-Range Electric Aircraft' IEEE 29th International Symposium on Industrial Electronics (ISIE), Delft, Netherlands, 2020, pp 300–306

Awards: Best paper award in WEMDCD conference, 2021

ORCID: https://orcid.org/0000-0003-3429-9074

Where are you from and where did you study before Nottingham?

"I'm from Alexandria in Egypt and I have a Bachelor's and Master's degree in Electrical and Control Engineering from The Arab Academy for Science, Technology and Maritime Transport in Alexandria, Egypt, with a specialism in Machine Design."

Why did you want to be a Marie Skłodowska-Curie researcher over other PhD programmes?

"I researched and applied for a number of PhD programmes but the MSCA proposition was far more prestigious and I was also impressed with Nottingham. The university is well organised, has a good reputation for electrical and machine engineering and is a world-leading institution. It's been an honour to study here."

What have you been studying for your PhD?

"I've been looking at aircraft electric propulsion – designing a motor for an electric aircraft that seats between 2 and 12 passengers. It's logical to work with a smaller aircraft like this first to test out different ideas, as in 2035 it's suggested the first full electric aircraft will take flight and the concepts being researched now could influence the redesign of aircraft all over the world."

How has being at the IAT helped your studies?

"Being in a group of people with the same mindset as you helps improve your insight into what you're studying, especially when you haven't come from an aerospace background. There were some excellent projects going on within the group and you all support each other to achieve your goals."

What key findings have you made during your studies?

"I know the electrification of an aircraft is possible and affordable, as well as very cost-effective in operation. I successfully designed the motor needed for a 12-person aircraft, but I'm yet to talk to industry to see how this might be adopted."

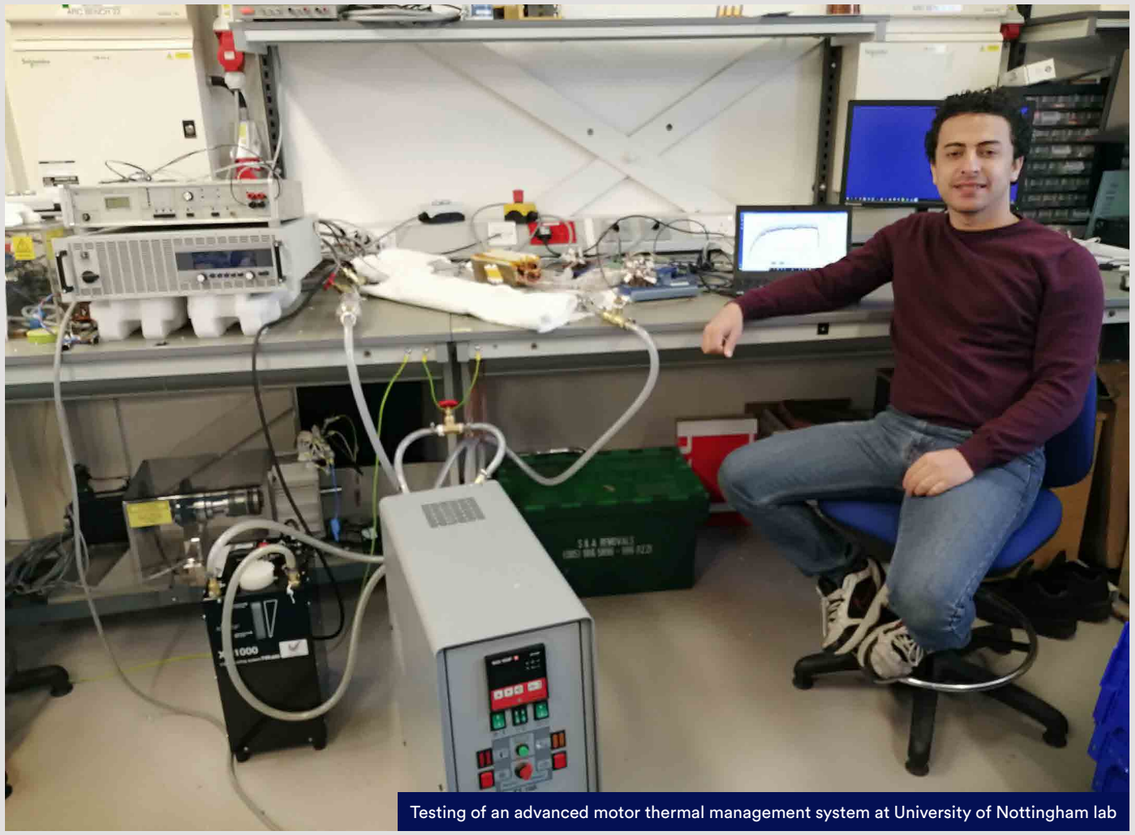
Have any of your supervisors contributed particularly to your work?

"All my supervisors were supportive and I couldn't have worked without them, but Dr Peter Connor in particular provided excellent support for me in thermal modelling. This isn't an area I have much experience in, so I found his help extremely useful."

What's the best place you've been to as part of your work?

"We attended the Farnborough Airshow for three days and it was a fantastic event. Again, because I don't have a background in aerospace this event really opened my eyes. It was impressive being able to explore different aircraft in detail and meeting various companies to talk about my work.

I also took part in an open day held by the university, presenting my work to school children who were learning about different industries. It was a unique experience and one that I really enjoyed."



Testing of an advanced motor thermal management system at University of Nottingham lab

What's been your favourite INNOVATIVE team activity?

"It was the Airbus Challenge. In our team we were looking at 'The State of Health for Batteries of Future Aircraft'. This is an interesting concept, since future aircraft will be dependent on batteries, hence keeping a good track of not only the state of charge, but also the state of health is of paramount importance."

If someone was going to read one of your papers, which would you recommend and why?

"It would be 'Feasibility Design Study of High-Performance, High-Power-Density Propulsion Motor for Middle-Range Electric Aircraft'. It's a comprehensive study about designing a high-performance propulsion motor for electric aircraft."

What have you enjoyed most about being at Nottingham?

"The campus. Nottingham's University Park is magnificent - I feel very lucky to have studied here and been able to enjoy the grounds."

What would you do differently if you were going to start again?

"I'd plan ahead more – outlining my thesis earlier in terms of ideas, and then sticking to a more rigorous timeline!"

What's your ambition now?

"I'd like to work in industry. I had a five-month secondment during my PhD working at Motor Design Ltd in Wrexham, UK, which I enjoyed very much. I'd like to move into a software or research-based position in industry now."

How do you think being a Marie Skłodowska-Curie fellow will help your future career?

"The aerospace industry knows the MSCA programme and it's well respected. Being a MSCA Fellow will definitely help my future career and I'd certainly recommend it to others."

"Being in a group of people with the same mindset as you helps improve your insight into what you're studying, especially when you haven't come from an aerospace background."

Jayakrishnan Harikumaran

Project: High reliability power converters for aerospace applications

Research group: Power Electronics, Machines and Control

PhD supervisors: Professor Giampaolo Buticchi, Professor Michael Galea, Professor Pat Wheeler

Secondment: University of Nottingham Ningbo China / Yuyao Electrification Centre, China

Read my work here: J Harikumaran, G Buticchi, G MIgliazza, P Wheeler, M Galea 'Reliability oriented thermal management of aircraft power converters' IEEE 9th International Power Electronics and Motion Control Conference (IPEMC2020-ECCE Asia), 2020, pp 1590–1594

ORCID: https://orcid.org/0000-0001-5180-0970

Where are you from and where did you study before Nottingham?

"I'm from Kerala in South West India. I studied for my Bachelor's degree in Electronics and Telecommunications Engineering at National Institute of Technology Calicut and then worked for Texas Instruments in Bangalore as a Hardware Design Engineer. Choosing to return to study, I attended Delft University of Technology and read Sustainable Energy Technologies for my Master's degree before working for Shell in The Netherlands for the next four years."

Why did you want to be a Marie Skłodowska-Curie researcher?

"I wanted to specialise further in power electronics as I'd been doing some work on this during my time in industry. I saw an opportunity with the Marie Skłodowska-Curie Actions (MSCA) programme to broaden my knowledge and explore the challenges in this area, ultimately to make my own contribution to this field of engineering. I liked the emphasis the MSCA programme placed on training and its connections with industry, suggesting this would be the right path for me to take at this point in my career."

How has being at the IAT helped your studies?

"IAT has strong tie-ins with industry - it's multidisciplinary with links into other universities and industrial partners. It presented me with two opportunities for internships – with Siemens and with Rolls-Royce. However while I didn't take these up, I opted for a secondment in China at the Yuyao Electrification Centre which best suited my interests."

What problem were you trying to solve as part of your PhD?

"More and more systems on aircraft are becoming electrified. Electronics have always been on board aircraft – known as avionics – but we're now proposing electric propulsion. Electric propulsion usually involves an energy source like a battery, which supplies power to an electric motor. The power delivered to an electric motor is controlled by power electronic converters. The reliability requirements for aerospace power converters are very high. So, as part of my research, I've been looking at fault tolerance solutions for these power electric drives, to ensure an aircraft can still operate even if an electrical component fails."

What key findings have you made?

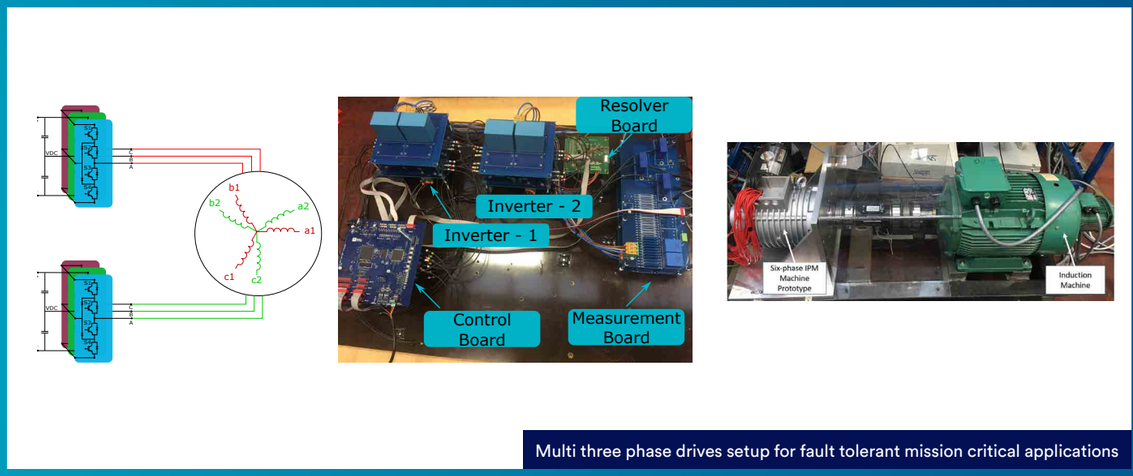
"I've learnt that reliability performance of power converters would be different in the air. I've analysed operation of Three-Level converters during faults. Through my research, I am proposing some new control methods to continue operation of Three-Level converters, even under certain types of faults."

Have your research findings already been implemented by industry?

"Companies are interested but my findings haven't been applied yet. I was in discussions with a company when I was on secondment at the Yuyao Electrification Centre in China, but they need proof of the concept before they can commit to it."

What's the best place you've been to as part of your work?

"The Yuyao Electrification Centre in China. It is a newer research facility and I was able to work directly on some big projects. I found it a positive experience and I've remained part of that team delivering a project to the industry partner."



Multi three phase drives setup for fault tolerant mission critical applications

Explain some of the training you've undertaken

"I attended a number of courses run by the European Center for Power Electronics (ECPE). These provided a good background knowledge early on in my PhD and I still refer back to my notes from those courses now."

What's been your best INNOVATIVE team activity?

"The Airbus Challenge. Our team was designing an intelligent luggage carousel, although when we were working on the design of our app, we discovered our ideas weren't as original as we'd first thought! I found the whole process great fun, working with team members from different backgrounds."

If someone was going to read one of your papers, which would you recommend and why?

" 'Failure modes and reliability oriented system design for aerospace power electronic converters'. I'm drafting it at the moment. It talks about the under-design of current power electronics systems and how they're not fit for purpose. My conclusions are very relevant for the aerospace industry."

If you were to start your PhD again, is there anything you'd do differently?

"I'd start writing every week to generate my thesis. You only really get a clear idea of your work after about two years of studying and I think as soon as I had an idea for the structure of my thesis, I should have started writing."

How did you find living and studying in Nottingham?

"I enjoyed it very much. Everything you need is here and it's a great place to study. I also attended some language courses which I found useful as the university has a thriving international community."

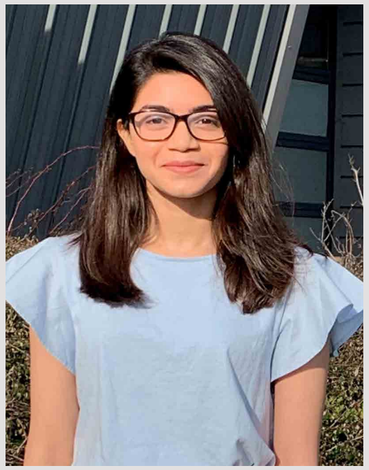
What's your ambition now?

"I may go back to work for Shell or possibly elsewhere in industry, or within the university. I don't know yet!"

Would you recommend the Marie Skłodowska-Curie programme to others?

"Yes, the training and secondments offered are very useful and no doubt help to secure future career paths. I've gained a great many contacts during my time on the programme and overall the support offered is very good."

"IAT has strong tie-ins with industry - it's multidisciplinary with links into other universities and industrial partners."



Sarah Shabbir

Project: Improving aerospace sealing technologies for extending seal life

Research group: Gas Turbine and Transmissions Research Centre (G2TRC)

PhD supervisors: Professor Seamus D Garvey, Dr Sam M Dakka, Dr Benjamin C Rothwell

Secondment: Leonardo Helicopters, UK

Read my work here: S Shabbir et al 'Analysis of the tribological interaction of a polytetrafluoroethylene-lined radial lip oil seal, shaft and lubricant sample' Proceedings of the Institution of Mechanical Engineers, Part J: Journal of Engineering Tribology

Awards: Runner-up for best paper at the BHR Group Sealing Conference

ORCID: https://orcid.org/0000-0003-1665-2487

Where are you from and where did you study before Nottingham?

"I'm from Karachi in Pakistan. I studied for my Bachelor's degree in Mechanical Engineering at the University of Nottingham Malaysia and from there, went straight on to my PhD."

Why did you want to be a Marie Skłodowska-Curie researcher?

"I've always been interested in aerospace but most PhD programmes focus solely on research. The Marie Skłodowska-Curie Actions (MSCA) programme is different you learn about so many other aspects that are relevant to your area of study. You have interaction with other students and with industry – and it's so much more relevant for your future career."

What have you been studying for your PhD?

"I research elastomeric seals for aerospace applications. There are seals inside helicopter gearboxes to prevent oil from leaking out and contaminants from entering in. If we can improve the lifespan of these components by increasing their overhaul intervals, they won't wear out or fail as often. This requires a deeper understanding of how they operate, why they fail and how we can improve them. We can then save costs and reduce overhaul times for aircraft."

What key findings have you made?

"We know that while you might think the shaft a seal sits on should be smooth for optimum performance, a microscopically rough surface is actually better. So I've been exploring what happens at that sealing interface, what enables the seal to perform and what mechanisms result in its performance or failure. My key findings are the essential factors and specific conditions that result in a successful or unsuccessful seal at a microscopic level."

What did being at the IAT bring to your project?

"Everyone at IAT works in aerospace, but with different scopes – mechanical, electrical, human-factors, etc. The IAT provides interdisciplinary learning – it's a place where you can bounce ideas off each other and learn through collaboration."

How has the equipment at Nottingham helped you complete your work?

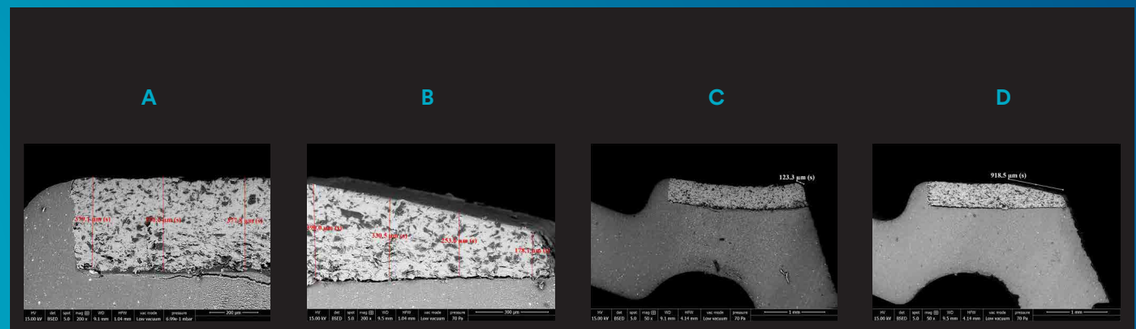
"Researchers on the previous Marie Skłodowska-Curie Doctoral Programme, INNOVATE, had built a test rig that already consisted of most of the parts I needed to conduct my experiments. I just needed to modify the test bench to accommodate for mounting and testing a seal, replicating conditions in service. However, the expensive parts like the motor and gears had already been purchased and built into a rig, so I was pleased to be able to utilise it."

Have you won any awards through your research?

"I presented my paper titled 'Heat Transfer of Couette Flow in Micro-channels: an Analytical Model of Seals' at the BHR Group sealing conference in Manchester and was awarded a runner-up place."

How have you interacted with industry during your studies?

"I had an secondment with Leonardo Helicopters. It's an Italian company but they have a base in Yeovil, Somerset. My secondment was unique in that I worked there for three or four stints of three or four weeks at a time, rather than all in one go – so it integrated fully with my PhD. My secondment there was also confirmed early on in the programme, so my project existed to solve a problem they had and I built up a really good connection with them."



SEM images to quantify wear on a PTFE-lined radial lip seal during a long term test replicating conditions of the input shaft of a helicopter gearbox (a) new seal – high magnification, (b) wear on used seal – high magnification, (c) new seal – low magnification, (d) wear on used seal – low magnification.

What's the best place you've been to as part of your work?

"I went to the University of New South Wales in Canberra, Australia to present my work at a conference. Located in the capital, it serves as the Australian Defence Force Academy, making it a huge aerospace hub for education, research and training. This made it a really unique experience for me! The speakers came from a diverse range of industries and universities, talking about their experiences and research. I learned so much about the aerospace industry and upcoming relevant work while I was there and came back with lots of new ideas to apply to my research. I also chaired a fluid sealing session, which was a great experience."

What training have you undertaken that you've found most useful?

"The university's professional skills development week was really useful in helping with things like writing your thesis and how to present, but the activity I enjoyed the most was volunteering for the STEM outreach programme. I also attended conferences, presented the findings of my research and generally built my confidence in talking to others. I particularly enjoyed interacting with a girls' school that came to the university, setting up aerospace related activities for them to enjoy and educating them on the opportunities in aerospace as a future path for study or a career."

What's been your favourite INNOVATIVE team activity?

"I really enjoyed the Airbus challenge. Our team was designing an intelligent luggage carousel, but it was brilliant to just come up with ideas and be given the chance to bring them to life."

If someone was going to read one of your papers, which would you recommend and why?

"A recent paper I worked on in collaboration with my industry partner and a few teams across the university. It's a paper titled 'Analysis of the tribological interaction of a polytetrafluoroethylene-lined radial lip oil seal, shaft and lubricant sample' and it provides a very in-depth analysis of the elastomeric seals I work on."

What would you do differently if you were going to start again?

"Because I didn't do a Master's degree first, I spent the first year of my PhD learning how to do effective research. I think if I'd had that insight when I started, I'd have got on with my work much faster."

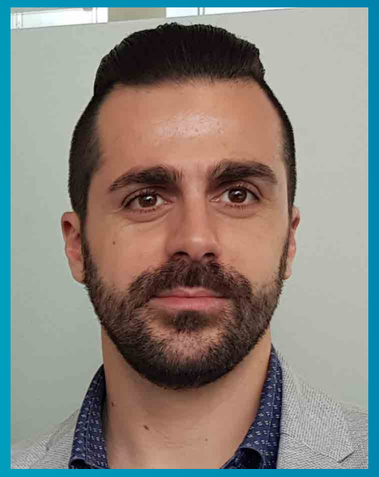
What's your ambition now?

"I'd like to move across to industry. I want to be in a more practical setting and see my ideas implemented – perhaps working in research and development (R&D) within a company."

Would you recommend the MSCA programme to others?

"I would. Even though it's an academic programme, it sets you up for anything in industry or academia. It's not limited to research because you're encouraged to pursue different paths. The project management team and budget allocation is great at enabling you to achieve your goals via external training and courses. You can do whatever you want to do."

"I really enjoyed the Airbus challenge. Our team was designing an intelligent luggage carousel, but it was brilliant to just come up with ideas and be given the chance to bring them to life."



Cosimo Spagnolo

Project: Analytical approach to design of electrical power system architecture for aircraft

Research group: Power Electronics, Machines and Control

PhD supervisors: Professor Serhiy Bozkho, Dr Sharmila Sumsurooah

Secondment: Aeromechs, Italy

Read my work here: C Spagnolo, S Sumsurooah, C I Hill, S Bozhko 'Finite state machine control for aircraft electrical distribution system' The Journal of Engineering, vol 2018, no 13, pp 506–511

Where are you from and where did you study before Nottingham?

"I'm from Calabria in Southern Italy. I studied for my Bachelor's degree in Electronic Engineering at the University of Messina and then for my Master's in Electrical Engineering at the University of Bologna.

Why did you want to join the MSCA programme?

"My professor at Bologna arranged for me to study for my Master's thesis at Nottingham and then made me aware of the MSCA programme. I was also interested to apply because I could see the benefits it offered for my future career – the funding for experiments and presentation to industry, for example. It seemed to be the right opportunity for me to take."

What is your research focused on?

"I'm working on electric aircraft – researching how fuel consumption and overall environmental impact can be reduced through aircraft electrification. My task has been to develop a device that can supervise the control of an aircraft, effectively managing all electrical systems."

What findings have you made?

"By managing electrical systems more effectively, I've found it's possible to reduce the overall weight of an aircraft and achieve an optimal energy strategy and power source on board. In summary, my research has found a way to make onboard electrical systems easier to operate."

What conversations have you had with industry about your research?

"A number of companies such as Airbus and Leonardo have been interested in my findings, but only from a research point of view. At this stage, more robust application and test data is needed before any investment can be made."

What's the best place you've been to as part of your work?

"The Paris Air Show. I'm very fortunate that the IAT was able to arrange for me to go to this event and I found it incredibly interesting. It was attended by many global aerospace manufacturers and I was able to explore some exciting prototype electric aircraft models."

What training did you receive through the programme?

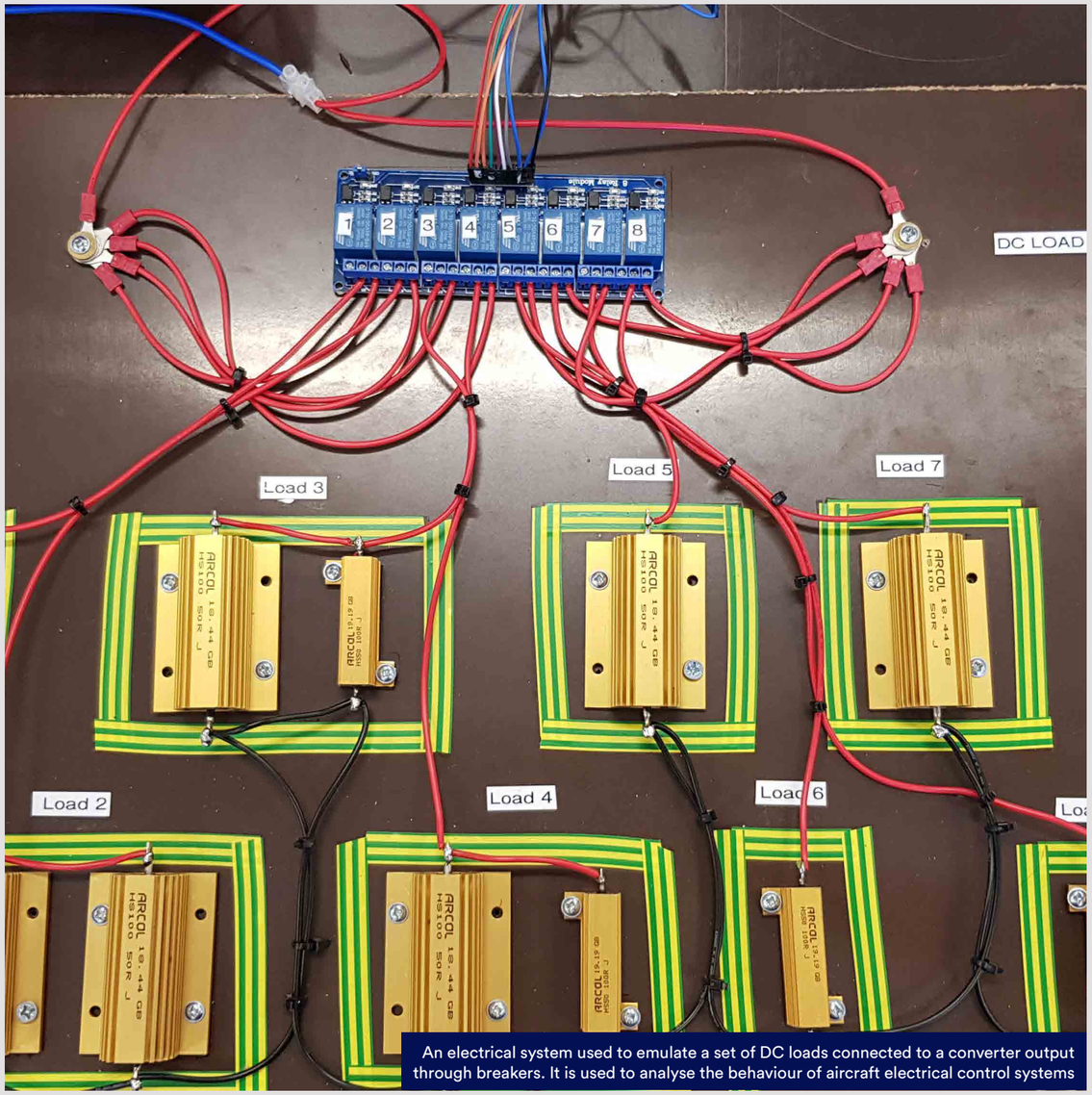
"The university provided training for me in MATLAB. This was crucial to my research and I used it to programme the controller I was developing."

What's been your favourite INNOVATIVE team activity?

"That would be our solar challenge. We worked together to build a solar-powered unmanned aircraft. Although none of us had the practical experience to do this when we started, we combined our skills in maths, electronics, engineering, etc to complete the task – and it flew! It was one of the best things I've ever done!"

What have you enjoyed most during your time at the University of Nottingham?

"I value the facilities and opportunities it's provided. Nottingham is well connected internationally, is heavily focused on technology and has a very relevant library. The university also gave me the opportunity to connect with a wide support network of electric aircraft specialists – I value this enormously for the development of my future career."



An electrical system used to emulate a set of DC loads connected to a converter output through breakers. It is used to analyse the behaviour of aircraft electrical control systems

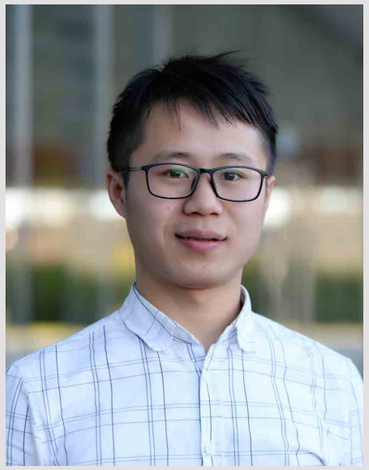
If you were to start your PhD again, what would you do differently?

"I'd have focused more on training in my first year. When I completed training courses in my second year, I saw the benefit they brought to my work and wished I'd done them earlier."

What are your plans for the future?

"After I submit my thesis I'd like to work in industry and apply the learnings I've gained from my studies."

"The university provided training for me in MATLAB. This was crucial to my research and I used it to programme the controller I was developing."



Shaohong Zhu

Project: Direct drive actuation system for aircraft control surface, looking at modular aircraft actuators

Research group: Power Electronics, Machines and Control

PhD supervisors: Dr Tom Cox, Dr Zeyuan Xu, Professor Chris Gerada

Secondment: Cummins Generator Technologies, UK

Read my work here: S Zhu, T Cox, Z Xu, C Gerada, C Li 'Design Considerations of Fault-Tolerant Electromechanical Actuator Systems for More Electric Aircraft (MEA)' IEEE Energy Conversion Congress and Exposition (ECCE), 2018, pp 4607–4613

ORCID: https://orcid.org/0000-0003-0173-4033

Where are you from?

"I'm from Jingdezhen, a city in the south of China which is known as the 'Porcelain Capital'. I studied Electrical Engineering for my Bachelor's degree at Jimei University and also did three years of postgraduate study at the Harbin Institute of Technology."

What attracted you to the Marie Skłodowska-Curie Actions programme at Nottingham?

"I was attracted by the project collaboration opportunity that the MSCA programme offered – to be able to research and engage with the aerospace industry as well as colleagues from all over the world. I felt it was a good platform for a future career in the aerospace industry."

What did being at the IAT bring to your work?

"The IAT offered a cross-disciplinary learning environment – collaboration with colleagues. I was researching the electromagnetic design of electric motors, but through the IAT I was able to work with a colleague on thermal studies. At the IAT you don't just focus on your own work. There are also a lot of opportunities to attend events such as aerospace showcases or lectures, which enabled me to understand current and emerging trends, and challenges facing the aerospace industry."

What problem have you been studying for your PhD?

"I've been developing an electric actuator for flight control systems for use in more electric aircraft. An aircraft's flight control surfaces such as flaps and spoilers will move during take-off and landing – this is currently a hydraulic action operating at high pressure, with high maintenance costs, excessive weight and a complex system overall. By replacing this with an electric actuator and introducing a distributed electric actuation system, the complexity, weight and maintenance costs of the actuation system can be reduced."

What approach did you take to solving this problem?

"I took a cross-disciplinary approach, so instead of just looking at electric motors, I looked at other component parts, broadening my understanding step by step to determine requirements."

What key findings have you made?

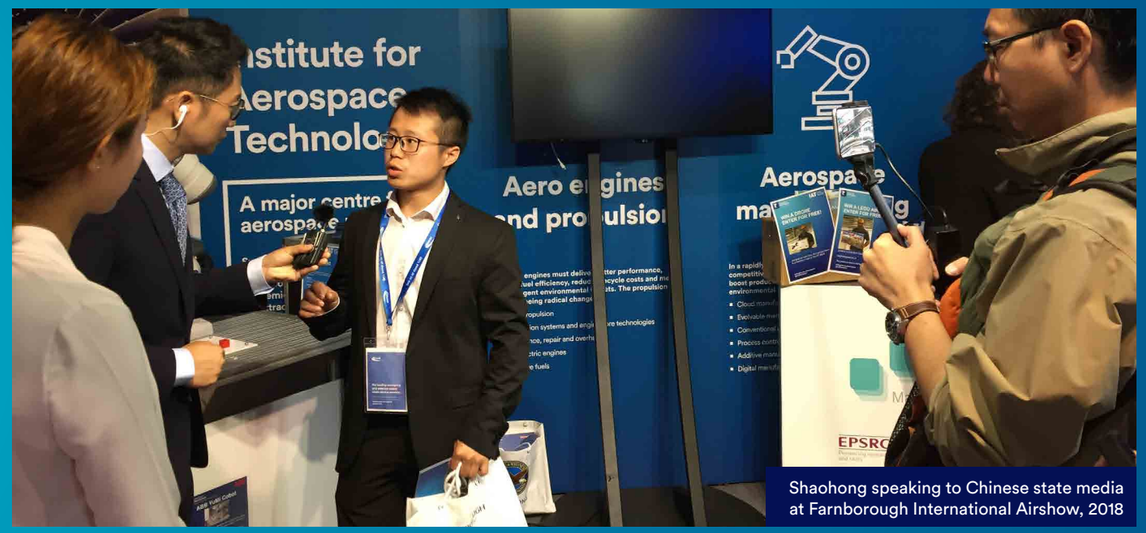
"I've developed a fault-tolerant modular actuator demonstrator. Other universities and companies are also researching this, but I'm working on the development of a modular actuator system with excellent fault tolerance. Different aircraft control surfaces have different power requirements, so by making it modular I can put less or more of the components together to provide the level of power required for a given application. The high fault tolerance is also critical, offering fail-safe capability for aircraft components."

How has the equipment at Nottingham helped you complete your work?

"The control drive I needed for my motor prototype had already been developed by someone at the university, so I'm pleased I was able to use this for my research."

What training have you undertaken that has been of most use to your work?

"I found the research writing and presentation skills courses particularly useful because it's important for you to be able to promote your work. I've also attended a number of professional courses in the use of power electronics and advanced electric motor theory and application, which helped to make my research more efficient."



Shaohong speaking to Chinese state media at Farnborough International Airshow, 2018

What's the best place you've been to while on the Marie Skłodowska-Curie programme?

"I went to the 2017 International Conference on Electrical Machines and Systems (ICEMS) in Sydney, Australia. This was a good event and a great place to visit."

And where's the best place you've presented your work?

"That would be at the ECCE 2017 (IEEE Energy Conversion Congress and Exposition) – one of the high-impact conferences in electrical engineering in Cincinnati, Ohio, USA. I presented one of my papers about linear motors there, which was a great experience."

What's been your favourite INNOVATIVE team activity?

"The solar challenge. Nine of us worked together to design and build an electric UAV (Unmanned Aerial Vehicle). It was a really exciting project and we developed a few prototypes, but only one successfully flew. I very much enjoyed the test flight where we collaborated with a flying club in Nottingham to carry it out on a field next to East Midlands Airport."

How have you interacted with industry during your studies?

"I had a six-month full-time secondment with Cummins R&T in the UK– and I'm still working with them now. They're developing an efficient lightweight integrated powertrain system for a pure electric truck. I'm interested to work in an environment in which the electrification in all forms of transport is being explored, not just aerospace."

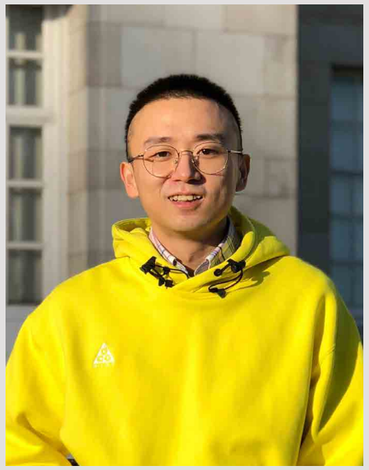
What have you enjoyed most about being at Nottingham?

"The university is very inclusive. My colleagues came from a wide range of backgrounds and I enjoyed getting to know them and engaging in cross-cultural interactions. I also enjoyed Nottingham city and its beautiful parks."

How do you think being a Marie Skłodowska-Curie fellow will help your future career?

"It demonstrates to others that I know how to research in greater depth – looking at the whole picture to see what industry needs and then researching according to future opportunities and challenges. I'd recommend a MSCA programme to others considering their PhD options."

"I was attracted by the project collaboration opportunity that the MSCA programme offered – to be able to research and engage with the aerospace industry as well as colleagues from all over the world."



Xipeng Lyu

Project: Novel simulation tools such as smoothed-particle hydrodynamics for meshless fluid simulation capability

Research group: The Gas Turbine and Transmissions Research Centre

PhD supervisors: Dr Richard Jefferson-Loveday, Dr Arno Kruisbrink, Professor Herve Morvan

Secondment: Rolls-Royce, UK

Awards: 1st place, Pecha Kucha, University of Nottingham professional skills week

Where are you from and where did you study before Nottingham?

“I’m from Wuhan in China. I studied for my Bachelor’s degree in Naval Architecture and Ocean Engineering at Hubei Engineering University, and stayed on there to study Naval Architecture and Ocean Engineering, focusing on smoothed-particle hydrodynamic (SPH) methods for my Master’s.”

Why did you want to be a Marie Skłodowska-Curie researcher?

“There was a specific subject I wanted to study and and the INNOVATIVE programme offered it. It was also an attractive option for me as it offered a good salary with research funding available and the opportunity for a six-month secondment with industry.”

What’s it like being a member of the Faculty of Engineering?

“I found it good. My supervisor was very helpful and the faculty’s High Performance Computer (HPC) was key for my research.”

What problem were you trying to solve as part of your PhD?

“I’m researching the movement of fluids in a bearing chamber. I’m working specifically on a solution to the particle clustering that is experienced in SPH simulation, applying the particle collision shift model to research the turbulence phenomena in the bearing chamber of aircraft engines.”

What key findings have you made?

“I’ve proposed a new particle shift method to prevent clustering – a model that is suitable for application in the complex boundaries found in aerospace.”

And what impact do you think your findings will have on the aerospace industry?

“There’s a little way to go yet to make my method strong enough for use in simulating engineering products, but it has the potential to prevent problems in complex boundary projects.”

What training have you undertaken that has been most useful to your work?

“I’ve done a number of courses. The research writing training was probably the most helpful, while the presentation skills and leadership courses were also useful.”

Have you had any interaction with industry during your PhD?

“I did an internship with Rolls-Royce. I’m looking for ways to improve clarity and remove the repetition of ‘method’ but I’m struggling to rewrite it because I don’t have the technical knowledge.”

What’s the best place you’ve visited as part of your PhD?

“I went to the 2020 Aerospace Europe Conference in France. I met a number of delegates who were studying the same method as me. I found it useful to review their different methods of research and the progress they were making.”

From left to right, these images are the pressure distribution of oscillation droplet, rotation of square fluid patch, Taylor green vortex and Taylor couette flow

What’s been your favourite INNOVATIVE team activity?

“I enjoyed going to the Farnborough Airshow with other INNOVATIVE colleagues. It was the first time I’d seen aircraft that close up and it was an experience I’ll never forget.”

If someone was going to read one of your papers, which would you recommend and why?

“The best paper would be ‘An energy conserving particle shift model based on particle collisions to avoid particle clustering in SPH’. It includes my method and the most significant part of my findings from my PhD studies.”

If you were to start your PhD again, is there anything you’d do differently?

“I’d start the 3D simulation process earlier. I started it after my first year and missed out on some early insight.”

How did you find living and studying in Nottingham?

“The sports facilities here are excellent. I play basketball and the courts are just one minute from my office!”

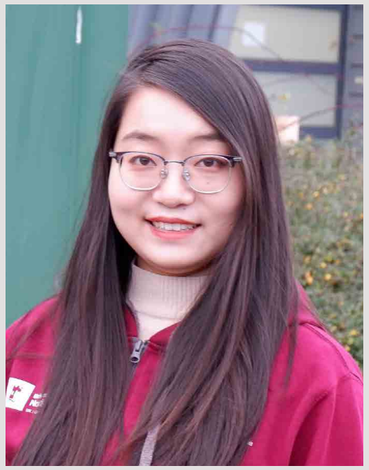
What’s your ambition now?

“I’ll maybe go into industry, or perhaps look at a post-doctoral programme – I’ll see what interests me.”

How do you think being a Marie Skłodowska-Curie fellow will help your future career?

“The university gave me the opportunity to connect with a wide support network of electric aircraft specialists – I value this enormously for the development of my future career.”

“The sports facilities here are excellent. I play basketball and the courts are just one minute from my office!”



Xin Wang

Project: Optimal control design for electric power system on More Electric Aircraft

Research group: Power Electronics, Machines and Control

PhD supervisors: Professor Serhiy Bozhko, Dr Jason Atkin, Dr Sharmila Sumsurooah, Dr Chris Hill

Secondment: Centre for Research on Microgrids (CROM), Aalborg University

Read my work here: X Wang, J Atkin, C Hill, S Bozhko 'Power Allocation and Generator Sizing Optimisation of More-Electric Aircraft On-board Electrical Power during Different Flight Stages' AIAA/IEEE Electric Aircraft Technologies Symposium, 2019, pp 1–10

ORCID: https://orcid.org/0000-0002-9923-5728

Where are you from?

"I'm from Baoji City, in the Shaanxi province of China. I studied for my Bachelor's and Master's degrees in Electrical Engineering at the Northwestern Polytechnical University in Xi'an."

What attracted you to the Marie Skłodowska-Curie Actions programme?

"I'd researched electric aircraft during my Master's degree and I knew Nottingham had a specialism in this area. I also knew the MSCA programme provided an opportunity for training and industry connections, as well as a budget to attend conferences and summer schools. I took the opportunity to apply so that I could continue working in aerospace technology."

What problem have you been studying for your PhD?

"I've been looking at the architectural concept of electrical power systems in aircraft. I've been asking what the optimal supervisory control for aircraft should be in terms of energy management and load shedding for overall fuel consumption to be reduced."

What approach did you take to solving this problem?

"I've used model predictive control and adopted several mathematical optimisation techniques to help me generate results."

Have your research findings already been implemented in industry?

"Rolls-Royce is looking at electric aircraft research and the method I've been working on is likely to be used, as they know there's a need to improve the intelligence and environmental impact of aircraft.

It's very important for the aerospace industry to move forward to electric aircraft. There's a requirement for complex power systems to be on board, but good design will help these systems to work efficiently, save energy, reduce waste and cut down on fuel consumption."

How have your PhD supervisors contributed to your work?

"They've contributed greatly. They helped me find the right direction to take for my work and modify my approach to help my research progress."

How has the equipment at Nottingham helped you complete your work?

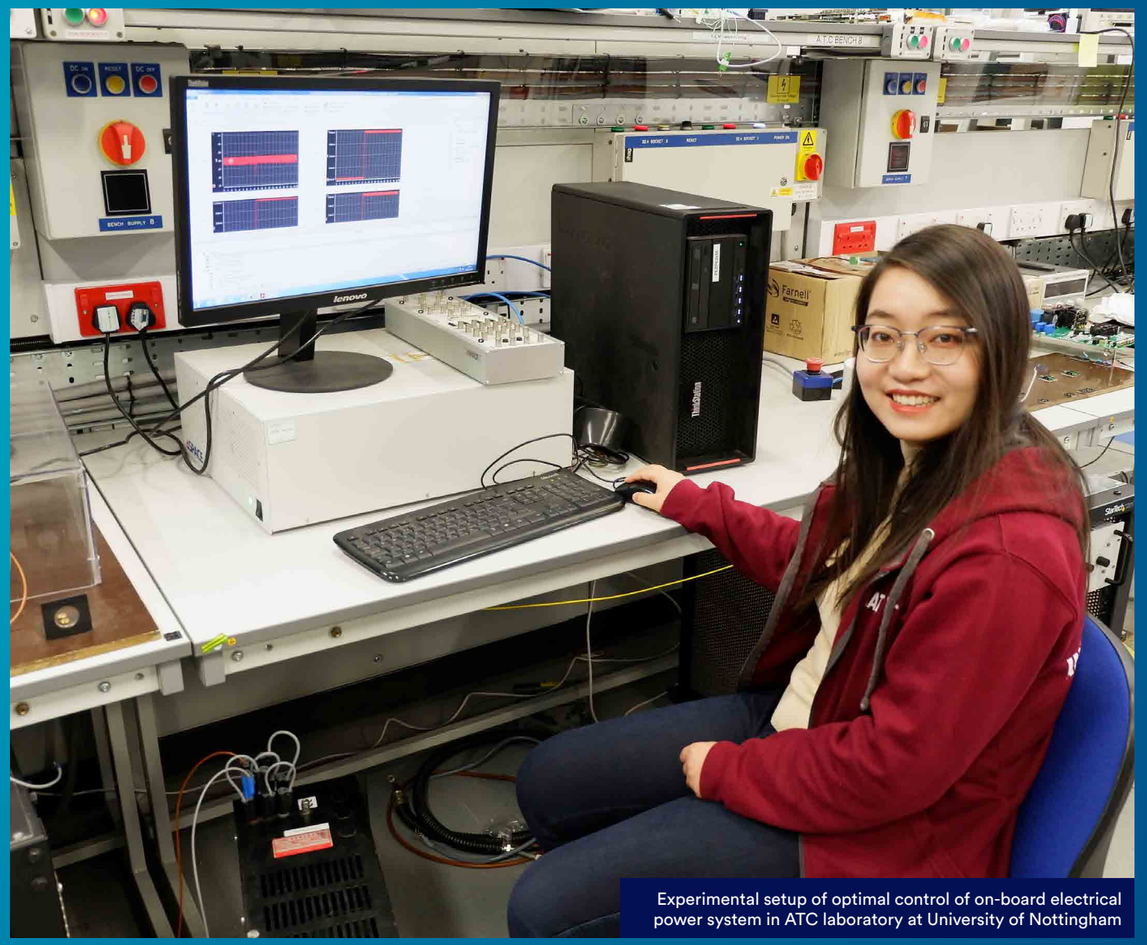
"I used their High Performance Computer (HPC) and Hardware-In-Loop test bench. For my research, I didn't need to work on a whole vehicle to generate test results, I just needed one simulator and then designed the controller on the HPC – the university computer had the capability to do this."

What's the best place you've been to while on the Marie Skłodowska-Curie programme?

"I attended the AIAA conference in North America where I met people from NASA, Boeing and right across the aerospace industry. That was really exciting!"

What's been your favourite INNOVATIVE team activity?

"I enjoyed going to the Farnborough Airshow. I found it interesting to meet other students and representatives from industry, introducing my work to them and seeing the work others were doing in a similar field to mine."



Experimental setup of optimal control of on-board electrical power system in ATC laboratory at University of Nottingham

What was it like being a member of the Faculty of Engineering?

"It gave me a good opportunity to work in the lab with very helpful, knowledgeable and efficient staff around me who could help me solve problems."

What have you enjoyed most about being at Nottingham?

"I've met some lovely people here – colleagues and staff. Everyone is easy to get along with and very helpful. I've particularly enjoyed playing badminton and tennis at the sports centre – it's given me more energy to be able to do my work!"

What are your plans for the future?

"I'd like to go further with my research in academia and perhaps collaborate with industry partners through a knowledge transfer programme."

What would you say to anyone considering the MSCA programme?

"The MSCA programme is an excellent experience. I learned a lot and improved my professional skills. The programme helps you build your career networks and I would recommend it to other students."

"I enjoyed going to the Farnborough Airshow. I found it interesting to meet other students and representatives from industry, introducing my work to them and seeing the work others were doing in a similar field to mine."

Angel Recalde

Project: Optimal design and synthesis of MEA power system architectures

Research group: Power Electronics Machine and Control

PhD supervisors: Professor Serhiy Bozhko, Dr Jason Atkin, Dr Sharmila Sumsurooah

Secondment: Induelectric S A, Ecuador

Read my work here: AA Recalde, JA Atkin and S Bozhko 'Optimal Design and Synthesis of MEA Power System Architectures Considering Reliability Specifications' IEEE Transactions on Transportation Electrification, vol 6, no 4, pp 1801–1818, Dec 2020

ORCID: https://orcid.org/0000-0001-7379-9165

Where are you from and where did you study before Nottingham?

"I'm from Guayaquil in Ecuador. I studied Electrical Engineering and Industrial Automation for my Bachelor's degree at the Polytechnic Institute of Littoral. I then went to work in industry for almost five years on several generation and power systems projects before applying for my Master's Scholarship in Science and Electrical Engineering at the University of Queensland in Australia."

Why did you want to be a Marie Skłodowska-Curie researcher?

"The research work undertaken through the MCSA programme is cutting edge and the topics studied are multidisciplinary, which provides a large degree of freedom to develop integral solutions and the opportunity to collaborate with others. I enjoy studying, I knew the University of Nottingham was good for aerospace and I liked the topic proposed for a PhD, so I made the decision to move with my family to the UK.

What did being at the IAT bring to your project?

"Studying for a PhD is very different to a Master's. It's individual, hard work and you focus on your own subject matter. However, the IAT provided the chance to meet others, find out what they're doing, work together and become friends."

What's it like being a member of the Faculty of Engineering?

"I enjoyed it – I was able to engage in discussions and seminars as well as attend many courses held within the faculty, which helped broaden my ideas and way of thinking."

What problem are you trying to solve as part of your PhD?

"I'm looking at electrical power transmission within a More Electric Aircraft (MEA) – seeing how existing thermal energy can be transformed to electrical energy and then how its distribution within an aircraft can be optimised for maximum efficiency."

What key findings have you made?

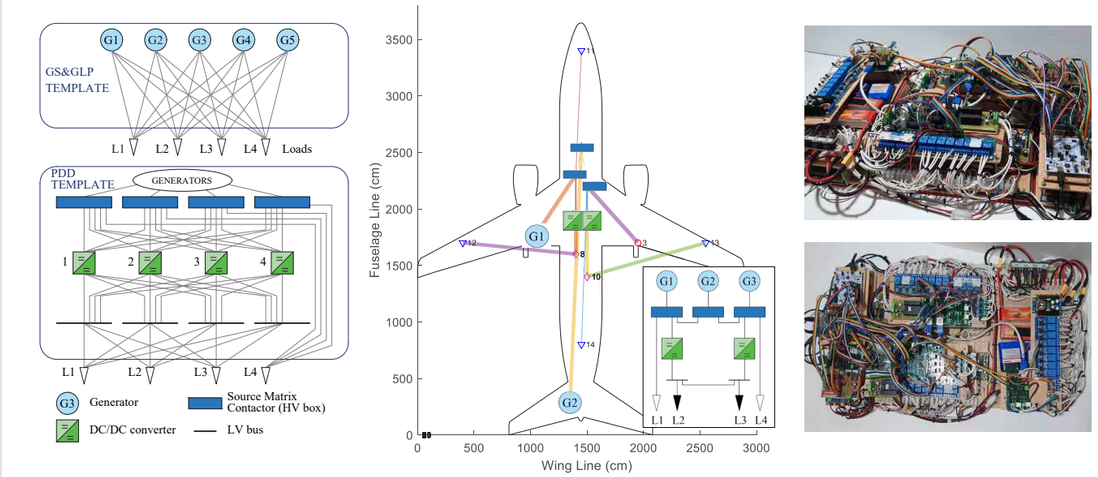
"I'm pleased with the progress I've made so far and have published a journal article about the optimisation-based design that industry designers can use to synthesise an aircraft's architecture. The method I've proposed can work for different types of aircraft allowing designers to tailor it for their needs."

What was your approach to solving this problem?

"I focused on the architecture of an aircraft's electrical power system, looking at which components are needed and how component parts are connected. I looked at how to optimally route power from generators and sources to critical loads within an aircraft, such that the aircraft can operate. By using optimisation methods, I examined the best and most reliable way of supplying and distributing power in an aircraft's electrical network."

What's the best place you've been to as part of your work?

"I travelled to Indianapolis for the American Institute of Aeronautics and Astronautics (AIAA) Conference where I attended a course about electrified propulsion systems and component design. I also enjoyed the Farnborough Airshow in the UK – it was impressive seeing so many cutting-edge aerospace solutions in one place. Also, when I went to the Paris Air Show in Le Bourget I was able to understand more about current trends and the evolution of aerospace."



Design framework flow to synthesize a MEA architecture

What training have you undertaken that has been most useful to your work?

"I attended a NATCOR course in Southampton, UK on Operational Research (OR). I also took part in a week focused on professional soft skills training – five days looking at teamwork, personal development, public outreach and time management. And I was lucky enough to attend a summer school in Gaeta, Italy for an immersive experience exploring the latest advances and research on electrical machines and power electronics."

If someone were to read one of your papers, which would you recommend and why?

" 'Optimal Design and Synthesis of MEA Power System Architectures Considering Reliability Specifications' – it's a research contribution in which optimisation and network flow knowledge are used to produce a design framework that has potential to be used in industry. Optimisation has been extensively used and its application on disruptive solutions is attracting the attention of industry. The journal provides a good introduction to my work, demonstrating the research that is underway and so far, it has received positive feedback from external reviewers."

What's been your favourite INNOVATIVE team activity?

"I very much enjoyed the Airbus Challenge 'Fly Your Ideas 2019'. It was a wonderful experience to engage in our own international multidisciplinary project and have the freedom to propose an innovative solution to a real problem. Our team was selected out of 251 entries to go through to the second round and we received a lot of technical support from Airbus to develop our idea. Although we didn't make it to the finals, we did get an acknowledgement for our effort."

What's the best place you've been to present your work?

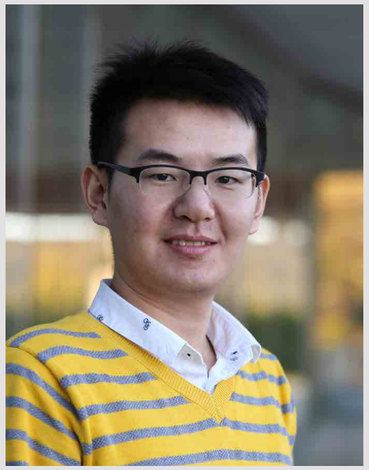
"I've presented my papers at five international conferences and have received a lot of attention as a result. Companies such as Boeing, Rolls-Royce and NASA have engaged in what I've spoken about, which has been a remarkable experience for me."

How did you find living and studying in Nottingham?

"Nottingham is a welcoming place with a lot of places to visit, but also has more peaceful suburbs and places to study. I lived in Beeston and enjoyed the bars and restaurants nearby, but could also be in the city centre in just 15 minutes by public transport. There's also plenty of international food to choose from and I enjoyed socialising with my friends from the IAT."

"I've presented my papers at five international conferences and have received a lot of attention as a result. Companies such as Boeing, Rolls-Royce and NASA have engaged in what I've spoken about, which has been a remarkable experience for me."

Aerospace manufacturing



Dongdong Xu

Project: On the machining of exotic materials required to enable successful future aircraft

Research group: Advanced Manufacturing

PhD supervisor: Professor Dragos Axinte

Secondment: EMPA, Switzerland. SECO Tools, Sweden

Read my work here: D Xu, Z Liao, D Axinte, JA Sarasua, RM Saoubi, A Wretland 'Investigation of surface integrity in laser-assisted machining of nickel based superalloy' Materials and Design, Vol 194, 2020

Awards: CIRP Affiliate, RA-RAeS

Please introduce yourself

"I'm Dongdong. I'm from China and I have a Master's degree in Mechanical Engineering from Beihang University."

Why did you want to join the Marie Skłodowska-Curie Actions programme?

"I wanted to do a PhD first and foremost, but the MSCA programme stood out for two reasons. It offered a multidisciplinary approach for my subject area and it provided the opportunity to research alongside other staff at the university, developing my future network for a career in academia."

What problem were you trying to solve?

"I've been exploring how different parts of an aeroplane – from an engine to a wing – could be made and rapidly tested using a combination of parts and materials to develop lighter, stronger aircraft for the future. Mainly to understand the machinability and surface integrity of applied new materials."

How have you interacted with industry during your studies?

"I was lucky enough to work with three different companies. At Empa (Laboratories for Materials Science and Technology) in Switzerland I focused on how materials are made. At SECO in Sweden I examined the tools required for the manufacturing process. And at Rolls-Royce in the UK I worked with people in their labs to develop and test products from these new materials."

Has any of your training taken you out of your comfort zone?

"Working at Empa broadened my experience enormously. It presented me with a whole new way of thinking and I'm incredibly grateful for everything they taught me."

How are your findings going to be applied to the aerospace industry?

"The findings made through my secondment with Rolls-Royce are confidential and I'm continuing to work with them on product development. This is very exciting for me because it means my research will be of practical use to the aerospace industry."

If someone was going to read one of your papers, which would you recommend?

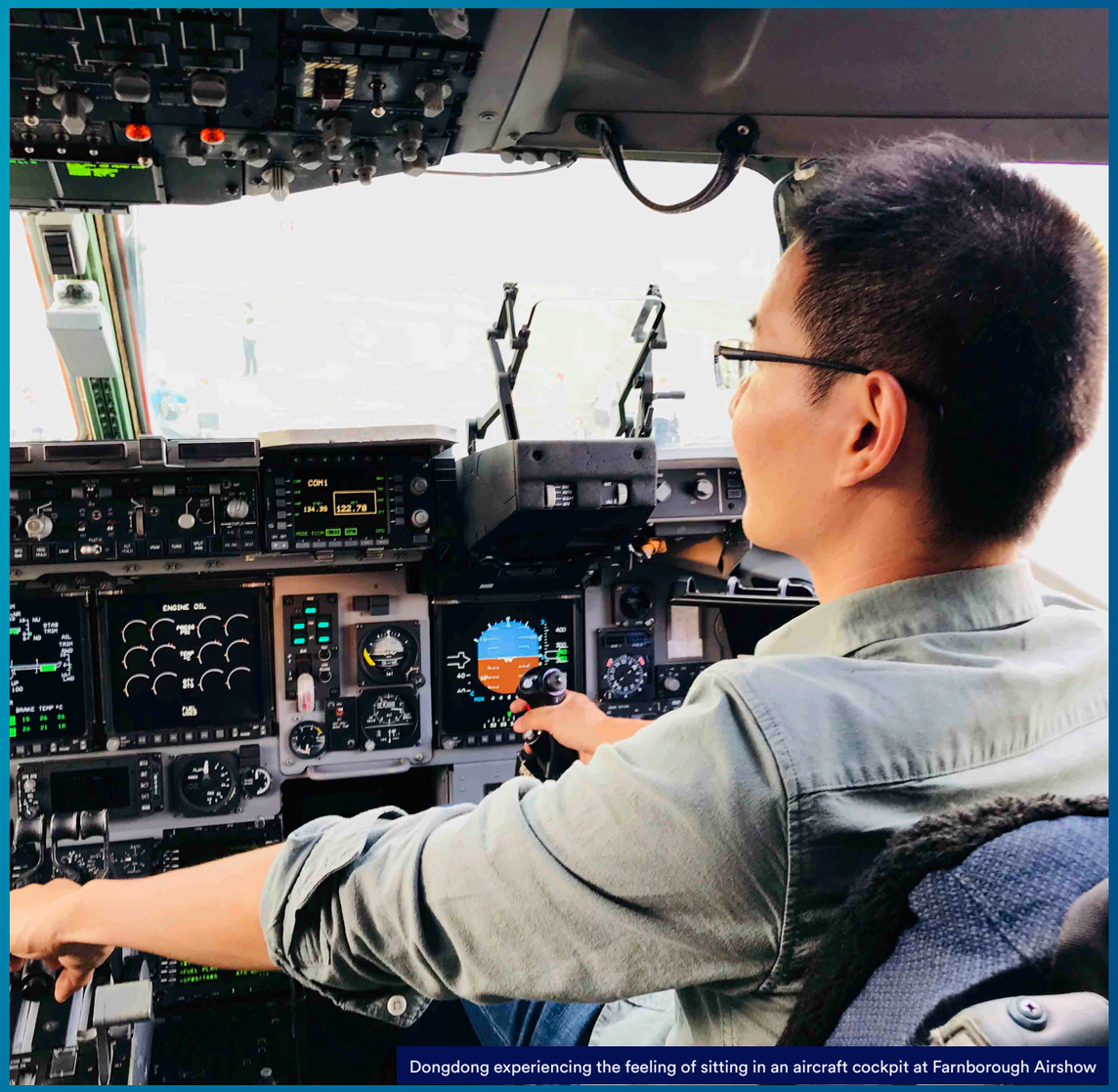
"The paper I worked on with Rolls-Royce. It's called 'A quick method for evaluating the thresholds of workpiece surface damage in machining'. It opens up the possibilities of studying different materials for use in aerospace, focusing in particular on safety-critical areas."

What have you enjoyed most during your time at the University of Nottingham?

"I definitely enjoyed the summer more than the winter! I've particularly enjoyed the green areas surrounding Nottingham – its vast parks and nature reserves. I've also enjoyed travelling with fellow researchers to other parts of the UK."

How do you think being a MSCA fellow will help your future career?

"I want an academic future and I think being part of the MSCA programme has opened my eyes to many other avenues for research. It's developed my ability to think in far more detail and explore many more possibilities for my ideas, which I believe will stand me in good stead for my future career."



Dongdong experiencing the feeling of sitting in an aircraft cockpit at Farnborough Airshow

"Working at Empa broadened my experience enormously. It presented me with a whole new way of thinking and I'm incredibly grateful for everything they taught me."

Mohammad Tanvir Chowdhury

Project: Integration of design and manufacture; decision making in a concurrent engineering context

Research group: Composites Research

PhD supervisors: Dr Thomas Turner, Dr Joel Segal

Secondment: National Composites Centre (NCC), UK

Read my work here: MT Chowdhury, TA Turner 'A Novel Methodology to Quantify Shape Complexity of Composite Aerospace Parts' 22nd International Conference on Composite Materials 2019, Melbourne

Awards: 3rd prize, INNOVATIVE Summer School Poster Competition, 2019

ORCID: https://orcid.org/0000-0002-8280-5480

Where are you from and where did you study before Nottingham?

"I'm from Bangladesh but grew up and went to school in the United Arab Emirates. I studied MEng in Mechanical Engineering at the University of Nottingham Malaysia."

Why did you want to be a Marie Skłodowska-Curie researcher?

"The MSCA programme offered funding and access to resources, which is rarely seen for PhD study. I could see I would have the opportunity to receive excellent training, develop my professional and academic skills and be able to attend conferences around the world, which would help further my research."

What did being at the IAT bring to your project?

"IAT is one of only a few aerospace institutes in the UK. It's in a unique position whereby it can invite industry experts, pilots and academics for seminars – and through this network of links, provide the opportunity to go on industry visits, attend trade shows and build up our own network of contacts."

What's it like being a member of the Faculty of Engineering?

"There was always lots going on. When I had the opportunity to get together with other faculty members to discuss my research, they too would share their individual area of interest and we would always have plenty to talk about."

What problem were you trying to solve as part of your PhD?

"I've been looking at the impact changes to the original aircraft design decisions can have during the manufacturing stage some years later. Revisiting original design decisions can be expensive, so I wanted to establish a framework for the decision-making process that helps people make the right decision first time."

What key findings have you made?

"Conventional thinking assumes part design and part manufacturing are separate entities in the development process, but they're in fact inter-related. They must be considered simultaneously so I needed to be able to quantify certain parameters that were previously qualitative."

How have you interacted with industry during your PhD?

"I was on a secondment at the National Composites Centre (NCC) in Bristol. I worked within the Composite Moulding Team on large-scale composite manufacturing projects. I also conducted Time-in-Motion studies on certain projects to model the manufacturing processes."

Have any of your research findings been implemented by industry yet?

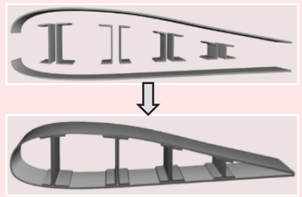
"No, this project is very much in the research stage so it's not ready for industrial-scale deployment."

What training have you undertaken that has been most useful to your work?

"In terms of my personal development, I've attended a First Aid course and I've been learning to speak German. For professional skills, I took an advanced Excel and CATIA V5 training course. And academically, I took a number of aerospace and mathematics modules to build my knowledge of the industry."

Problem Description ⚠

Composite parts in the aerospace industry are increasingly being developed using concurrent engineering CE principles to shorten the time-to-market by **factoring in the manufacturing processes during the early stages**. However, manufacturers are not able to gain much by using CE principles since they **struggle to make informed decisions** during these early stages [1]. These design decisions need to be taken appropriately for the development to progress towards the next stages. Traditionally manufacturers work around this obstacle by making decisions derived from "expert opinions" and historical data. Although this allows the development to progress, it results in suboptimal and low quality parts due to outdated and inadequate knowledge and data [2].



The wing skin and spars are independent parts that are joined together with rivets to form the wing.

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The wing skin and spars are integrated to form the wing as a single part.

The philosophy behind the research problem

What's the best place you've been to as part of your PhD?

"Visiting Airbus. I was able to see first-hand the manufacturing technologies that are currently being used in modern aircrafts – it's one thing referring to articles and books to gather evidence, but quite another to actually see things in person. I found the visit extremely informative and enjoyed it very much."

What's been your favourite INNOVATIVE team activity?

"Going to the Farnborough Airshow. A few of us managed the IAT stand together, which meant we were able to talk to visitors, network and get many of our questions answered. We attended on the allotted trade days, so were able to put detailed technical questions to industry experts and, in turn, talk about our research to them."

If you were to start your PhD again, is there anything you'd do differently?

"I'd try to be more organised from the start. I have notes written all over the place and it's a challenge to find them and make sense of what I've written!"

How did you find living and studying in Nottingham?

"Nottingham is one of the nicest UK cities to settle into for living or studying. You have incredible places all around the city to unwind after a tough day or find a quiet place to study."

What's your ambition now?

"I'd like to work as a Project Manager or Project Investigator – managing my own manufacturing projects for an aerospace company."

How do you think being a Marie Skłodowska-Curie researcher will help your future career?

"MSCA is a perfect match for industry. It has an excellent reputation, provides professional training and equips you with the skills you need for your future career. Personally, the programme has given me the confidence to run my own projects and I'd certainly recommend it to others.

Also, as some advice to others looking to apply – research your supervisors. Understand their backgrounds and areas of specialism, and interact with them – it'll give you a head start over other candidates."

"The MSCA programme offered funding and access to resources that is rarely seen for PhD study."

Julan Wu

Project: Additive manufacturing of laser powder bed fusion of permanent magnetic Nd-Fe-B

Research group: Centre for Additive Manufacturing

PhD supervisors: Professor Ian Ashcroft, Professor Richard Hague, Dr Michele Degano and Dr Nesma Aboulkhair

Read my work here: Julan Wu, Nesma T Aboulkhair, Michele Degano, Ian Ashcroft, Richard J M Hague 'Process-structure-property relationships in laser powder bed fusion of permanent magnetic Nd-Fe-B' Materials & Design, 2021, pp 109992, ISSN 0264-127

ORCID: https://orcid.org/0000-0002-7220-9351

Where are you from and where did you study before Nottingham?

"I'm from Inner Mongolia in China. I studied Civil Engineering for both my Bachelor's degree at SiChuan University and my Master's degree at the University of Nottingham."

Why did you want to be a Marie Skłodowska-Curie researcher?

"I took part in a 3D printing project when I was studying for my Bachelor's degree. Then when I was studying for my Master's degree my tutor was researching structural composite materials, so I started looking at this as well. Then I saw the Marie Skłodowska-Curie Actions (MSCA) programme, INNOVATIVE was recruiting and among the subjects available was a project on composite materials and 3D printing. I applied, was accepted and here I am.

The MSCA programme provides an excellent opportunity for overseas students. Funding can often be limited for us, but I found that students from different countries were eligible and the programme manager was very helpful when I enquired. I do feel very lucky to have been given a place. I was offered a scholarship to study elsewhere, but I decided the MSCA programme would provide me with a better overall experience."

What did being at the IAT bring to your project?

"IAT and the INNOVATIVE programme bring together groups of people working on different research projects. People who are studying simulation, materials, motors, machines, for example – but all with the same objective to contribute to the future development of aircraft. The IAT offered lots of potential for future collaboration."

What have you been studying for your PhD?

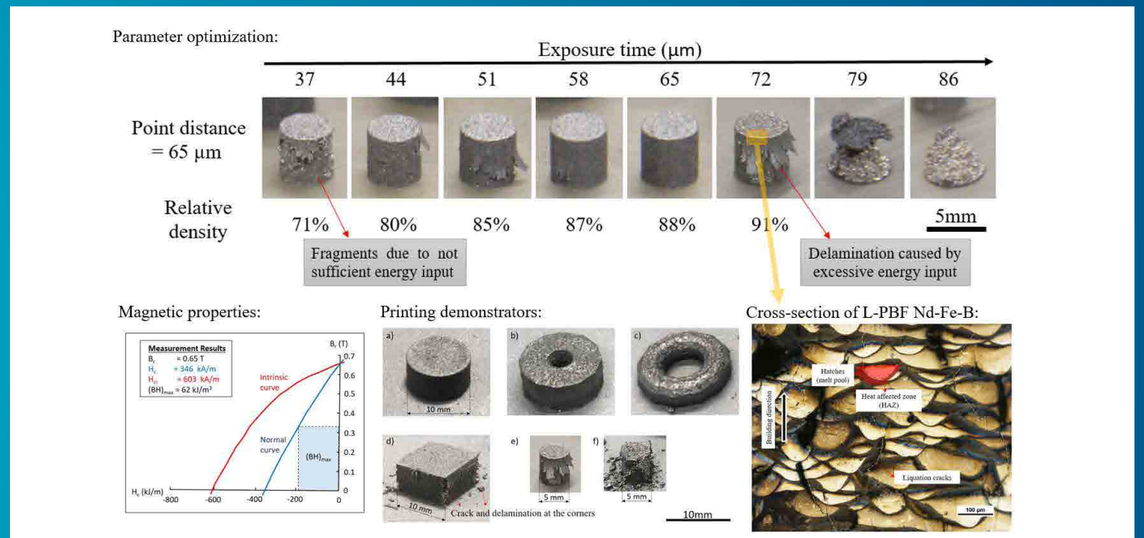
"I've been using 3D printing to produce permanent Nd-Fe-B magnets. These can be widely used in daily life due to their outstanding magnetic performance – in everything from cameras and microphones, to electric motors and renewable energy facilities. The higher performance Nd-Fe-B magnets are being heavily researched for the future development of robots, electric vehicles and aerospace. In the motor design of aircrafts, specialist magnets are required, but the precise shapes needed often can't be achieved using conventional machinery. Post-production work is therefore required, generating further cost and waste. But, with the geometric freedom of 3D printing, we can solve this issue and I've been looking at the flexibility this can bring, saving money, waste and energy on an aircraft."

What training have you undertaken that you've found most useful?

"Neodymium is an element used in Nd-Fe-B magnets and is actually mined in my home town in China. So I spent some time back at home working with a company that works in this field, learning about the different materials they use. It was a unique and interesting experience."

Has any training taken you out of your comfort zone?

"I did some presentation training, which I found useful, but I think the most challenging training for me was the academic writing skills. I need to be able to write professional English to convey and support my research findings."



Graphical abstract showing the results of parameter optimisation, magnetic properties, printing demonstration and cross-section of the Nd-Fe-B material processed via Laser Powder Bed Fusion (LPBF)

What's the best place you've been to as part of your work?

"As a member of the IAT I was fortunate to be able to go to the Paris Air Show. This was a fantastic experience and I hope that when I get some results from my research, I might be able to contribute something to a future show.

I also attended a conference at the Centre for Additive Manufacturing here in Nottingham. They have extensive lab facilities for 3D printing, providing much of the equipment I need for my research. At the conference I was able to see applications from active 3D printing companies, which really helped to broaden my understanding of the subject."

If someone was going to read one of your papers, which would you recommend and why?

"I'm drafting two at the moment so I'll see how they go first before I recommend one!"

If you were to start your PhD again, is there anything you'd do differently?

"I'd read a lot more as early as possible to give me a solid foundation in the subject. Because I jumped from civil engineering to metallurgy and electrical engineering I had a steep learning curve from the start, so it was difficult to decide which direction I should take my research in. If I'd started with better background knowledge I'd have been able to think and analyse my route forward more effectively."

How did you find living and studying in Nottingham?

"University Park is very beautiful and the equipment at the Faculty of Engineering is very advanced. The technicians were also very friendly and helpful – and I like the Chinese restaurant!"

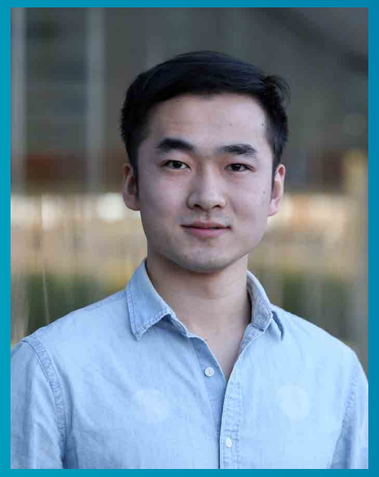
What's your ambition now?

"I have a way to yet go to finish my PhD. I'd like to do the best I can, learn as much as possible and publish as many papers as I can. I think when I've finished, I'd like to continue in research but also perhaps see how I can use my knowledge of manufacturing and aerospace engineering to contribute to industry."

Would you recommend the MSCA programme to others?

"Yes, it's very supportive, innovative and open to anyone in the world. It provides knowledge without boundaries."

"As a member of the IAT I was fortunate to be able to go to the Paris Air Show. This was a fantastic experience and I hope that when I get some results from my research, I might be able to contribute something to a future show."



Liang Ding

Project: Dry lubrication technologies for transmissions and power systems to deliver better performance and simplified systems in aerospace engineering

Research group: Machining and Condition Monitoring

PhD supervisors: Professor Dragos Axinte, Paul Butler-Smith

Secondment: SKF, UK

Read my work here: L Ding, D Axinte, P Butler-Smith, A Abdelhafeez Hassan 'Study on the characterisation of the PTFE transfer film and the dimensional designing of surface texturing in a dry-lubricated bearing system' pp 448–449, 2020

ORCID: https://orcid.org/0000-0002-2212-6259

Where are you from and where did you study before Nottingham?

"I'm from the Hubei province of China. I attended Hubei University of Technology for my Bachelor's degree in Naval Architecture and Ocean Engineering. Then for my Master's I joined the Erasmus programme and studied Mechanical Engineering at Leeds, Ljubljana and the University of Technology in Sweden."

Why did you want to be a Marie Skłodowska-Curie researcher?

"Towards the end of my Master's studies I was looking for a suitable PhD subject and Marie Skłodowska-Curie Actions (MSCA) offered a programme that was very closely related to what I'd been studying. I also found the programme offered a range of opportunities such as funding to attend conferences, working with other students and the chance to reach out to industry, which appealed to me."

What did being at the IAT bring to your project?

"PhD studies are usually very specialised and focused on a single discipline. At the IAT, however, I had the opportunity to connect with others – learning about electronics, design, manufacturing and other general applications in aerospace. This really helped to broaden my knowledge in a way I perhaps wouldn't otherwise have done."

What's it like being a member of the Faculty of Engineering?

"It's good – overall I found it was easy to get the help you need to complete your work. There's so much to do when working on your PhD – setting up tests, experiments, etc, that you need the help of those around you and I found the technicians, administrators and other members all very helpful."

What problem were you trying to solve as part of your PhD?

"I'm looking at the lubrication and application of surface textures on bearings in the rotor head on a helicopter. The flexible/tilt movement required uses a spherical joint bearing which needs to be lightweight to save on energy and reduce emissions. A dry component is needed for its lubrication and I've been studying the use of lasers and manufacturing technologies to make suitable textures on the bearing to successfully contain this."

What was your approach to solving this problem?

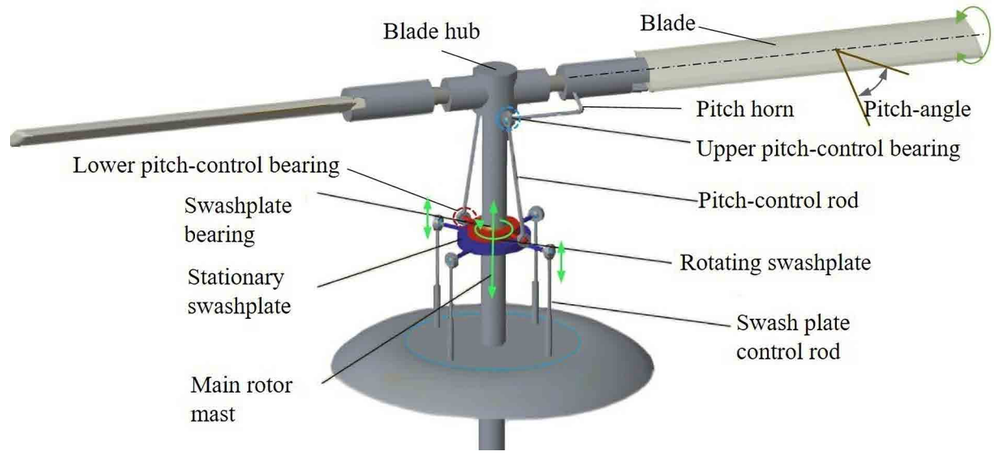
"I used numerical simulators before starting the manufacturing process to gain an insight into the materials I was using, to ensure they were capable of withstanding the pressures that would be applied."

What key findings have you made?

"I've achieved results in the two areas I've been looking at. One is concerned with the sliding mechanism of the lubricant on the bearing where precise dimensions and patterns of textures are needed. The other is to do with the binding of the lubricant where, conversely, surfaces need to be as rough as possible."

Have you had any interaction with industry during your PhD?

"Yes, I had an internship with UK bearing manufacturing company, SKF. I worked with them into find an innovative method for roughening sleeve textures. I got on well with the team there and may continue to work with them when I finish my PhD."



Model of a helicopter main rotor (rigid-type) assembly, highlighting location of lower pitch-control bearing

What training have you undertaken that has been most useful to your work?

"Learning how to write research papers has been very valuable. I've also attended a number of other courses – learning about the software used in aircraft design, for example, and understanding more about aircraft and how they operate."

What's been your favourite INNOVATIVE team activity?

"In our first year we were set a solar challenge to build an unmanned aerial vehicle – a UAV. The final competition was unfortunately cancelled, but we did the work, making the UAV out of plastic and wood, etc. We had two or three trials and although we broke the first two, one model did fly. I enjoyed the whole process – it was a good hands-on experience."

If someone was going to read one of your papers, which would you recommend and why?

"I'd recommend 'Study on the characterisation of the PTFE transfer film and the dimensional designing of surface texturing in a dry-lubricated bearing system'. It brings about the conception of what I'm studying, explaining the need to be careful with the design of surface textures to reduce the wear rate of bearings. It also talks about the need to carry out the numerical simulation to generate theoretical values first, rather than approaching the project randomly."

If you were to start your PhD again, is there anything you'd do differently?

"Before starting the testing process, I'd do as much preparation possible. I'd also gather the opinions of all the different people around me – supervisors and assessors, for example, and then decide on the right route to take."

How did you find living and studying in Nottingham?

"Nottingham has everything you need and overall I found it a good experience."

How do you think being a Marie Skłodowska-Curie fellow will help your future career?

"The title is an honour. Just this alone can give you credibility and the whole experience means you've learnt how to challenge yourself and achieve better things."

"PhD studies are usually very specialised and focused on a single discipline. At the IAT, however, I had the opportunity to connect with others – learning about electronics, design, manufacturing and other general applications in aerospace. This really helped to broaden my knowledge in a way I perhaps wouldn't otherwise have done."

Leonidas Gargalis

Project: Additive manufacturing of soft magnetic alloys for 3D printed electric motors

Research group: Centre for Additive Manufacturing

PhD supervisors: Professor Ian Ashcroft, Professor Micheal Galea, Professor Richard Hague

Secondment: Lawrence Livermore National Laboratory, USA

Read my work here: L Gargalis, V Madonna, P Giangrande, R Rocca, M Hardy, I Ashcroft, M Galea, R Hague 'Additive Manufacturing and Testing of a Soft Magnetic Rotor for a Switched Reluctance Motor' IEEE Access, vol 8, pp 206982–206991, 2020

Awards: Excellent paper award at the 23rd International Conference on Electrical Machines (ICEMS2020)

ORCID: https://orcid.org/0000-0002-2739-1115

Where are you from and where did you study before Nottingham?

"I grew up in Athens, Greece. I have a Bachelor's and Master's degree in Production and Management Engineering from the Technical University of Crete, and a Master of Science in Space Studies from the International Space University in Strasbourg."

Why did you want to be a Marie Skłodowska-Curie researcher?

"I was aware of the collaboration between the Centre for Additive Manufacturing and the Institute for Aerospace Technology at the University of Nottingham. I found the interdisciplinary connection of these two centres very interesting and while I was offered PhD places elsewhere, it was this opportunity along with the prestige of the Marie Skłodowska-Curie Actions (MSCA) programme that made my decision for me."

What did being at the IAT bring to your project?

"It provided me with a different perspective. I was part of a power electronics and machine group, testing prototype 3D printing electric models and I wouldn't have completed as many tests without the help of my fellow researchers. The IAT helped me to bridge the gap between electrical engineering and additive manufacturing."

What's it like being a member of the Faculty of Engineering?

"It was interesting. I met a lot of very clever people, collaborating across different departments. I was able to access a wide range of equipment for use in my research, and overall I enjoyed the culture and openness of the faculty."

What problem were you trying to solve as part of your PhD?

"I'm looking at the impact additive manufacturing has on electrical machines. By using a selective laser melting process, I've been trying to see if a 3D printing manufacturing technology can be used to create electric motors in different metals and alloys."

What key findings have you made?

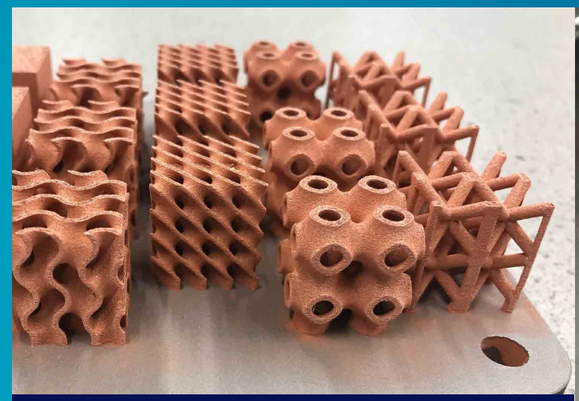
"I've developed an extensive list of magnetic alloys and highly conductive metals that can be used for generating electromagnetic models. I've discovered that silicon steel processed by laser powder bed fusion has properties that are comparable to steel available in the market and with proof of concept, successful prints can be achieved using this, for electromagnetic applications in the industry."

Have your research findings already been implemented by industry?

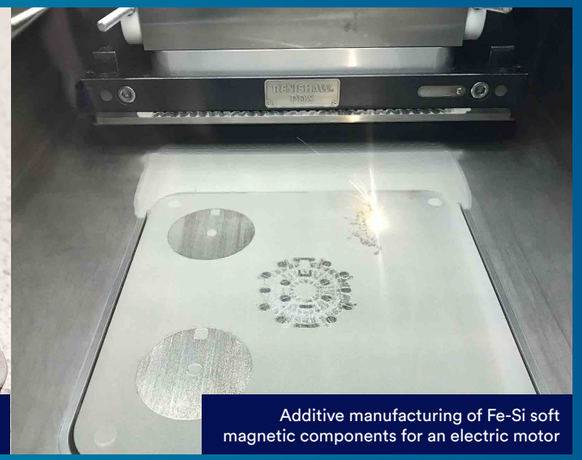
"My findings are being used and there's a lot of interest in their future development – and not just in aerospace. They're transferable to lots of different applications, from aerospace and aviation to automotive. It's because 3D printing gives you the design freedom to create complex prototype models quickly."

How has the equipment at Nottingham helped you complete your work?

"Knowing the availability of specialist equipment at Nottingham was one of the reasons I chose the INNOVATIVE programme. The Additive Manufacturing Building at the Jubilee Campus has a state-of-the-art lab that made both non-destructive and destructive testing possible for my research."



Pure copper lattice structures for electric and thermal applications manufactured via Laser Powder Bed Fusion (LPBF)



Additive manufacturing of Fe-Si soft magnetic components for an electric motor

What training have you undertaken that has been most useful to your work?

"Because my background isn't in electrical engineering, I've had training to help me understand more about how machines operate and I've attended courses to learn about the techniques involved in non-destructive testing. I also took part in a secondment at the Laurence Livermore National Laboratory in California where I was able to carry out experiments with high purity copper for cooling and thermal applications."

Have you done any training that has taken you out of your comfort zone?

"I had some training in the use of software for aircraft design. I've never worked on anything like that before so it was well out of my field of expertise and I had a steep learning curve, but I found it very interesting."

If someone were to read one of your papers, which would you recommend and why?

"The paper would be 'Additive Manufacturing of a soft magnetic high silicon steel rotor for a Switched Reluctance Motor'. It shows the proof of concept in my work – the potential of technical and material properties for future implementation, bridging the gap between additive manufacturing and electronic engineering, proving this is now feasible and paving the way for future research in the field."

What's been your favourite INNOVATIVE team activity?

"I enjoyed the team solar challenge. We were tasked with building an unmanned aerial vehicle (UAV) – it was a fun, hands-on activity working together with people from different disciplines with different perspectives and cultures. We bonded well and even had some successes with our test flights!"

If you were to start your PhD again, is there anything you'd do differently?

"I'd spend more time on simulation and modelling, not just on carrying out experiments. I spent a lot of time in the labs early on in the programme, trying out ideas and that's what I think I'd change."

How did you find living and studying in Nottingham?

"I like the size of Nottingham. It has a young, positive vibe with plenty of parks and lots of options for food and drink."

What's your ambition now?

"I'm actually working part-time for a spin-off company from the university called Added Scientific Ltd, and as a Research Assistant at the Centre of Additive Manufacturing, so I have the opportunity to further develop and implement my research in industry. I'll see where the company takes me – there's a lot of interest in what I'm doing."

How do you think being a Marie Skłodowska-Curie fellow will help your future career?

"It's a prestigious fellowship. The budget is available for you to attend conferences, publish and present your papers and benefit from training both in the UK and overseas."

"I met a lot of very clever people, collaborating across different departments. I was able to access a wide range of equipment for use in my research and overall I enjoyed the culture and openness of the faculty."

Aerospace materials

Victor Thierry

Project: Numerical simulation of elastic wave propagation in textile composite structures

Research group: Composites

PhD supervisor: Dr Dimitrios Chronopoulos

Secondment: Commissariat à l'Energie Atomique (CEA), France

Read my work here: V Thierry, O Mesnil, D Chronopoulos 'Experimental and numerical determination of the wave dispersion characteristics of complex 3D woven composites' Ultrasonics, vol 103, 2020

ORCID: https://orcid.org/0000-0002-0439-3935

Please explain your background

"I'm from Lille in France and I have a Master's degree in Mechanical Engineering from the University of Technology of Compiègne, north of Paris.

Why did you want to join the Marie Skłodowska-Curie Actions programme?

"I wanted to do a PhD that was focused on engineering and industry, which this programme was, but I was particularly interested in the practical training element it offered, focusing on aerospace and the environment."

What did being at the IAT bring to your project?

"The IAT's allocation of budget for training, industry visits and practical applications made my PhD experience very different to others. In our first year we even built a solar-powered unmanned aerial vehicle (UAV), which I think was a highlight for all of us!"

What problem were you trying to solve?

"I've been studying wave propagation within textile composites, using these properties to identify areas that may be damaged in an aircraft structure to ultimately improve operational capabilities and safety."

What findings have you made?

"I found textile composites need to be modelled at mesoscale level to be able to predict wave propagation accurately."

How have you interacted with industry during your studies?

"My six-month secondment at The French Alternative Energies and Atomic Energy Commission in France brought my PhD to life. I worked in the department that studies non-destructive technique and structural health monitoring. I was also lucky enough to speak to pilots during summer schools, gaining first-hand knowledge of how my research could impact them."

Have your research findings been implemented yet?

"Not yet, but CEA are interested in my simulation work and there may be an opportunity to develop something with them in the longer term."

If someone was going to read one of your papers, which would you recommend?

"I worked on a paper when I was at my secondment at CEA – 'Experimental and numerical determination of the wave dispersion characteristics of complex 3D woven composites'. One of my mentors co-wrote it with me and I benefitted enormously from having industry insight."

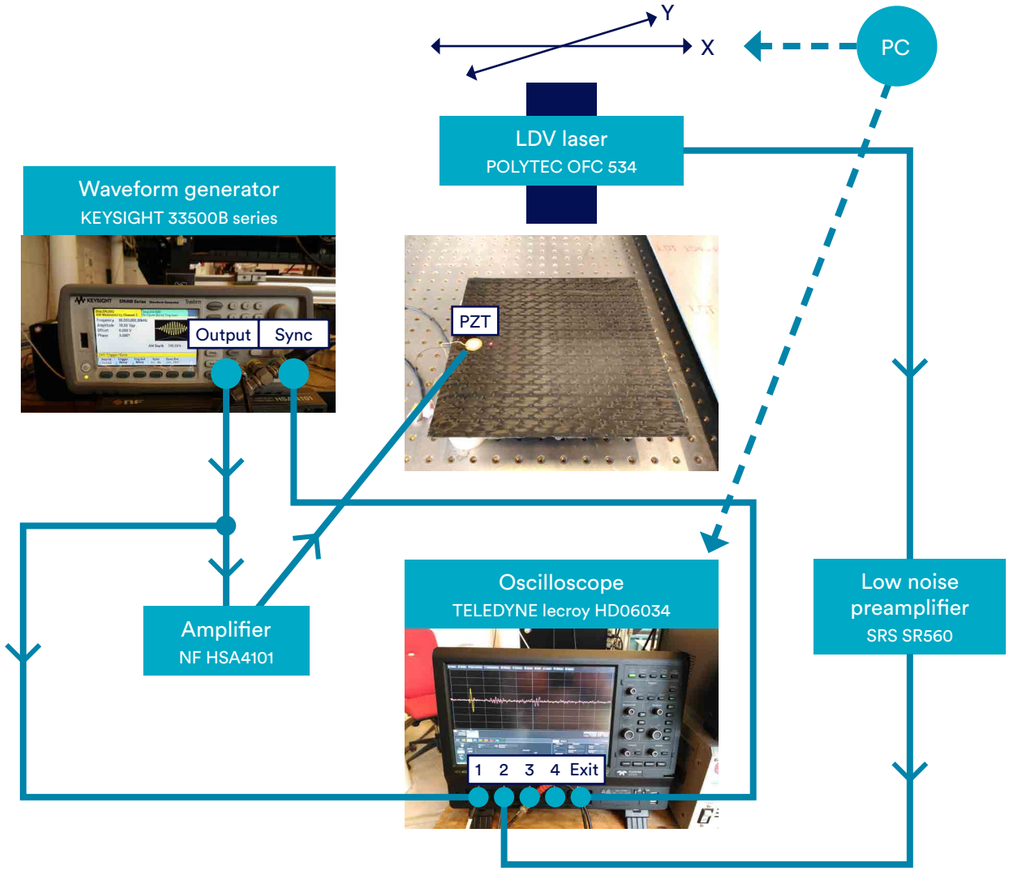
What have you enjoyed most during your time at the University of Nottingham?

"The people I was with. There were 23 of us on the INNOVATIVE programme, all working in a similar field, all of a similar age – it was a really good group and we enjoyed each other's company. I was very sad to leave!"

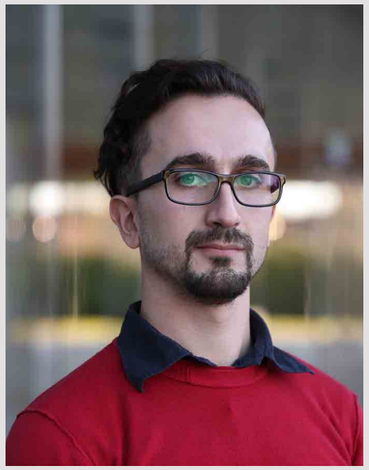
How do you think being a Marie Skłodowska-Curie researcher will help your future career?

"The Marie Skłodowska-Curie programme is very well known and respected in the aerospace sector – and therefore good for me to be associated with it. I'm starting a postdoctoral researcher position now, working for the French Space Agency, CNES – a position that my status as a Marie Skłodowska-Curie researcher helped me to secure."

"My six-month placement at the CEA in France brought my PhD to life."



Experimental set-up for B-scan measurements. A signal is generated by the waveform generator, amplified and transmitted to the PZT. The PZT transmits the vibrations to the composite plate. The LDV laser measures the out-of-plane displacements that are filtered by the low noise preamplifier. The input and measured signals are recorded by the oscilloscope.



Francesco Zangrossi

Project: R&D of carbon nanotubes-based nanocomposite for self-heating and de-icing application

Research group: Advanced Materials

PhD supervisors: Dr Xianghui Hou, Dr Fang Xu, Professor Nick Warrior

Secondment: Meggitt Composites and Polymers, UK

Read my work here: F Zangrossi, F Xu, N Warrior, P Karapappas and X Hou 'Electro-thermal and mechanical performance of multi-wall nanotubes buckypapers embedded in fibre reinforced polymer composites for ice protection applications' SAGE Publishing and Journal of Composite Materials, April 2020

ORCID: https://orcid.org/0000-0002-1203-1758

Where are you from and where did you study before Nottingham?

"I'm from an Italian town called Este. I studied Materials Engineering for my Bachelor's and Master's degrees at the University of Padova."

Why did you want to be a Marie Skłodowska-Curie researcher?

"I worked in industry after completing my Master's but wasn't particularly enjoying my job and wanted to return to research. I heard about the Marie Skłodowska-Curie programme and was keen to study at Nottingham because I knew the university had a good reputation for materials engineering and the study of nanocomposites – so I applied for the programme and was awarded a place."

What did being at the IAT bring to your project?

"The IAT is focused on aerospace technology so it provided the right environment for my studies. I enjoyed being based there, having everything I needed close to hand."

What problem were you trying to solve?

"I was researching a method to develop self-heating composites for ice protection purposes, finding a process whereby production capacity could be scaled up for application. Self-heating composites are generally used to prevent ice accumulation, removing it from surfaces such as aircraft wings or wind turbines where it might compromise performance. My studies have included finding a way to create a suitable composite structure, focusing on the particular characteristics of the nanomaterial."

What key findings have you made?

"I've found two processes to produce self-heating composites – different methods and different materials that can be used to improve the production process. The next step is to scale this up."

What problem were you trying to solve?

"The method I've been using is already documented in journal articles, but I had to confirm this approach because previous studies have looked at mechanical and thermal characteristics separately whereas I need to look at them together."

What's the best place you've been to as part of your work?

"I very much enjoyed the Paris Airshow where I was able to meet a number of companies who were interested in my topic and I gained a great many industry contacts."

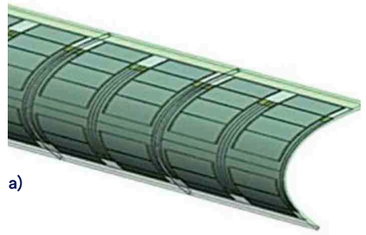
What training have you undertaken that has been most useful to your work?

"I spent around two months in the labs when I first started my PhD, learning how to use the equipment I needed for my research – the storage units, keeping constant conditions, etc. So yes, learning how to manage the lab environment was most useful to me."

How have you interacted with industry during your studies?

"I had a three-month secondment with Meggit, which was a really good experience. Being able to experience a working production line at a manufacturing company and see composite production first hand was valuable for my research.

I also spent some time at the Kyoto Institute of Technology in Japan where I had the opportunity to work in their labs and develop my research further."



a)

b)

a) Metal heater for wing's leading edge of civil aircraft (eg Boeing 787) developed by GKN
b) De-icing test with the carbon nanotube-based ice protection system developed by Fraunhofer Institute for Structural Durability and System Reliability

Have your research findings already been implemented by industry?

"Not yet, although Meggit has been very impressed with my results and would like me to continue working with them."

What's been your favourite INNOVATIVE team activity?

"The UAV solar challenge project we worked on together was good. We worked as a team to help each other reach our end goal."

What's been the best place you've presented your work?

"I presented my topic at the International Conference on Metallurgical Coatings and Thin Films (ICMCTF) in San Diego. While many different topics were presented for discussion, I did receive some useful feedback on mine."

What would you do differently if you were to start your PhD again?

"I'd develop more composite parts to enable me to carry out analysis and research in greater depth."

How did you find living and studying in Nottingham?

"I like the city, it's full of life and I met a lot of great people here. I had a very good three years!"

What's your ambition now?

"I'm currently working as a process engineer in automobile manufacturing. I really like what I'm doing and my wish is to continue and to develop this role in materials production engineering."

How do you think being a Marie Skłodowska-Curie fellow will help your future career?

"It's helped me to be more open-minded, understanding different research cultures, as well as how to relate to and interact with different people. I think it will help me a great deal in my future career."

"I very much enjoyed the Paris Airshow where I was able to meet a number of companies who were interested in my topic and I gained a great many industry contacts."

Nurkanat Aimakov

Project: Elastic wave energy scattering and propagation in composite structures

Research group: Wave Chaos and Composites

PhD supervisors: Professor Gregor Tanner, Dr Dimitrios Chronopoulos

Secondment: Romax Technology, UK

Read my work here: N Aimakov, G Tanner, D Chronopoulos 'Transmission and reflection of waves at structural junctions connecting thin orthotropic plates' Wave Motion, vol 102, 2021

Awards: Top 4 best poster in School of Mathematical Sciences

ORCID: https://orcid.org/0000-0002-4377-5020

Where are you from and where did you study before Nottingham?

"I'm from Kazakhstan and studied Mathematics for my Bachelor of Science degree at Novosibirsk State University in Russia. I also hold double Master of Science degrees in Mechanics and Mathematical Modelling from Novosibirsk State University and in Engineering from Ecole Centrale de Lyon in France."

Why did you want to be a Marie Skłodowska-Curie researcher?

"I returned home after studying in France and started looking for jobs as well as for PhD programmes. Although initially I knew nothing about the Marie Skłodowska-Curie programme, I soon discovered so many aspects of it that interested me. There was of course the project you were studying, but also the IAT, visits to industry and the opportunity to develop in all areas, professionally and personally. I rejected two other PhD offers to join the INNOVATIVE programme and see 'Marie Skłodowska-Curie Researcher' as a respectable title to hold."

What did being at the IAT bring to your project?

"The IAT is a wonderful place with many people from different backgrounds and with different experiences. It provided a great setting for developing my inter-personal skills, discussing ideas and learning from others."

What's it like being a member of the Faculty of Engineering?

"I wasn't so involved with the Faculty of Engineering because my project was focused on maths, so instead I was part of a research group with the School of Mathematical Sciences. I enjoyed this as it provided me with a different perspective on my own work and broadened my knowledge in other areas. It also gave me the opportunity to develop my presenting skills through talking to different professors."

What problem were you trying to solve as part of your PhD?

"My research work focused on the vibro-acoustic analysis of composite structures. I was extending an existing method that had been developed by my supervisor for the case of composite-based structures often used in aerospace and automotive industries. The results of my PhD can be used to investigate zones prone to poor acoustic performance, that is zones creating a lot of noise."

What key findings have you made?

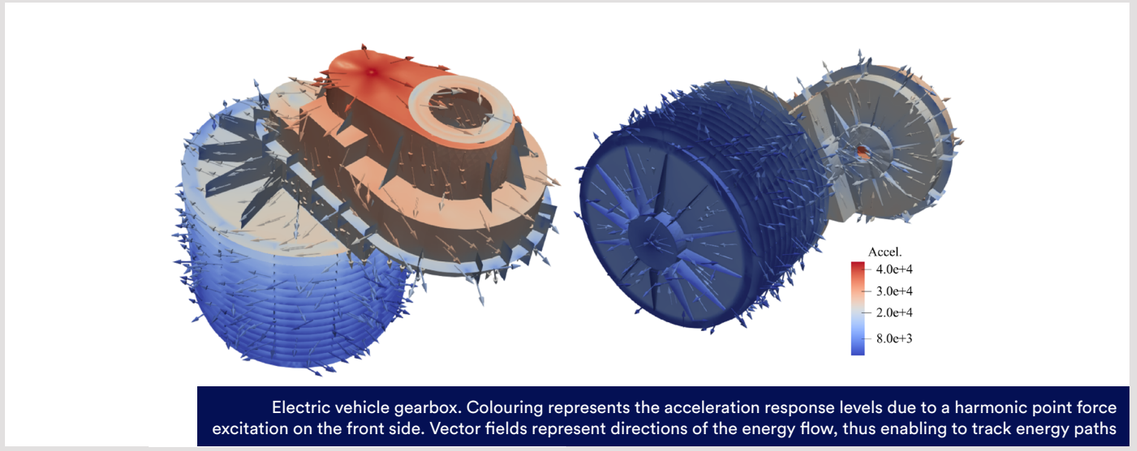
"The theory behind the method extension hadn't been developed, so it's something I've had to develop first, but now the method has been implemented and applied for vibro-acoustic analysis of composite plate junctions."

What problem were you trying to solve as part of your PhD?

"My research approach was inductive. I started with the analysis of existing methods and how I could extend them to simple orthotropic structures, then elaborated them to composite laminated structures and so on."

What's the best place you've been to as part of your work?

"I attended a conference in Spain on the topic I'm studying and was able to meet some of the best academics and professionals working in this field. Having the opportunity to talk to them, share ideas and network was incredibly valuable."



Electric vehicle gearbox. Colouring represents the acceleration response levels due to a harmonic point force excitation on the front side. Vector fields represent directions of the energy flow, thus enabling to track energy paths

What training have you undertaken that has been most useful to your work?

"I've had training specifically in the topic I've been studying, improving my background knowledge, and have attended additional lectures on other related topics to aid my wider learning in aerospace. I also attended a couple of summer schools on software development, which helped with my implementation method. One was at the University of Sussex and the other was in Wales and run by the UK Acoustics Network."

How have you interacted with industry during your studies?

"I've enjoyed a six-month secondment at Romax Technology in Nottingham where I was analysing the vibro-acoustic properties of an electric aeroplane gearbox. I've also collaborated with Japanese diesel engine manufacturer, Yanmar. They're interested in reducing the noise levels in their tractors, so I've been doing some simulation work for them. I also attended a site tour of Meggit and I enjoyed my visit to the Farnborough Airshow."

What's been your favourite INNOVATIVE team activity?

"I found the solar challenge project very enjoyable. The goal was to create an unmanned aerial vehicle (UAV) powered only by solar cells. The project continued for most of my first year and helped me get to know my fellow students. We developed the theory around how our aircraft would fly, then worked through the manufacturing phase, cutting out the wing shape, etc. I was trained by certified pilots to fly our aircraft with radio controllers. The first couple of test flights were fun - our aircraft were taking off nicely but then coming down again, so it was back to the drawing board!"

What would you do differently if you were to start your PhD again?

"You don't know what skill set you need at the start of your PhD. You need the experience you've gained by the second year at the start of the first year to help you make faster progress – that's obviously not possible though!"

How did you find living and studying in Nottingham?

"I got married and started a family here – so I like Nottingham very much! The city isn't too big to find your way around and it has everything you need, as well as plenty of parks and green open space to enjoy."

"I attended a conference in Spain on the topic I'm studying and was able to meet some of the best academics and professionals working in this field."

What's your ambition now?

"I'm in a post doctoral researcher position with my PhD supervisors, working on a European project simulating wave propagation on aeroplane propellers. I have another 18 months to go, and then I think I'd like to consider a position in industry – perhaps software development alongside further research."

How do you think being a Marie Skłodowska-Curie researcher will help your future career?

"It's a great honour. People are interested when you tell them you're a Marie Skłodowska-Curie researcher. It's more prestigious than just a PhD. I've also gained so much experience during my time on the programme and know it will help me in whatever career route I choose to take."

Daniela Munalli

Project: The use of techniques such as non-destructive testing (NDT) to enhance quality of production and eliminate rejects in composites manufacturing

Research group: Composites

PhD supervisors: Professor Andrew Long, Dr Dimitrios Chronopoulos, Dr Stephen Greedy, Dr Georgios Dimitrakis

Secondment: Iowa State University, USA

Read my work here: D Munalli, G Dimitrakis, D Chronopoulos, S Greedy, A Long 'Electromagnetic shielding effectiveness of carbon fibre reinforced composites' Composites Part B: Engineering, 173, pp 106906, 2019

Awards: Best poster award, Composites Research Group poster competition, 2019

Where are you from and where did you study before Nottingham?

"I'm from Rome and studied for my Bachelor's degree in Aerospace Engineering and my Master's degree in Aeronautical Engineering at Sapienza University of Rome. I also studied the equivalent of an MEng in Civil Aviation."

Why did you want to be a Marie Skłodowska-Curie researcher?

"After completing my Master's degree, I was working in the aerospace industry but didn't feel I was making much of a contribution. I heard the Marie Skłodowska-Curie Actions (MSCA) programmes were only open to international students, so I applied and was awarded a place. I like being back in academia and enjoy the challenge my research has given me."

"Nottingham ran short courses on management training and general business skills, which I found very useful."

What did being at the IAT bring to your project?

"I enjoy the shared office environment, meeting the different people there and working together with them. No one is left to work on their own and even if you have a scientific problem that is specific to your area of study there are always other researchers who are willing to help."

What's it like being a member of the Faculty of Engineering?

"I was a little detached from the faculty, but I did work with other faculty members during engineering open days – talking at career events, explaining why Nottingham is a good place to study. I also enjoyed sharing my project work and research within the faculty research group meetings."

What problem were you trying to solve as part of your PhD?

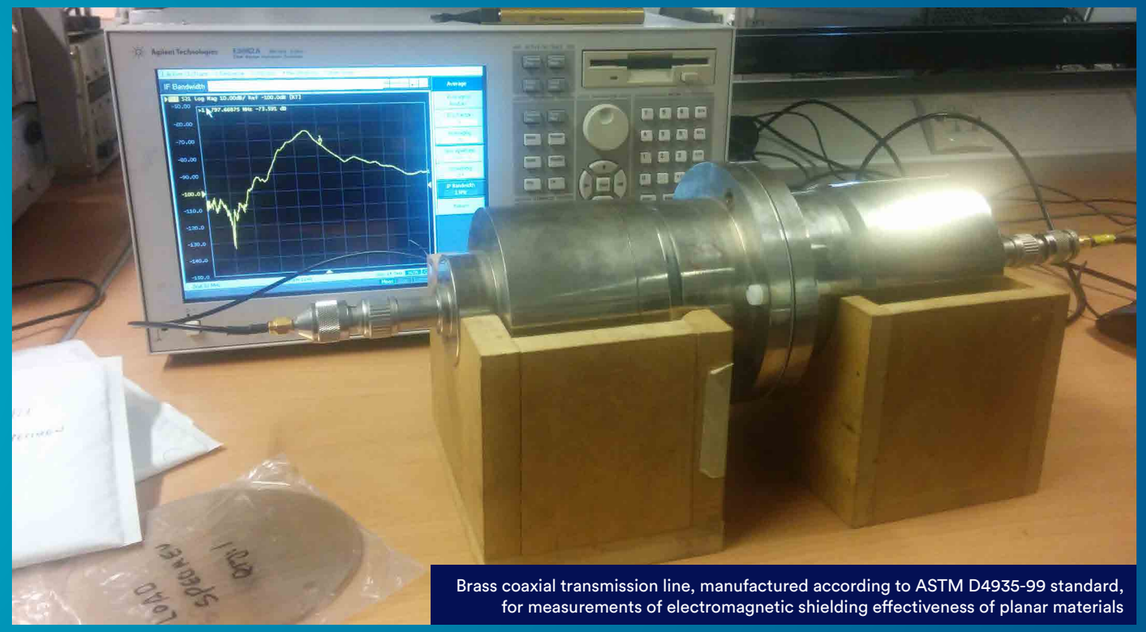
"I've been trying to apply microwave non-destructive testing (MNDT) methods to examine defects in carbon fibre reinforced composites (CFRP), looking to enhance the quality of their production in aircraft manufacture."

What key findings have you made?

"I started by working with the permittivities of carbon fibres, using results from existing studies, but the experimental methods weren't good enough for my research. So I used a variation of the filled transmission line technique whereby a carbon fibre sheet is positioned in between the two probes instead of inside. Then, using a circularly polarised antenna, I've been able to identify areas of fibre waviness and where there are gaps or overlaps, and changes in fibre orientation."

What problem were you trying to solve as part of your PhD?

"I was one of only a few people at the University of Nottingham to face this topic and, while I had support from my research group, there isn't a microwave lab at the university. However, my secondment was at Iowa State University where they have a centre for non-destructive evaluation (CNDE) and an advanced microwave lab run by a research team headed up by Professor Reza Zoughi. On my secondment. I was able to advance my research and effectively conduct experiments and calculate the complex electrical properties (permittivities) of CFRP materials with different structural properties."



Brass coaxial transmission line, manufactured according to ASTM D4935-99 standard, for measurements of electromagnetic shielding effectiveness of planar materials

What's the best place you've been to as part of your work?

"I enjoyed going to the Farnborough Airshow – the presentation given by Boeing there was particularly amazing. I also enjoyed attending a conference in Manchester about structural health monitoring. It was the first time I'd attended a conference and experienced so many scientists sharing their ideas and achievements."

What training have you undertaken that has been most useful to your work?

"Nottingham ran short courses on management training and general business skills, which I found very useful. And there was the INNOVATIVE summer school where professors from the United States presented classes on More Electrical Aircrafts, sharing their research and experiments with us."

How have you interacted with industry during your studies?

"It is still too early to produce relevant achievements in the industry but I've collaborated with a research group in the USA who were among the first to produce patented technology on the topic."

If someone were to read one of your papers, which would you recommend and why?

"My papers are a work in progress, but I'd recommend reading the journal 'Electromagnetic shielding effectiveness of carbon fibre reinforced composites'. It talks about the shielding effectiveness (SE) of CFRP and is relevant to researchers who may want to apply this method to carbon fibre projects."

What would you do differently if you were to start your PhD again?

"I would advise future students who have a large part of their PhD focused on experiments to start their lab work very early."

How did you find living and studying in Nottingham?

"The city is very easy to live in – we say in Italy it's 'shaped for people'. It's a lively city with lots of students living there. University Park is beautiful and the university sports facilities are very good – I enjoyed trying the climbing wall."

What's your ambition now?

"I've been offered positions abroad in the world of academia. But for now, it's too soon. I would like to pursue an academic career, but I think first I'll head back to the UK, finish my PhD, then perhaps apply for a research or industry position in Europe."

How do you think being a Marie Skłodowska-Curie researcher will help your future career?

"I think it's a great opportunity for international students to be part of a MSCA fellowship. MSCA programmes are widely recognised in the world of academia."

Aerospace operations

Mahnaz Sharafkhani

Project: Using Soma design to develop immersive interventions that improve aircraft passenger comfort

Research group: Human Factors

PhD supervisors: Dr Sue Cobb, Dr Paul Tennent, Dr Elizabeth Argyle

Secondments: University of the Sunshine Coast, Queensland, Australia, and KTH Royal Institute of Technology in Stockholm, Sweden

Read my work here: M Sharafkhani, E Argyle, S Cobb, P Tennent 'Posture, Movement, and Aircraft Passengers: An Investigation into Factors Influencing In-Flight Discomfort' WORK, 68(s1), S183–S195, 2021

Awards: One of the best papers at the International Comfort Congress 2019

ORCID: https://orcid.org/0000-0001-8942-6742

Please introduce yourself

"I'm a Human Factors Marie Skłodowska-Curie researcher exploring immersive technology-based strategies to improve aircraft passenger comfort. I'm originally from Iran and obtained my Bachelor's degree in Industrial Engineering from Sadjad University of Technology and my Master's in the same subject from Azad University.

Why did you want to be a Marie Skłodowska-Curie researcher over other PhD programmes?

"The Marie Skłodowska-Curie Actions (MSCA) programme has a lot of benefits to offer – it provides the opportunity to experience a range of different activities such as attending international conferences and training courses and going on industrial secondments. I also know Nottingham is ranked as one of the world's top 100 universities, so I was keen to study there."

What problem have you been trying to solve as part of your PhD?

"I've been trying to find a solution for maintaining a high level of aircraft passenger comfort and satisfaction, while working with a minimal amount of physical space."

What key findings have you made?

"I identified aircraft passengers' postures and discomfort areas. I took a traditional ergonomics approach and merged it with the methodological application of Soma design. This enabled me to design relevant interventions."

How do you think your findings might be applied in industry and what impact do you think they'll have?

"Flying in economy class is currently an awful experience, so hopefully the results of my PhD will help to make long-haul flights more enjoyable."

What training have you undertaken that has been useful to your PhD?

"I went to the Media Technology and Design Lab at the KTH Royal Institute of Technology in Stockholm to learn about Somaesthetic design. I found this a very useful experience and it helped me understand how to get the most out of the design methodology for my ongoing research."

What did being at the IAT bring to your project?

"Being at the IAT has enabled me to work on a programme that promotes equality in aerospace. This is a male-dominated sector and I'm thrilled to be the co-chair of the University of Nottingham's Women in Aviation and Aerospace Charter. This was launched in March 2019 and aims to engage students, supporting equality, diversity and inclusion within the aerospace sector and beyond."

What's the best place you've been to while on the Marie Skłodowska-Curie Actions programme?

"I went to the International Comfort Congress at Delft University in The Netherlands. I made lots of new connections in my field of interest and learned more about what other scientists are researching in passenger comfort."

Have you won any awards for your research?

"I haven't completed my PhD yet, but I was awarded Best Paper at the Comfort Congress."

Designing and prototyping a virtual reality intervention

What's been your favourite INNOVATIVE team activity?

"I took part in an IAT showcase event. I worked with my colleagues in the preparation stages and then we presented our work to other industry and academic individuals and the general public."

If someone was going to read one of your papers, which would you recommend and why?

"I'd recommend 'Posture, Movement and Aircraft Passengers: An investigation into factors influencing in-flight discomfort'. It describes the first studies of my PhD and explains why I'm researching this particular subject."

What have you enjoyed most about being at Nottingham?

"I've enjoyed working on different research projects, having access to the equipment I need and having the support and supervision of a very knowledgeable team. Nottingham itself is also a lovely city to explore and there's plenty to do."

What's your ambition now?

"I'd like to work in the aerospace industry and implement the results of my PhD in the real world."

How do you think being a Marie Skłodowska-Curie researcher will help your future career?

"Having a Marie Skłodowska-Curie Actions position is highly respected in industry and academia, so to have this on my academic record is a privilege."

What would you say to anyone considering a Marie Skłodowska-Curie Actions programme?

"Being a researcher on a Marie Skłodowska-Curie Actions programme is an excellent experience. I learned a lot and improved my professional skills. The programme helps you build your career networks and I would recommend it to other students."

"Flying in economy class is currently an awful experience, so hopefully the results of my PhD will help to make long-haul flights more enjoyable."

Divish Rengasamy

Project: Embedding and extracting domain knowledge in machine learning for condition-based maintenance

Research group: Advance Data Analysis Centre, Gas Turbine Transmission Research Centre

PhD supervisors: Dr Grazziela Figueredo, Dr Benjamin Rothwell

Secondment: Rolls-Royce, UK

Read my work here: D Rengasamy, M Jafari, B Rothwell, X Chen, GP Figueredo 'Deep learning with dynamically weighted loss function for sensor-based prognostics and health management' Sensors, 20(3), pp 723, Jan 2020

ORCID: https://orcid.org/0000-0001-5397-1271

Where are you from and where did you study before Nottingham?

"I'm from Kuala Lumpur, Malaysia. I have a Bachelor's degree in Electrical and Electronics Engineering, with a focus on software. I studied for this at the University of Nottingham Malaysia and then transitioned straight to my PhD."

What attracted you to the Marie Skłodowska-Curie Actions programme, INNOVATIVE?

"During the final year of my Bachelor's degree I wrote a research paper, which captured my interest in research, so I began looking for a PhD project in my chosen field. I'd heard people on MSCA programmes had a wide range of opportunities open to them, with access to the funding and training they needed. The programme also seemed to be targeted at people from a variety of backgrounds – I'm always interested to meet others from different cultures and experiences, so it really appealed to me."

What were you studying?

"I was looking at how we can use Artificial Intelligence (AI) to predict the early onset of faults in aircraft – knowing which part of an aircraft is going to fail and when. By identifying this, we can determine the end of life of a specific component perhaps six months before it happens. There's some early research on this dating back to 2016, but exploring how to use AI in a safer, more responsible way, particularly for the aerospace industry, is largely a new area."

What key findings have you made?

"I've developed a new algorithm to make AI more transparent. A lot of methods are 'black box', but I wanted to look inside to find out why certain decisions were being made – if we have that insight, we can decide whether to continue in the same way or alter our approach."

How has being at the IAT helped your studies?

"The IAT acts as a hub for a lot of people at Nottingham. I was able to collaborate with people working on additive manufacturing, for example, and even wrote papers with them."

Did you take part in any training that you found particularly useful?

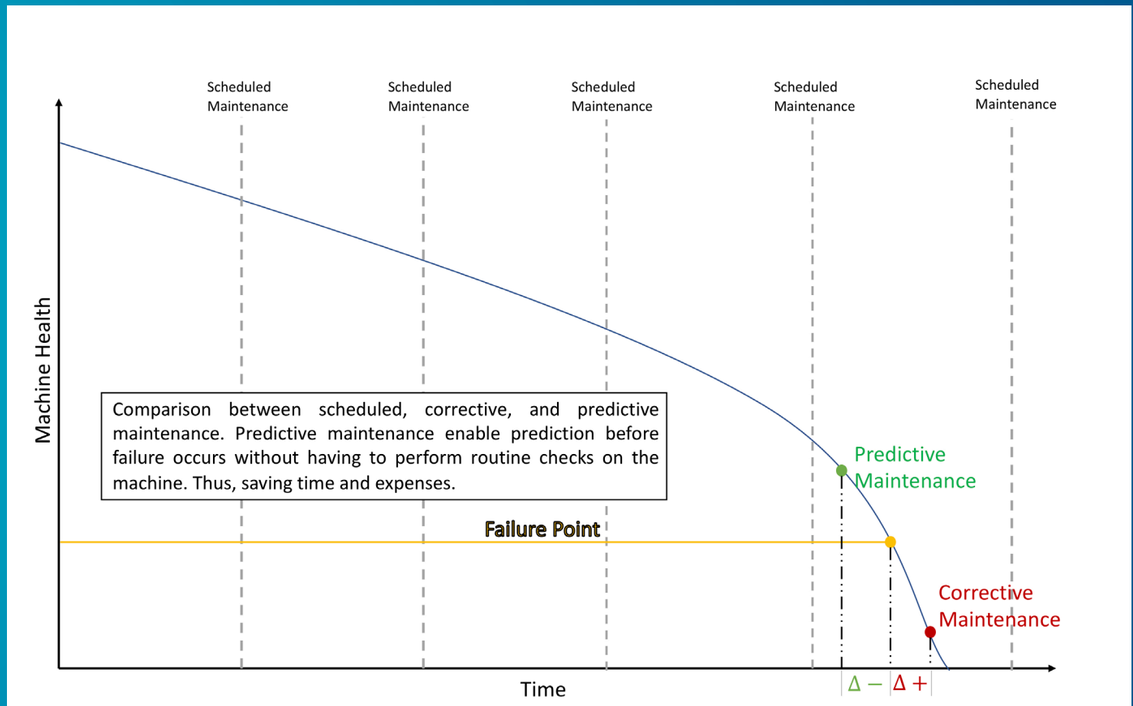
"The INNOVATIVE programme ran a summer school on electric aircraft. I don't have a background in aerospace so this training gave me a focus and helped me to identify how my research could impact the industry. I also took part in a presentation skills training course using the Pecha Kucha format. This took me completely out of my comfort zone as I had to talk in front of a few hundred people. I'm pleased I did it though."

What's been your favourite INNOVATIVE team activity?

"The Airbus Challenge. A group of three of us came up with an idea, wrote a proposal and created a video, which saw us reach the final stages of the competition. Our project was 'How can you get your luggage more quickly at an airport?'. We used AI for face recognition when passengers disembarked an aeroplane, matching them up with their luggage. It was great fun!"

If someone was going to read one of your papers, which would you recommend and why?

"That would be 'Towards a More Reliable Interpretation of Machine Learning Outputs for Safety-Critical Systems using Feature Importance Fusion'. The current techniques used in AI are not safe enough for aerospace, so this paper talks about intervention to create a better solution."



Comparison between predictive, corrective and scheduled-based maintenance

What have you enjoyed most during your time in Nottingham?

"It has a very diverse campus, which I like. And University Park is a lovely place to be – I went there a lot during my studies."

What's your ambition now?

"I'd either like to work in industry or maybe start my own company. I want to explore how we can use the AI model more responsibly. There's too much focus on profit at the moment and I think we need to find a better balance – a more holistic approach to enable AI to be used across multiple industry sectors."

What would you say to anyone considering a Marie Skłodowska-Curie Actions programme?

"Take the leap! Studying for a PhD can be very lonely, but the MSCA programme is different. You have the camaraderie of a group of people on the same journey as you, but everyone's studying something different so your experience will be very diverse."

"The IAT acts as a hub for a lot of people at Nottingham. I was able to collaborate with people working on additive manufacturing, for example, and even wrote papers with them."

Hery Mwenegoha

Project: Advanced navigation architecture for low-cost UAVs

Research group: Nottingham Geospatial Institute (NGI)

PhD supervisors: Dr James Pinchin, Dr Mark Jabbal, Professor Terry Moore

Secondment: Thales, UK

Read my work here: HA Mwenegoha, T Moore, J Pinchin, M Jabbal 'A Model-based Tightly Coupled Architecture for Low-Cost Unmanned Aerial Vehicles for Real-Time Applications' IEEE Access, 2020

Awards: 1st place, Pecha Kucha presentation competition, professional skills week, 2019, University of Nottingham

ORCID: https://orcid.org/0000-0003-3067-1174

Where are you from and where did you study before Nottingham?

"I'm from Tanzania in East Africa. I have an MEng degree in Aviation Engineering from Brunel University London. After completing my studies I returned home and worked on the design and development of guidance, navigation and control systems for UAVs (unmanned aerial vehicles)."

Why did you want to be a Marie Skłodowska-Curie researcher?

"I spent some time researching PhD programmes in the UK and found very few provided funding for overseas students. While conducting this research, I came across the Marie Skłodowska-Curie Actions (MSCA) programme, which offered an excellent worldwide doctoral programme funded by the EU. Also, the university is home to the Nottingham Geospatial Institute (NGI) with expertise in satellite navigation and positioning systems, sensor integration, earth observation geodesy, to name a few. I was also keen to work with Professor Terry Moore (former Director of the NGI) who has many years of research experience in positioning and navigation technologies."

What did being at the IAT bring to your project?

"The IAT is a major centre for aerospace research. It's home to multidisciplinary aerospace research ranging from aircraft range extenders to future More Electric Aircraft. I found there was plenty to immerse myself in, which was something I hadn't expected, and all the facilities were so well set up and easy to use."

What's it like being a member of the Faculty of Engineering?

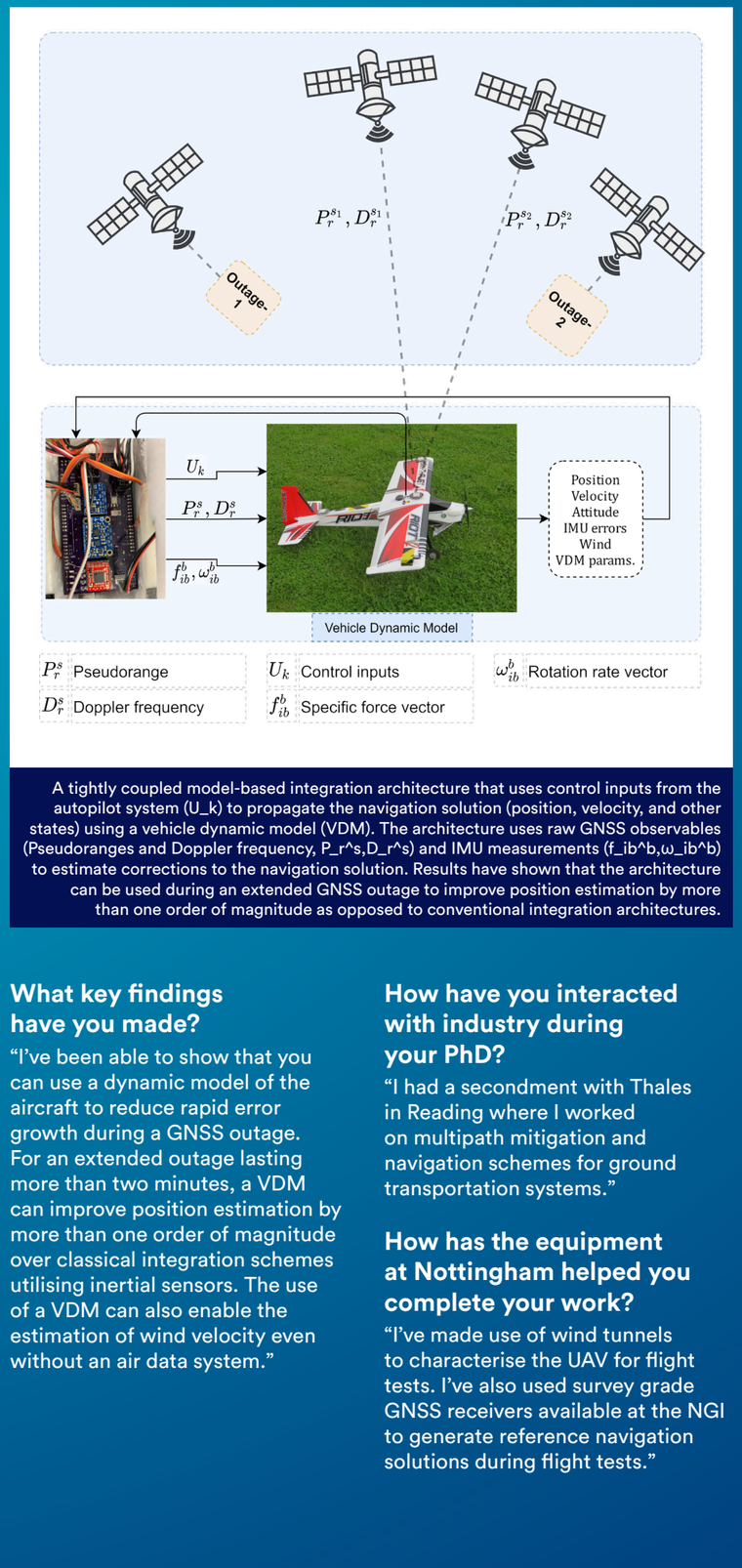
"My research is quite multidisciplinary, ranging from positioning and navigation technologies to aircraft aerodynamics. Being a member of the Faculty of Engineering made it easy to engage with different research groups and use all available resources, from wind tunnels to surveying equipment."

What problem were you trying to solve as part of your PhD?

"UAVs, ground vehicles and aircraft rely on GNSS or GPS receivers for positioning and navigation. This requires the receiver to be tracking at least four satellite signals at any one time. A GNSS outage is essentially the loss of position and velocity information from a receiver and could occur because of jamming or signal interference, for example. During this period, a UAV fitted with low-cost sensors will experience drift, so I'm researching different ways to mitigate this by using a mathematical model of the UAV, known as a Vehicle Dynamic Model (VDM)."

What has been your approach to solving this problem?

"I started by researching the use of a VDM in mitigating error growth as a result of a GNSS outage. This helped me identify different architectures that could be used in integrating the VDM with other sensors fitted on a UAV. After identifying an appropriate integration scheme, I developed a simulated model and evaluated the performance of this in different scenarios. I then compared the performance of the developed architecture with state-of-the-art integration schemes that are currently being used to mitigate error growth as a result of GNSS outage."



A tightly coupled model-based integration architecture that uses control inputs from the autopilot system (U_k) to propagate the navigation solution (position, velocity, and other states) using a vehicle dynamic model (VDM). The architecture uses raw GNSS observables (Pseudoranges and Doppler frequency, P_r^s,D_r^s) and IMU measurements (f_ib^b,ω_ib^b) to estimate corrections to the navigation solution. Results have shown that the architecture can be used during an extended GNSS outage to improve position estimation by more than one order of magnitude as opposed to conventional integration architectures.

What key findings have you made?

"I've been able to show that you can use a dynamic model of the aircraft to reduce rapid error growth during a GNSS outage. For an extended outage lasting more than two minutes, a VDM can improve position estimation by more than one order of magnitude over classical integration schemes utilising inertial sensors. The use of a VDM can also enable the estimation of wind velocity even without an air data system."

How have you interacted with industry during your PhD?

"I had a secondment with Thales in Reading where I worked on multipath mitigation and navigation schemes for ground transportation systems."

How has the equipment at Nottingham helped you complete your work?

"I've made use of wind tunnels to characterise the UAV for flight tests. I've also used survey grade GNSS receivers available at the NGI to generate reference navigation solutions during flight tests."

What training have you undertaken that has been most useful to your work?

"I've attended a total of 21 courses outside of my PhD studies, including a summer school at the Dutch Institute of Systems and Controls (DISC). This training was very useful for my PhD and enabled me to build a control system for the UAV, which I used in simulation and in flight tests. I also attended training at the Graduate School in subjects such as writing conference papers and giving dynamic presentations."

What's the best place you've been to as part of your PhD?

"I presented one of my papers at the Institute of Navigation's GNSS conference in Miami where I met some people I highly respect in this field, including Frank van Diggelen and PJG Teunissen. I felt honoured to be there."

What's been your favourite INNOVATIVE team activity?

"I enjoyed our industry visits – particularly to Meggitt, an aerospace business in Coventry. And I enjoyed taking part in the Airbus Challenge where our team worked on the development of a luggage tracking system."

How do you think being a Marie Skłodowska-Curie researcher researcher will help your future career?

"You're exposed to so many conferences and training opportunities and you build a good network. You can use this to open doors, forge links to industry and find routes to extended research."

"You're exposed to so many conferences and training opportunities and you build a good network."

Ridwan Aji Budi Prasetyo

Project: Predicting pilot mental workload using various indicators

Research group: Human Factors

PhD supervisors: Dr Robert Houghton, Dr Paula Moran, Dr Elizabeth Argyle

ORCID: https://orcid.org/0000-0001-9728-4078

Where are you from and where did you study before Nottingham?

"I'm from Jakarta, Indonesia. My interest is in engineering psychology, otherwise known as human factors/ergonomics. The University of Nottingham is well known for its specialism in this field, so I studied for my Master's in Human Factors here. I also attended Gadjah Mada University (UGM) to read Industrial Psychology."

Why did you want to be a Marie Skłodowska-Curie researcher?

"I looked at a number of PhD options but the opportunities and projects offered under the Marie Skłodowska-Curie programme were the best match for my area of interest."

What did being at the IAT bring to your project?

"It provided a networking opportunity. So many students from different backgrounds and working in different aviation disciplines are incorporated within the IAT. Because of this, I learnt an awful lot about different aspects of aviation, from green technology and electrical to manufacturing and engineering. The IAT also provided the opportunity to engage with the aerospace industry, facilitating interaction with big companies like Airbus."

What's it like being a member of the Faculty of Engineering?

"It was wonderful! My background is in social sciences so shifting my focus to engineering meant I was taking a problem-based approach to my studies – something that was completely different to what I was used to. But the faculty helped me to learn, providing support on the software and programming skills I needed to complete my PhD research."

What problem were you trying to solve as part of your PhD?

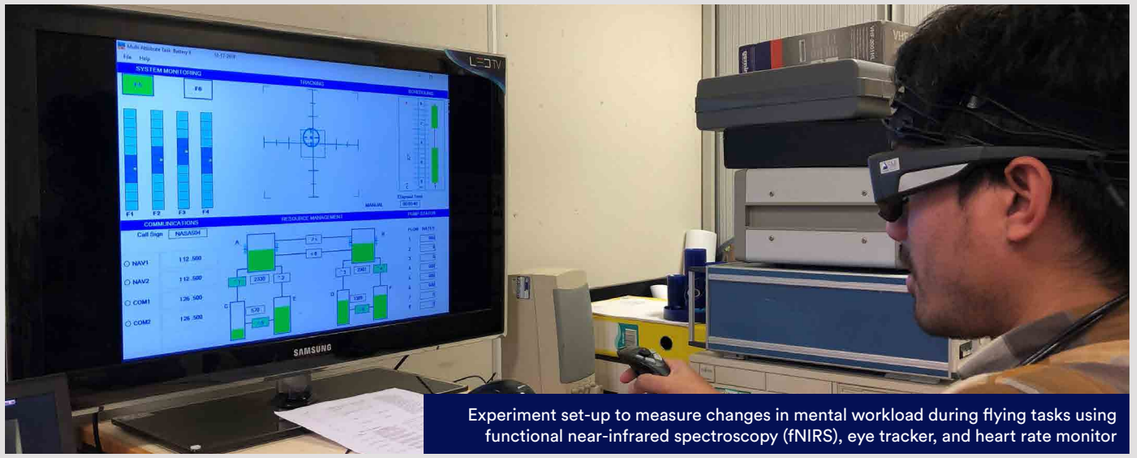
"Originally I was working to establish an objective measurement of real-time pilot mental workload. I wanted to create objective indicators of the mental workload change experienced in different situations – however, the Covid-19 pandemic has unfortunately impacted my research."

What has been your approach to solving this problem?

"I've been taking a qualitative, pragmatic approach to my research, interviewing professional pilots about their mental workloads using Critical Decision Methods (CDM) to track their cognitive activity during the landing phase of a flight. This will lead to the next phase of my research where I will see if we can predict mental workload before the task has started."

What key findings have you made?

"My hypothesis is that when a pilot is busy – occupied with taking off or landing, for example – oxygenated haemoglobin in the frontal cortex of the brain increases to a greater extent than when they're in a state of inactivity. My findings are inconclusive at the moment, however, as I need to carry out more one-to-one experiments with pilots. Working within the restrictions of Covid-19, I have agreed with my professor that I will continue my research through online and virtual experiments rather than in person."



Experiment set-up to measure changes in mental workload during flying tasks using functional near-infrared spectroscopy (fNIRS), eye tracker, and heart rate monitor

How has the equipment at Nottingham helped you complete your work?

"I've used the flight simulators at the Faculty of Engineering as part of my study plan."

What training have you undertaken that has been most useful to your work?

"I've undertaken training through DataCamp – learning about data sciences to help with my research. From this, I've been able to analyse the statistics I've generated and will be able to handle big data as my research progresses."

What's the best place you've been to as part of your PhD?

"I went to a conference in Amsterdam, which I found very interesting, and I was going to visit Boston University, but that has unfortunately had to be cancelled."

How have your supervisors contributed to your PhD work?

"All the teams who supported me have been great. My main supervisor was Dr Robert Houghton and he's been very helpful throughout."

What's been your favourite INNOVATIVE team activity?

"I enjoyed the Airbus Challenge. We debated ideas and were trying to find an effective way of weighing a passenger's luggage at an airport without it having to be weighed at Check In. I enjoyed working within a team, reviewing ideas and had good fun throughout the whole process."

If you were to start your PhD again, is there anything you'd do differently?

"I'd like to learn more about the connections between the brain and factors we can't see, such as the mind, workloads, stress, etc. The conventional methods used in psychology are very subjective in their results, but I'd like to look at the technology of the brain and see its reactions in specific situations (real-world context). The development of studies in this area are in their infancy at the moment, but they hold great promise for the future and their potential integration into workplace situations."

"I looked at a number of PhD options but the opportunities and projects offered under the Marie Skłodowska-Curie programme were the best match for my area of interest."

How did you find living and studying in Nottingham?

"Nottingham isn't a big city. The campus is very quiet and lovely compared to many other UK universities. I grew up in a city so have enjoyed having green open space around me here."

Training and outputs

Key publications

Best paper awards

Ahmed Hebala: Best paper award

Improved Propulsion Motor Design for a Twelve Passenger All-Electric Aircraft

A Hebala, S Nuzzo, P Connor, P Giangrande, C Gerada, M Galea, '**Improved Propulsion Motor Design for a Twelve Passenger All-Electric Aircraft**' IEEE workshop on Electrical Machines Design, Control and Diagnosis (WEMDCD), 2021

Leonidas Gargalis, Vincenzo Madonna: Excellent paper award

Development and Testing of Soft Magnetic Rotor for a Switched Reluctance Motor Built Through Additive Manufacturing Technology

L Gargalis, V Madonna, P Giangrande, R Rocca, I Ashcroft, R Hague, M Galea '**Development and Testing of Soft Magnetic Rotor for a Switched Reluctance Motor Built Through Additive Manufacturing Technology**' 23rd International Conference on Electrical Machines and Systems (ICEMS), Japan, 2020

Vincenzo Madonna: Best student paper award of the IEEE Industrial Electronics Society

Thermal Overload and Insulation Ageing of Short Duty Cycle, Aerospace Motors

V. Madonna, P. Giangrande, L. Lusuardi, A. Cavallini, C. Gerada, M. Galea, '**Thermal Overload and Insulation Aging of Short Duty Cycle, Aerospace Motors**' in IEEE Transactions on Industrial Electronics, vol 67, no 4, pp 2618–2629, April 2020

Mahnaz Sharafkhani: Selected as one of the best papers

Identifying Aircraft Passenger Postures and Factors Influencing Body Part Discomfort

M Sharafkhani, E Argyle, S Cobb, P Tennent, R Houghton '**Identifying Aircraft Passenger Postures and Factors Influencing Body Part Discomfort**' Second International Comfort Congress (ICC2019), Delft, Netherlands, 2019

Vincenzo Madonna, Brian J. Chalmers: Best paper award

On the Effects of Advanced End-Winding Cooling on the Design and Performance of Electrical Machines

V Madonna, P Giangrande, A Walker, M Galea '**On the Effects of Advanced End-Winding Cooling on the Design and Performance of Electrical Machines**' 2018 XIII International Conference on Electrical Machines (ICEM), pp 311–317, 2018

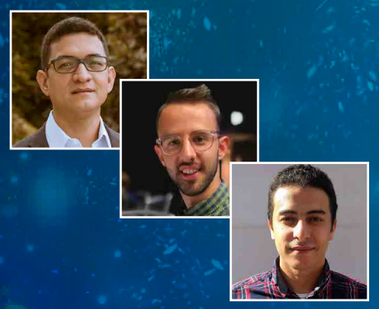
Key publications

Collaborative ESR publications

Failure Modes and Reliability Oriented System Design for Aerospace Power Electronic Converters

December 2020

J Harikumaran, G Buticchi, G Migliazza, V Madonna, P Giangrande, A Costabeber, P Wheeler, M Galea '**Failure Modes and Reliability Oriented System Design for Aerospace Power Electronic Converters**' IEEE Open Journal of the Industrial Electronics Society, vol. 2, pp 53-64, 2021



Energy Storage System Selection for Optimal Fuel Consumption of Aircraft Hybrid Electric Taxiing Systems

November 2020

A Recalde, M Lukic, A Hebala, P Giangrande, C Klumpner, S Nuzzo, P Connor, J Atkin, S Bozhko, M Galea '**Energy Storage System Selection for Optimal Fuel Consumption of Aircraft Hybrid Electric Taxiing Systems**' IEEE Transactions on Transportation Electrification, 2020

Additive Manufacturing and Testing of a Soft Magnetic Rotor for a Switched Reluctance Motor

November 2020

L Gargalis, V Madonna, P Giangrande, R Rocca, M Hardy, I Ashcroft, M Galea, R Hague '**Additive Manufacturing and Testing of a Soft Magnetic Rotor for a Switched Reluctance Motor**' IEEE Access, vol 8, pp 206982-206991, 2020

Improving Performance and Extending Lifetime of PMSMs via Advanced End-Winding Cooling

July 2020

V Madonna, C Spagnolo, P Giangrande, M Galea '**Improving Performance and Extending Lifetime of PMSMs via Advanced End-Winding Cooling**' IEEE 29th International Symposium on Industrial Electronics (ISIE), pp 319-325, 2020

Optimised low voltage loads allocation for MEA electrical power systems

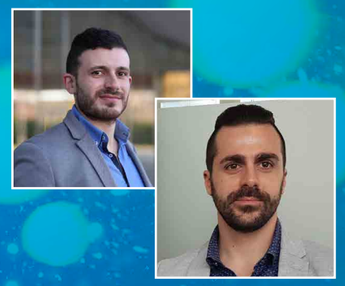
December 2019

C Spagnolo, V Madonna, S Sumsurooah, C I Hill, S Bozhko '**Optimised low voltage loads allocation for MEA electrical power systems**' AIAA/IEEE Electric Aircraft Technologies Symposium (EATS), pp 1-8, 2019

Review, Challenges, and Future Developments of Electric Taxiing Systems

November 2019

M Lukic, P Giangrande, A Hebala, S Nuzzo, M Galea '**Review, Challenges, and Future Developments of Electric Taxiing Systems**' IEEE Transactions on Transportation Electrification, vol 5, no 4, pp 1441-1457, Dec 2019



Reduced Order Lumped Parameter Thermal Network for Dual Three-Phase Permanent Magnet Machines

April 2019

P Giangrande, V Madonna, S Nuzzo, C Spagnolo, C Gerada, M Galea '**Reduced Order Lumped Parameter Thermal Network for Dual Three-Phase Permanent Magnet Machines**' IEEE Workshop on Electrical Machines Design, Control and Diagnosis (WEMDCD), pp 71-76, 2019

State of the Art of Electric Taxiing Systems

November 2018

M Lukic, A Hebala, P Giangrande, C Klumpner, S Nuzzo, G Chen, C Gerada, C Eastwick, M Galea '**State of the Art of Electric Taxiing Systems**' IEEE International Conference on Electrical Systems for Aircraft, Railway, Ship Propulsion and Road Vehicles and International Transportation Electrification Conference (ESARS-ITEC), pp 1-6, 2018

ESR group and individual training activities

Individual ESR training

International secondments

ESRs took part in six-month international industry or academic secondments. This was a huge development opportunity for the ESRs, enabling them to gain new skills and unique industry perspectives. ESRs have been placed across the world in companies such as Rolls-Royce, Meggitt, SKF, Romax and the National Composites Centre.

Technical and professional skills courses

ESRs used their research budgets to take advantage of external technical training courses, boosting their technical skills and knowledge needed to develop their PhD work. ESRs were also able to benefit from the many technical and non-technical University of Nottingham training courses while undertaking their PhD.

International conferences

ESRs have presented all over the world and published at 70 leading conferences. The experience of presenting and networking at conferences has been a huge benefit to their careers. Many have won best paper awards, showcasing the high standard of their research work.

Team building and group training activities

Cohort 1 - the RSA Solar Challenge

The RSA Solar Challenge is a national competition where teams design, build and fly model scale aircraft over a measured figure-of-eight course to test the viability of solar powered flight.

Cohort 1 successfully worked together, bringing their individual expertise to a mulitdisciplinary project. Their solar plane passed flight tests and ESRs developed their teamwork skills.

October 2016 – June 2017

Cohorts 2 and 3 - Airbus Fly Your Ideas challenge

Fly Your Ideas is a biennial competition organised by Airbus that offers students from around the world the opportunity to apply their classroom learning and research to solving real-world aerospace challenges.

Two teams from cohorts 2 and 3 submitted their ideas to the judges using professional videos. Out of 270 entries, both teams made it through to the second round of 46 entries.

October 2018 – March 2019

Two day PACElab software training

PACElab software is an industry - specific tool enabling engineers and scientists to model and determine the effect of their design on the overall efficiency of selected aircraft.

PACElab delivered a bespoke two-day course to our ERSs. This course enabled our researchers to gain industry-ready skills.

September 2017

INNOVATIVE summer school

The INNOVATIVE programme organised a six-day summer school. Highlights included Andy Bayliss of Boeing lecturing on the integration of aircraft design, while Professor Maria Angeles Martin gave a presentation on electrical architectures. Dr Adrian Marinescu, a former MSCA fellow from the previous IAT doctoral programme, INNOVATE, talked about how he progressed his career after his PhD.

June 2019

Professional skills training

ESRs were able to join the University of Nottingham Graduate School's annual professional skills week. Each year, ESRs accessed courses tailored to their PhD year, including Delivering Dynamic Presentations with Impact, Creative Problem Exploration and Continuing Professional Development for Doctoral Candidates. The week concluded with a Pecha Kucha competition which our ESRs Xipeng Lyu and Hery Mwenegoha won!

March 2017, 2018, 2019

ESR group and individual training activities

Aerospace sector training

Visits to industry- Meggitt Industrial Polymers and Airbus

ESRs have taken part in two industry visits. The first was to Meggitt Industrial Polymers where they learnt about aerospace braking systems. The second was to the Airbus factory in Chester where they learnt about aircraft wing assembly. On both visits ESRs were able to meet graduate engineers and learn about careers in industry.

January 2018, 2020

Farnborough and Paris air shows

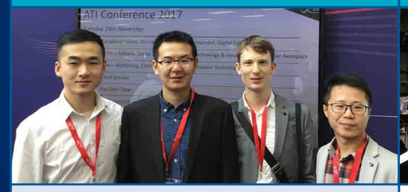
ESRs have visited Farnborough International Airshow and the Paris Airshow, enabling them to network with aerospace industries, see a wide variety of aircraft, both on the ground and in the sky, while also disseminating their own work.

July 2017, 2018, 2019

Royal Aeronautical Society lectures

ESRs have attended numerous Royal Aeronautical Society lectures throughout their time at University of Nottingham. Talks have included Teamwork and Striving for Excellence from the RAF Red Arrows and Dassault, a first century of aviation from Luc Berger, Dassault Aviation.

December 2017 – November 2019



Aerospace Technology Institute (ATI) annual conference

Many ESRs attended the ATI's inaugural conference at the NEC in Birmingham in 2017. Speakers included Paul Eremenko, Chief Technology Officer at Airbus, Paul Stein, Chief Technology Officer at Rolls-Royce, Dr Jaiwon Shin, Associate Administrator for Aeronautics at NASA, and Stéphane Cueille, Head of R&T and Innovation at Safran.

Aerospace museum visits

The ESRs have visited numerous aerospace museums, including the Imperial War Museum in Cambridge and Aerospace Bristol. These trips have enabled them to learn about the history of flight, to reflect on technological advances and also to build bonds across the team.

Transport Technologies Showcase

This event brought together transport experts from academia, industry and supporting organisations such as the Transport Systems Catapult to discuss hot topics in transport technologies across a range of disciplines and transport sectors. Again, this was a great networking opportunity for ESRs.

Outreach and dissemination

Institute for Aerospace (IAT) showcase

The IAT holds a biannual event where industry and academia come together to discuss technical progress across the sector. At these events, the INNOVATIVE programme is showcased and ESRs are able to network and disseminate their individual work.

November 2016, 2018

Wonder event

Wonder is a University of Nottingham public engagement event that invites the local community to learn about the research conducted across its campuses. The INNOVATIVE team joined forces with the IAT and ran events and fun activities for children and adults, opening up conversations about aerospace and aerospace research.

June 2017, 2019

Farnborough and Paris air shows

The IAT works to disseminate aerospace research from across the University of Nottingham at these international air shows. As part of this, INNOVATIVE team members have been able to showcase their research work to the public and private sector over numerous days at each event.

July 2017, 2018, 2019

IAT winter expo

The INNOVATIVE team disseminated their work at another IAT-led event – the winter expo in Nottingham. At this public event, industry and academic staff joined us to learn more about the INNOVATIVE programme. ESRs were able to engage the audience using physical examples of their work to bring their research challenges to life.

November 2017

University of Nottingham open days

ESRs supported numerous open days where potential undergraduate and postgraduate students came to find out more about the University of Nottingham. ESRs were able to talk about their experiences of undertaking a PhD at Nottingham and what it's like to live in the city and local area.

June 2018

INNOVATIVE virtual end-of-project conference

Our final large-scale dissemination event, this two-day virtual conference brought all 23 ESRs together. They delivered 23 short technical presentations, had an inciteful live Q&A and four brilliant panel sessions, reflecting on their experiences on the INNOVATIVE MSCA programme.

To find out more, visit:
nottingham.ac.uk/aerospace/projects

December 2020

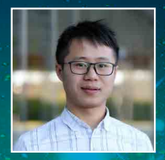
Success stories from industry secondments

“**Cosimo Spagnolo** has strong expertise in control strategies to optimise power consumption on board aircraft, which is one of our research interests here at Aeromechs. Having Cosimo in our team allowed us to boost collaborative work with the University of Nottingham on a joint EU-funded Clean Sky 2 research project called ESTEEM. During his stay here in Naples, Cosimo interacted on a daily basis with our R&D team, allowing the exchange of scientific know-how, and he was able to receive training in technical activities like microcontroller programming and testing.”

Dr Beniamino Guida
CEO
Aeromechs Italy

“**Xipeng Lyu’s** work on flow simulation using a meshless method (SPH) is of interest to us at Rolls-Royce. Hosting Xipeng meant we were able to share with him some industrial problems that needed innovative solutions. Xipeng was familiar with the SPH simulation of multi-phase flows (on different applications) so a rapid generation of results of what can be done with SPH was of great value.”

Dr Shahrokh Shahpar
Rolls-Royce Fellow in Aerothermal Design Systems
Innovation Hub-Future Methods
Rolls-Royce UK

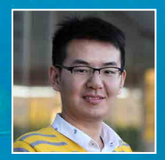


“**Shaohong Zhu** and his experience in the electromagnetic design of electrical machines helped us discover and implement new and novel methods of electrical machine parametrisation. He also created a link between electromagnetic design and the thermal design of our current development prototypes.”

Krzysztof Paciura
Power Electronics & Electrical Machines Leader
Cummins Corporate R&T UK

“When we realised that **Angel Recalde** was conducting research in power distribution for the Institute for Aerospace Technology at the University of Nottingham we thought of initiating international cooperation and starting a mutual collaboration for the development of new solutions in electrical engineering.”

Julio C. Cárdenas Landín
CEO
INDUELECTRIC Ecuador



“**Dongdong Xu** was provided with full access to our research infrastructure at Seco Tools where he was able to use the machining research facilities and associated equipment to conduct experiments for his PhD project.”

Dr. Rachid Msaoubi
R&D Expert Cutting Technology
Seco Tools AB Sweden

“Hosting **Francesco Zangrossi** enabled us to explore new and novel anti-icing technologies and understand their potential as well as the challenges for scaling up for production.”

Dr Peter Karapapas, PhD CEng MRAeS
Principal Engineer Composites
Meggitt UK

“**Mohammad Tanvir Chowdhury** proved to be a valuable member of the Composite Moulding team, supporting a number of high-profile projects. One of the projects Tanvir worked on received praise from the customer on how well the team dealt with some of the challenges faced throughout the project.”

Mindaugas Max Sasnauskas
Engineering Capability Lead
National Composites Centre UK

Success stories from industry secondments

"In Cummins generally, but in my department particularly, we are always happy to support bright and eager-to-learn individuals who question the current status quo and always try to improve. We take this phase very seriously and ensure that passionate people have the right environment to open their minds, and possess the right tools and training to channel the passion in the right direction. Such an individual can potentially lead our company in the future."

Krzysztof Paciura
Power Electronics and Electrical Machines Leader
Cummins Corporate R&T UK

"One of NCC's missions is to stimulate growth of the UK manufacturing sector by developing and upskilling the future generation of engineers."

Mindaugas Max Sasnauskas
Engineering Capability Lead
National Composites Centre UK

"After learning about INNOVATIVE, we definitely wanted to support cutting-edge research and provide resources as best as we could."

Julio C Cárdenas Landín
CEO
INDUELECTRIC Ecuador

"Hosting an ESR at Rolls-Royce meant we were able to share with him some industrial problems that needed innovative solutions."

Dr Shahrokh Shahpar
Rolls-Royce Fellow in Aerothermal Design Systems
Innovation Hub-Future Methods
Rolls-Royce UK

"It was important for our small team to establish cooperative work with an important institution like the University of Nottingham, opening our company to internationalisation and cooperation with foreign entities."

Dr Beniamino Guida
CEO
Aeromechs Italy

"Hosting an ESR benefited our business as he brought an insight into how nanotechnology and nanomaterials could help improve our current de-icing and anti-icing products and make them not only more competitive but also greener."

Dr Peter Karapapas PhD CEng MRAeS
Principal Engineer Composites
Meggitt UK

Programme management team

Professor Serhiy Bozhko

INNOVATIVE Coordinator

Director, Institute for Aerospace Technology

Professor of Aircraft Electrical Power Systems

Dr Tao Yang

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