| **Institution:** |
| University of Gloucestershire |
| **Unit of Assessment:** |
| 12 (General Engineering) |
| **1. Unit context and structure, research and impact strategy** |

The UoA12 Engineering academic community is based in the School of Computing and Engineering based at the Park campus, Cheltenham, in a recently refurbished facility, and at the C11 facility at Berkeley, Gloucestershire. The academic community has developed an international reputation for high quality research in the areas of (1) Cybersecurity and Digital Innovation (body physiological signal inspired theory and application) and (2) Engineering Technologies with smart business information systems (e-busines technology, system and big data and data mining theory and application). The Unit is based within the School of Computing and Engineering which undertakes pure, applied and impactful researches through the active engagement with a wide variety of local, national and international academic and business partners in the UK, Europe, China, Malaysia, Brazil and Japan.

Our approach is to embed and develop a robust, multi-disciplinary applied research agenda built upon UK and international funding, and to apply the researches outputs to the businesses with focus on meaningful impacting on business performance, human health, sustainability, transformation, co-innovation and resilience from the two subject groups within the School of Computing and Engineering.

Our research objectives are:
1. Through national and international collaboration to create an intellectually stimulating diverse research environment that sustains a supportive research culture.
2. To develop the quality, volume and breadth of research capacity and capability, including knowledge exchange in (1) Cybersecurity and Digital Innovation and (2) Engineering Technologies (Bionics for Health Enhancement and Smart Industrial Systems).
3. To support staff development in achieving their career aspirations through embedding interdisciplinary research into the teaching and learning strategy aimed at enhancing the student learning experience.

Our research portfolio has consolidated through volume growth, funding stream value and topic diversity. Our PGR numbers and completions are rising from less than 10 in 2014 to more than 34 in 2020 as we build upon close collaborations with international partners such as The Key Laboratory of Bionics Engineering, Jilin University, China and industrial alliances in Germany. We continue to expand and strengthen our research community reach and stakeholder network , aided by an active social media presence, a range of online and published outputs and regular engagement with local businesses, particularly SMEs through the University of Gloucestershire Growth Hub.

The University's Research Priority Area for the School of Computing and Engineering is Applied Business & Technology, with staff line management responsibility for School research activity undertaken by two Academic Subject Leaders (ASLs), one female and one male. Co-ordination with Academic Subject Leads is also key to implementing the School's research strategy within its wider plan for teaching and learning and staff development. The Research Degrees Committee, on which the School Postgraduate Lead, and research degree course leaders, and the UoA12 Co-ordinator (**Zhang**) attend, has responsibility for postgraduate research governance and reporting and the management of approximately 34 PhD and 5 DBA doctoral

students. Research is promoted to the University's internal and external stakeholders through the Research Repository. This mechanism also facilitates greater awareness and transparency of the increasing number of research outputs and activity produced in the School. **Zhang** and **Chizari** are an integral part of the Research Priority Group and **Zhang** as UoA12 Coordinator reports on a three-monthly basis to the University Research Committee.

The 2013-2020 period has been one of significant growth and development for UoA12. Our research portfolio has featured a suite of Technology Strategic Boards and InnovativeUK funded technology transfer research projects based on five key themes:

- **Medical implant device Cybersecurity -** Generating strong cryptographic keys from physiological body signals to secure smart medical implant communications. (Projects: InnovativeUK; lead by **Chizari**)
- **Smart integrated information system for enhancing business performance** - Researching, designing and developing smart algorithms and information systems for local businesses (Projects: TSB and industrial projects; lead by **Zhang**).
- **Cybersecurity policy** – Yielding a model for Public Private Partnerships to support cybersecurity capacity building in the developing world. Research commissioned by the Foreign and Commonwealth Office and the Bank of England to inform policy amongst the UK's international partners (Projects: FCO and the Bank of England; lead by **Bechkoum**).
- **Human health enhancement**- Researching, designing and developing innovative systems to generate bio-electromagnetic signals for enhancing human and animal health by mimicking the Earth's natural magnetic fields, the frequencies, strengths and waveforms of body organs and cellular pulsations, working with UK businesses and international academic and business partners. (Projects: International collaboration on new bio-health enhancement systems and their applications; lead by **Zhang** and **Bechkoum**).
- **Developing a security system on chip for IoT devices -** ensuring a trusted environment with highly secured communication channels, lightweight algorithms, high processing speed, and low power consumption by implementing cryptographic algorithms as a promising solution for greater IoT security (Projects: PhD studentships lead by **Bechkoum**).

We have also continued and extended our work in developing practical technological solutions for various local businesses to successfully support competitive advantage.

**Typical examples of this work:**
- Contributing to the Mechanics Analysis of Over-Constraint Linear Track Industrial Robot Mobile Platform and integrated e-business systems with smart functions for innovative marketing and sales to enhance local companies' business performances (**Zhang, Sayers**)
- Contributing to the geometrical feature analysis of large scanned data using reverse engineering technology for architecture designers and landscape planners. (**Zhang, Win**)
- Contributing to the modelling, analysis and simulation of banking note circulation processes in England (**Zhang, Bechkoum**)
- Contributing to the 3D modelling, and thermal analysis of micro-porous copper to product composition and production optimisation for the electronic industry. (**Zhang, Ikram**)

**Bechkoum** has led a key UK Government research related to cybersecurity and cyber resilience from our Cybersecurity and Digital Innovation Centre (CDIC), C11. C11 is a (£3m) government sponsored centre offering a secure environment for Gloucestershire's cyber community to work, innovate, learn and network. Subsequently CDIC has contributed to the UK National Cyber Security Strategy, the Institute of Coding and more recently in the Cheltenham Cyber Park development in collaboration with the universities of Bristol, Cardiff and Bath as part of £40.8m "Strength in Places" project. The Unit's primary contribution is setting up of a Research and Knowledge Exchange facility at the Cheltenham's Cyber Central UK and working closely with the National Cyber Security Centre, the National Cyber Innovation Centre and a number of large and small security firms.

In addition, UoA12 has active national and international collaboration including research in (1) bionics engineering in China, **Zhang**, **Li**, **Sayers;** (2) smart software in Brazil, **Thiago;** (3) an intelligent wireless endoscopy capsule (iWEC - France, Cyprus and Portugal), **Thiago;** (4) time series analysis in cybersecurity (Malaysia) **Chizari**, **Sayers**, **Ali Mirza;** (5) visiting fellowships developed by **Zhang** with Professor Donghui Chen from Key Laboratory of Bionics Engineering, Jilin University, China; (6) workshops (Bio-electromagnetic signals for health enhancement, 2018, China) **Zhang**, **Bechkoum**, **Chizari**, **Sayers;** and (7) the physiological body signals to secure smart medical implant communications (Imperial College, London) C**hizari**, **Sayers**, **Zhang)**.

UoA12 has doubled in size since 2014 to include 9.5 research staff, more than 48 post-graduate research students (14 PhD completion, 34 existing PhD) and a small support team. Externally-funding income and teaching-informed research has grown from about £100k to £487k in the REF period.

In parallel, UoA12 has been able to invest in staff during the REF period, and since 2013 has recruited nine active researchers (**Bechkoum, Chizari, Win, Ikram, Ali Mirza, Thiago, Sayers, Al Seyab, and Gorine**). Since July 2020 **Li and Abadi** have also joined the School of Computing and Engineering as part of the continued expansion of the School. The academic staff have specific skills and expertise in the areas of artificial intelligence, data science, cybersecurity, electronics and smart sensor based industrial control. This opened more opportunities to develop new techniques and approaches to address complex issues and challenges in the transformative development of businesses, community and society. With the expansion of both research and teaching capacity, we have been fortunate to recruit some younger individuals to the new posts created since 2014, and to retain them through staff development initiatives, including internal research funding and promotion.

In respect of our communications and outreach activities, UoA12 has maintained an active and open access policy to all research work completed in the period. The research outputs and achievements are published on dedicated websites (such as https://www.glos.ac.uk/business-and-partnerships/c11-cyber-security/pages/default.aspx, and https://www.glos.ac.uk/research/research-priority-areas/pages/default.aspx) or disseminated through the Growth Hub newsletters and business events. In addition, the research achievements in the bionics engineering are reported in the e-newsletters regularly published by the International Society of Bionics Engineering, with worldwide reach.

Building on the achievements of this REF period UoA12 aspires to make a substantive science engineering business social contribution within the two main subject areas of Cybersecurity and Digital Innovation, and Engineering Technologies (Bionics for Health Enhancement and Smart Industrial Systems). The forward research strategy aims to:

1) enhance and expand our current portfolio of research themes, increasingly working at a systemic level and embracing a wider connection between business, people, societies, economies and healthy ecosystems.
2) strengthen the trans-continental aspects of our work, linking with researchers in Asia and Africa, to ensure that global impacts are achieved, especially in the areas of worldwide human health enhancement and UK to Africa technological transfer.
3) accelerate the scope and pace of transformational change (especially after Brexit) within the UK, co-creating and distilling key science and engineering knowledge and practical experiences to help businesses, communities and society adopting smart technologies to achieve business advantages.

Within the next REF period, the research activities will be focused on implementing our forward research strategy by

1) specific research initiatives that build upon our core and emerging capabilities in the areas of applied computing and engineering in new ways that are particularly focused on

applying our knowledge transfer models to build a wide ecosystems consisting of businesses, people, communities to extend the research impact through UK government and industrial technology transfer projects.

2)  international and multi-disciplinary collaboration with Imperial College in the UK, Jilin University in China, EU and Africa universities and businesses, to engage in a suite of new work to employ the developed theories, engineering and computing technologies and methods to research, design and develop a set of health enhancement devices with proved performances and at low cost, suitable to ordinary people in both developed and developing countries.

3)  collaboration with UK academics and international businesses in the medical implant device industry to continue and expand existing research work on body physiological signal use to generate strong random numbers for medical implant device cybersecurity.

4)  collaboration with UK universities (Bristol, Cardiff, Newcastle and Bath), the NCSC and businesses to conduct research related to cybersecurity, cyber resilience, and the security threats inherent to blockchain, including the work that is currently based at the C11 Digital Innovation Centre and the role that the UoA12 plays in the development of the Cheltenham's Cyber Central UK to support the formation and growth of businesses, with smart technologies and integrated support services and enterprise facilities at the Cheltenham Cyber Park.

## 2. People

The UoA12 has a strong collegiate atmosphere and sense of shared purpose and achievement, which has evolved over the past decade through the close internal teamwork and external collaboration. The staffing strategy in the School of Computing and Engineering has developed from our research aspirations and delivery of multi-disciplinary research projects, reflecting a mix of experienced and new research staff with a broad range of applied computing and engineering expertise and competences. The School academic subject groups are shown in the organogram in Figure 1 and comprise a diverse academic community with an inclusive culture that includes 6 female and 15 male staff.

The collegiate atmosphere has been further strengthened under the new School administration for the last 5 years based at the Park campus in Cheltenham and at Berkeley. Research students and academic staff work in a shared open plan office space with a dedicated meeting room and on-line meeting space. Further investment in 2018 for a new dedicated engineering laboratory underpinned the university's support for the UoA12 subject community.

UoA12 currently has two groups of staff with defined management roles and responsibilities. There are (1) line managers for each group who oversees staff development and review,(2) a Management Group (7 members), which supports the Head of School in strategic management of the UoA12 including successful delivery of its annual Business Plan and the review of long term development plan, (3) a Communication group (3 staff) which manages our social media, news releases, research output records and promotional aspects of our research for achieving the best possible impact, (4) a smaller team overseeing our internationalisation strategy, our teaching input and teaching excellence framework (TEF) and *continuing professional development* (CPD) for the academic staff and our ethics and sustainability agenda. Each group combines experienced and earlier researcher staff and is gender and cultural background diverse with 13 people from the BAME+ groups.
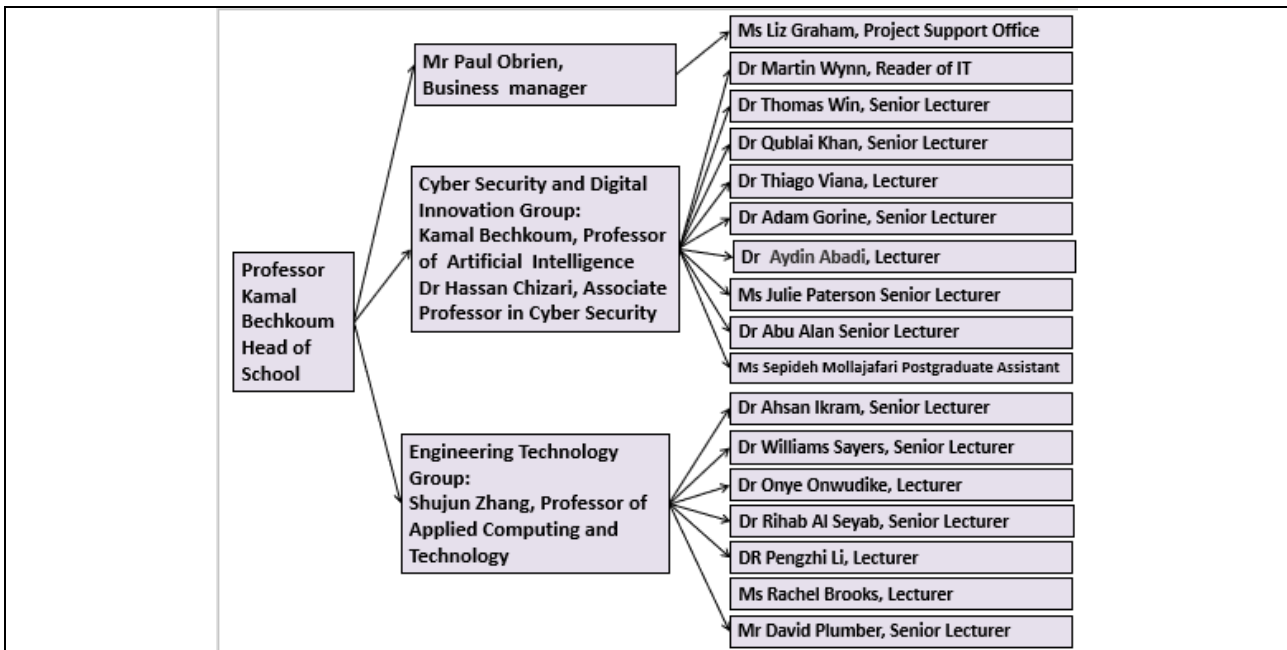
Figure 1 UoA12 Organogram

As a result of careful succession planning, the demographic profile of the UoA12 in 2020 is more balanced in terms of age, gender, ethnic background, and experience than it was at the start of the period. Job adverts are checked for gendered language and where necessary revised to appeal to a broader audience. More recently the University has advertised in the Black History Magazine and placed all jobs on its associated jobs board. New academic starters complete the on-line equality and diversity e-learning module and staff also complete the iHasco module on Unconscious Bias. There is also a mix of full- and part-time staff and those on short term contracts, all can follow identical career pathways and have access to the same support and staff planning mechanisms. The diverse staffing base is supported through a combination of devolved and inclusive management, flexible and remote working practices and welcoming physical office and social space in pursue-built accommodation at both Park, Cheltenham and Berkeley campuses.

The UoA12 subject community maintains a lively and inquiring research culture, holding a regular bi-monthly research seminar series by either internal staff to share their research achievements and new ideas or the invited external speakers, in addition to several writing retreats providing a focal point for REF research output publications. The School's annual awayday enable strategic and policy learning and reflection. The School also hosts an annual research-student colloquium, offering a platform between students and supervision teams to discuss and exchange ideas.

For all School PGR students, supervision involves teams of at least 2 academics, usually drawn from within, and sometimes, beyond the School of Computing and Engineering. The University provides initial training and ongoing CPD for supervisors, to ensure they provide appropriate and effective support in this role. PGR students benefit from access to every aspect of UoA12 research activities including the bi-monthly research seminars, School's PGR colloquiums and writing retreats. For the School's early-career researchers, the University's early career researchers' network (ECRN) offers a forum to meet and share skills- with more experienced research staff: UoA12 also contributes to the ECRN's training, mentoring and coaching elements.

In addition to seeking gender diversity among employees, the School monitors gender aspects of promotion, recruitment and selection processes. The School has a relatively high (about 70%) BAME+ representation at all levels compared to that in the national population.

**STAFFING STRATEGY and STAFF DEVELOPMENT**
As mentioned above, UoA12 uses the line research management system to provide appropriate support for all staff pursuing a career in research; each mentor of less experienced research staff is an experienced researcher with a strong track record in their field.

The School benefits from an annual bidding process from the allocation of university Quality Research funds, which has amounted to approximately £27.5k annually for UoA12. Research leadership group overseas the management of the budget which includes support for widening staff participation in quality research activities, conference attendance, specialised equipment purchases and academic staff development. There is also support from the School's central budget or from ongoing research projects sponsored by our range of funders and partners. During the current period, 5 international visiting scholars have been sponsored from external sponsors to chair international conference sessions or delivering keynote speeches.

During this assessment period, the School has recruited 17 staff in grades ranging from research assistant to senior researchers. 6 of these posts (4 KTP associates and 3 postgraduate research assistants) began as task-defined roles, linked to specific multi-annual projects. To date, one of the fixed-term appointments has been made permanent, reflecting the individuals' significant contribution to the UoA12 and the University. Within UoA12, there have been one professorship appointment, one professorship promotion, one readership appointment and one associate professorship promotion in the period.

For positions that require regular attendance at group meetings, time is allocated within School staff workload and business planning processes. As explained in Section 1, our approach to inclusive and engaged research, combined with the nature of our externally funded project work, ensures that much of our work has impact.

**SUPPORT and TRAINING FOR RESEARCH STUDENTS**
7 PhD studentships secured during the period include collaborative industrial funds (e.g. Unielectronics Ltd and McCarthy Taylor Systems Ltd), KTP associate development funds and the University's own research studentships. All recruitment is via national and EU-advertised open competitions. We face few significant challenges in recruiting high-calibre PhD students to funded positions – demand is strong, and we always have more excellent applicants than we can fund. The School has also strategic partnerships with German industrial and University federations (Institut für Hochschulkooperation und internationale Promotionsprogramme (IHP) - Institute for University Cooperation and International Doctoral Programs (IHP) and Fachhochschule des Mittelstands-the 'University of Applied Sciences for SMEs'). Each year, more than five doctorial level projects from the federations are regularly undertaken and supervised within the School.

UoA12 PGR students are well supported by supervisory teams and we have a strong completions rate. From January 2014, UoA12 had 48 new doctoral enrolments and 14 (with 10 Doctoral Degree Completion for REF 2021) completions. There are currently 34 PhD.

Research students in UoA12 are regularly provided with the opportunity to contribute to our externally-funded research portfolio during their time with us and to ensure that all are encouraged to present papers at relevant academic conferences (notably IEEE, IMechE and IET etc), with funding support provided under the terms of the studentships, in line with University policy. Those with collaborative industrial studentships have the opportunity to gain work experience with their co-sponsoring partner organisations. School also organise bimonthly research seminars in last five years. All PGR students are invited, which provides the students the efficient platform to be actively in school's active and funded research projects.

**EVIDENCE OF SUPPORT FOR EQUALITY AND DIVERSITY**
The School of Computing and Engineering has adopted the Researcher Development Concordat that aims to provide an appropriate environment and culture, employment conditions and professional and career development. The promotion of equality and diversity is an intrinsic value of the School's culture and addressing issues of race, sexuality and gender have long been fundamental to our research and teaching culture. This is evident in diversity of staff returned – for instance in terms of gender, race, age, but also in relation to those on full- and fractional contracts and the balance of established and early career researchers. Personal pastoral support is part of the PGR supervisory role where staff routinely address equality and diversity issues that are often associated with mental and emotional health, particularly in dealing with the challenges of combining work, study and research. In these and other areas where issues of equality and diversity affect student well-being, staff work closely with the Senior Tutor and the University's disability, dyslexia and learning support service to offer confidential, one-to-one support to prospective and current students with disabilities, autism, learning difficulties and medical conditions.

The School has a culture of supporting flexible and/or remote working by research staff and students. With a commitment to high levels of trust between project managers and their research teams, research staff can work at home at least one day a week and those involved in projects are supported for national and international travel to attend meetings. Our flexibility in this regard is evidenced by staff from different background with 16 active staff from BAME, about 80% total research active staff of the School. Work continues on understanding all cultures and knowledge systems, with respect to what is being taught and researched, and how this then frames the world of knowledge and interpretation. An example has been the development work within the ECR Network to ensure decolonisation is built into research considerations for ECR academics.

**Gender and Flexibility**
The University has Equality, Diversity and Inclusion (EDI) as a central theme in its corporate strategy. Recently, a dedicated department within the University organised two workshops, one aimed at the Academic Leadership Group (Head of Schools + the Executive Team) and the other included the whole senior management team of the University (ALG + Directors of Professional Services). The aim of the workshops is to review, discuss and agree a revised plan for embedding EDI throughout the University business. This includes curriculum design and delivery but also staffing and recruitment. For the latter, the School of Computing & Engineering scores highly in the percentage of BAME staff representation but, as with similar faculties in the sector, needs to do more to address the gender imbalance. Currently, only five out of 33 members of staff are female. We have appointed a female member of staff to lead on outreach activities encouraging a greater number of females to take up computing & Engineering careers

(working with local schools and colleges and with the NCSC's CyberFirst programme). Our recruitment processes are continuously reviewed to remove any "unintended bias" from the selection process. We proactively encourage female applicants to consider applying to any advertised posts.

**Disability**

We have a number of PhD students with disabilities that require a great deal of support and investment. In addition to additional staff time, specialist equipment (depending on disability), dedicated working environment at our C11 Cyber Centre, we had to flex some of our regulations (e.g. word limits) to cater for specific disabilities.

Dyslexia is the main disability we manage but in the case of one particular student, who suffers from long term neuropsychiatric problems and displays evidence of obsessional and concrete thinking, extra care and additional support was provided by his supervisor, University regulations on word limit had to be flexed and specialist kit was acquired. Currently, we have no staff with a disability that require adjustment other than the standard "home kit" that some staff with specific long-term illnesses require to work remotely from home.

The member of the UoA12 Management Group with responsibility for internal staff morale and welfare provides an alternative and additional point of support for all staff in addition to their line manager and the dedicated HR 'business partner' to the School. All line managers are made fully aware of the wider wellbeing support provided to employees and students across the University including counselling, coaching, mindfulness training and dispute resolution.

**3. Income, infrastructure and facilities**

As part of its research strategy, since REF2014, the UoA12 subject community has developed its research income substantially. There has seen a marked increase in research bid applications with a particular focus on InnovativeUK and TSB (Technology Strategy Boards) funded projects. During this REF period, as a small but dynamic research unit, UoA12 has undertaken about 20 funded projects with the research income of about £500k, a considerable increase on the total income secured from the previous REF period. Besides, School is also active in providing consultancy to industrial partners (about £300k). Current income sources are: UK Gov / other 65% (including UK government departments, agencies and NGOs, and other national governments); industrial funding 35% (including Bank of England Cyber Security fund, funds from local businesses and organisations).

Our international project portfolio has been developing from our growing reputation, secured via high-profile publications and active engagement in conferences sponsored by the conference organisers. While Brexit has had an impact, efforts have been made to secure national and international collaborations to attract research funding (such as InnovativeUK fund with Imperial College, UK, £127k, International Collaboration Funds with Jilin University, China, 12 international lead journal outputs and with Tokyo University in Japan, developing international partnership). Such research funding is awarded on a competitive basis between a wide range of academic and management consultancy/independent research groups.

**Infrastructure and Facilities**

The School of Computing and Engineering has a dedicated building and laboratory for both teaching and research in areas of applied computing and integrated engineering. The research facilities are based on two sites in UK and one site with an international partner, Key Laboratory of Bionics Engineering, the Chinese Ministry of Education, and Jilin University, China. Total floor area of the three sites is more than 120k square feet.

The School has equipment to carry out pure and applied research in computing and engineering related areas. There are high-performance computing facilities, mechanical and electronic system test rigs based at the Park campus, Cheltenham for applied computing related (cybersecurity and digital innovation) and smart electronic system R&D activities. Further, C11 based at Berkeley, Gloucestershire undertook a £3m renovation and is a UK government sponsored centre offering a secure environment for the cyber community of Gloucestershire to undertake research and other activities.

Since REF2014, as a core part of the University's research strategy the Research Priority Areas (RPAs) are used as a mechanism for supporting funding for research including for infrastructure and facilities through an annual bidding process. UoA12 is part of the Applied Business & Technology RPA, where University funding has been instrumental with engaging staff in developing research capacity and capability, and generating research income. It has resulted in the funding of dedicated equipment for research use, such as specialist computing equipment, dedicated data analysis support for use across the academic subject areas and international conference attendance to develop research outputs and engage in network development.

The international research collaboration between the School of Computing and Engineering, the University of Gloucestershire and Key Laboratory of Bionics Engineering, Jilin University, China has existed for about 20 years. This key laboratory at Jilin University is the world largest bionics engineering laboratory with more than 10k square meters floor area, housing £10 million value of equipment for a wide variety of bionics engineering research. This collaboration enabled us to produce high quality outputs and gave us access to equipment in multi-disciplinary science and engineering projects. This has been important for long-term collaboration of body physiological signal inspired research projects for health enhancements and medical implant device cybersecurity.

## 4. Collaboration and contribution to the research base, economy and society

UoA12 research staff work in close collaboration with a strong network of research partners world-wide which has been developed further during the REF period. Strong collaborative networks have been developed with a number of key organisations including Key Laboratory of Bionics Engineering, Medical School, Jilin University China, Imperial College, UK, Tokyo University, Japan, the Federal Institute of Pernambuco - Brazil and Royal Bank of Canada, Toronto, Canada, Sorbonne Université, France, Universidade de Coimbra, Portugal and University of Cyprus. The results include joint project work, visiting fellowship exchanges, joint publishing and co-hosted conferences and international society professional activities, meetings and seminars. Further engagement includes PGR examining and research project scrutiny / peer review, as well as guest lecturing.

Rather than conventional secondment, we have staff from our international collaborators elected as representatives and office-holders China, Africa and EU. This includes (1) Tang Auqing Visiting Professor and Senior Advisory Board Member of Key Laboratory of Bionics Engineering,

Education of Ministry, Jilin University, China, Fellow and UK Country Representative of International Society of Bionics Engineering, (2)Chair of the Programme Committee and Founding Member of the "China-Europe International Symposium on Software Engineering", (3) Chair and Member of the Programme Committees of the "Algeria-UK Symposium on Intelligent Software in Natural life", (4)Advisory Board Member for SC-Media UK, and (5) Gloucestershire Commissioner for Cyber Security and Innovation

The School has also extended successfully in research base with a considerable number of local and international businesses through the knowledge transfer partnerships. The industries are from the manufacturing (Total Metal Products Ltd **Zhang and Sayers**, SKF Aeroengine Bearings Ltd **Wynn and Zhang**, Westley Plastics Ltd), **Zhang and Wynn**; advanced materials (Versarien Ltd, **Zhang and Win)**, health G(Gloucestershire NHS, BodyCap and AJM Med-i-Cap Limited **Hapeshi and Liewe**), transportation (Beaumont Travel Ltd and Protrack Ltd, **Zhang and Wynn)**, Software (McCarthy System Ltd, **Zhang and Bechkoum,** AuraQ Ltd **Zhang and Wynn** and 7 Layer Solutions, **Zhang and Bechkoum**), Advanced technology (Sounding Good Ltd, **Zhang and Al Seyab**), trading (Unielectronics Ltd, G&Z Trading Ltd **Zhang and Chizari**), Training (Enterprise Study Ltd, **Sayers and Zhang**), Service (Tiger Ltd, **Sayers and Zhang**). The collaborations result in impact for the local economy, engagement with business community, and the design and development of a business systems shown to greatly enhanced our partners' business performance.

**UoA12 Society contribution**
The School has a motivative and inspiring environments to encourage and supports all academic staff to be actively involved in professional activities from international society founding and operation, to industrial networks to journal publications.
**Zhang** is one of founding members and UK representative of the International Society of Bionics Engineering. His contribution has been awarded during 6th International Conference of Bionics Engineering, 2019. **Bechkoum** is an experienced senior leader and academic in Higher Education with an international background and an in-depth knowledge and understanding of the UK Higher Education sector. His research area includes the application of Artificial Intelligence and Machine Learning to Engineering Design, Cyber Security and Big Data Analytics. Examples of some of his PhD students' projects include "Advanced Persistent Threats" and "Security in Blockchain's Smart Contracts".

*Editorial board members:*
5 staff members are involved in 10 journal editorial work, either as the editorial members or as the special guest editors. The topic of the journals covers from engineering to applied computing, such as the International Journal of Robotics and Mechatronics, Journal of Bionics Engineering (Professor Shujun Zhang is the founding member), Sensors, Applied Science, Journal of Information Technology Management and Journal of Open Research Software.

*Regular journal reviewing:*
10 staff members have undertaken the regular reviewing work for 55 international rated academic journals in the area of applied computing and engineering. The examples include Journal of Bionics Engineering, the International Journal of Robotics and Mechatronics, Journal of Mechanical Engineering Science, Journal of Manufacturing and Management, Journal of Advanced Manufacturing Technology, IEEE Internet of Things Journal WOS, IEEE Transactions on Vehicular Technology WOS, Institute of Electrical and Electronics Engineers Inc. (IEEE),

IEEE Transactions on Systems, IEEE Transactions on Big Data and Future Generation Computer Systems.

**Public Duties**
4 academic staff service various committees, organise international conference, provide consultancy to governments and organisation. **Bechkoum** services 6 committees. He is (1) Chair of the Programme Committee and Founding Member of the "China-Europe International Symposium on Software Engineering", (2) Chair and Member of the Programme Committees of the "Algeria-UK Symposium on Intelligent Software in Natural life, (3) Member of the Technical Committee of the international conference on Computer Games: CGames, (4) Advisory Board Member for SC-Media UK, (5)Gloucestershire Commissioner for Cyber Security and Innovation and (6) Chair of Cyber Central UK Research & Innovation Stakeholders Group.

**Zhang** is (1) Founding fellow and UK representative of the International Society of Bionics Engineering, (2) Advisory Committee Member of Key Laboratory of Bionics Engineering, Ministry of Education, Jilin University, China, (3) The deputy chairman of the organising committee of the International Conference of Bionics Engineering 2006 and Session chairman for all 6 conferences during last 15 years, (4) The member of Scientific Committee of XI World Congress of Mechanisms and Machine Theory , (5) The senior consultant for DTI Southwest Regional Development Agency, and (6) The expert in the area of Information System and Technology for Regional and Urban Development Program of Sino-Europe Environmental Management Cooperation Program.

**Win** is Chairman – (1) Gloucestershire Branch of UK Computer Society and (2) Member of the Technical Committee of IEEE International Workshop on IoT Big Data and Blockchain (IoTBB'19), and IEEE International Workshop on Big Data Analytics for Cyber Intelligence and Defence (BDA4CID'18), Seattle, United States.
**Viana** is (1) Director role in the International Collegiate Programming Contest - South American Phase – 2012 and (2) Member of Judge Committee of the International Collegiate Programming Contest - South American Phase – 2009.

**Grants Committees, Selection Panels / peer reviewer for funded research**

**Zhang** has been the International Referee for China's highest funding organisation – National Natural Science Funding and **Rouhani** sits in the Grants Committee member (Iranian Innovation Centre).

**Other indicators of esteem:**

**Zhang** has been invited to give the keynotes to (1) 1st, 2nd, 3rd, 4th, 5th and 6th International Conferences of Bionics Engineering, (2) 2015 Research Seminars of Bionics Engineering, (3) Sustainable Development & Urban – Rural Integration Seminar of EMCP, Chengdu, China, (4) UK Manufacturing Research Conference, (5) UK Time Compressing Technology Conference and (6) International Conference of Process Engineering, IcoPE2000, Singapore.

**Bechkoum** has been invited to deliver a number of keynotes including (1) "The Centrality of Cyber Readiness". Cyber Security Summit, Algerian-British Business Council, Algiers, Algeria, (2) "IoT & Cyber Security: Tomorrow's Threats Today", Cyber Security Summit, London, UK, (3)

"Cyber Security in the Era of Internet of Things", Global Conference on Security, Bristol, UK, (4) "Cyber Readiness", National Security & Resilience Conference, London.

**Rouhani** has been invited to give the keynote for ICD business school seminars (France).