University of BRISTOL

Title: Automated analysis approaches for Structural Health Monitoring on aerospace primary structure with ultrasonic and electromagnetic sensor arrays

Type of award	PhD Research Studentship
Department	Mechanical Engineering
Scholarship	Minimum £15,609 p.a. (2021/22) plus an additional £5,000 p.a. from the industrial sponsor
Duration	4 years
Eligibility	Home/EU (UK settled status) with permanent UK residency
Start Date	October 2021

PhD Topic Background/Description

The aim of the project is to develop permanently installed sensors for monitoring structural hotspots. In this context a hotspot is a localised region of the structure that is thought to be a potential location for defect formation and growth. This project will explore approaches based on ultrasonic and eddy current arrays. The array would form images of a local region covering the hotspot. A key research aim is to ensure that these images are high resolution and that the coverage is as extensive as possible. The other key challenge is to design arrays that are low cost and reliable. Whilst the sensors will be permanently attached, the associated electronic instrumentation would be separate. Periodically the electronics would be connected to the sensors and readings taken. This could be via wired sensors of via electromagnetic coupling (i.e. near field communication).

Location and defects of interest: The initial focus will be on detecting and sizing defects initiating from bolt-holes in multi-layered aircraft wing skins. Hence, the hotspot is the region around the bolt hole. The failure mechanism of particular interest here is through a combination of corrosion and cracking and so both must be detected. Clearly the earlier in the defects-growth cycles the defects can be detected the better. Once detected, it is also useful to track their growth as a function of time.

Data fusion: Given that two sensing modalities will be explored, there is clear scope for data fusion to enhance detection and characterisation of damage. The question here is what sensitivity do the two modalities have to the defects of interest? This will enable us to understand the value of any data fusion.

Thin layer concepts: Ultrasonic systems can be externally or internally mounted, enabling them to image the interior of the structure. Eddy currents are confined by the skin effect to material surfaces and so must be embedded. Both sensor systems can be formed as thin layers and hence positioned between the wings skins. There is potential to make these layers very thin (<0.1mm) and soft, so they can be placed in between the plates at manufacture.

Connections: Wires, needed to operate the sensors, could be taken through an adapted bolt to facilitate external connection. An alternative would be to take the wires out via internal pathways between the plates. The potential for bolt-mounted eddy current devices will also be explored as will wireless concepts.

Starting point: The first year of the project would be to scope out the core concepts. Firstly, the use of low-cost surface-mounted ultrasonic and eddy-current sensor arrays. This would form a benchmark and a fall-back position as it is relatively low risk. Then the thin-layer sensor arrays would be explored. These are higher risk concepts, but potentially high impact and important to the aerospace industry (and many other industries). Based on this initial scoping and prototyping, the most viable concepts will be taken forward and explored in more depth in the remaining years.

Further Particulars

Candidate Requirements

Applicants must hold/achieve a minimum of a master's degree (or international equivalent) in a relevant discipline. Applicants without a Masters qualification may be considered on an exceptional basis, provided they hold a first-class undergraduate degree. Please note, acceptance will also depend on evidence of readiness to pursue a research degree.

Basic skills and knowledge required.

An enquiring and rigorous approach to research together with a strong intellect and disciplined work habits. Good team-working, observational and communication skills are essential.

Scholarship Details

Scholarship covers full PhD tuition fees and a **tax-free** stipend of a minimum £15,609 in 2021/22 plus an additional £5,000 p.a. from the industrial sponsor.

Open to UK students who have been ordinarily resident in the UK for at least 3 years prior to the start date of their programme. Also open to EU applicants who have no restrictions on how long they can stay in the UK and have been ordinarily resident in the UK for at least 3 years prior to the start of the studentship (with some further constraint regarding residence for education).

Candidates can check the eligibility criteria for the award at
https://www.epsrc.ac.uk/skills/students/help/eligibility/

Informal enquiries

For informal enquiries, please email Prof Bruce Drinkwater, B.Drinkwater@bristol.ac.uk or find-cdt@bristol.ac.uk

For general enquiries, please email came-pgr-admissions@bristol.ac.uk

Application Details

Prior to application Interested applicants should send an up-to-date CV to find-cdt@bristol.ac.uk.

To apply for this studentship, submit a PhD application using our online application system [www.bristol.ac.uk/pg-howtoapply]

Please ensure that in the Funding section you tick "I would like to be considered for a funding award from the **Mechanical Engineering** Department" and specify the title of the scholarship in the "other" box below with the name of the supervisor Prof Bruce Drinkwater.