

Title: Data Science for Improved Ultrasonic Measurement of Corrosion

<i>Type of award</i>	PhD Research Studentship
<i>Department</i>	Mechanical Engineering / Ultrasonics and NDT Group
<i>Scholarship</i>	Minimum £17,109 p.a. plus an additional £5,000 industry top-up subject to eligibility status and confirmation of award
<i>Duration</i>	4 years
<i>Eligibility</i>	Home (UK) and EU citizens who have confirmation of UK settlement or pre-settlement status under the EU Settlement Scheme.
<i>Start Date</i>	From Sept 2022

PhD Topic Background/Description

The annual global cost of corrosion was estimated to be USD2.5 trillion in 2013 or 3.4% of the world's total GDP [<http://impact.nace.org/economic-impact.aspx>]. Normal incidence Ultrasonic Testing (UT) is a widely used method of assessing remaining wall thickness in corroding components. This includes manual UT with gel-coupled probes, permanently installed UT sensors, and mechanically scanned immersion-coupled UT probes. Measuring absolute and relative wall thickness is important, as the latter is used to estimate the rate of corrosion. In a pristine component, the meaning of wall thickness is unambiguous, and the UT signal recorded by a properly aligned probe will contain readily identifiable ultrasonic echoes that enable wall thickness to be easily estimated. However, probe misalignment, surface debris, and corrosion all make it harder to interpret UT signals and accurately estimate wall thickness. Also, the meaning of wall thickness in the presence of corrosion is unclear: is it minimum, maximum, or mean thickness? and over what area?

The overall research hypothesis for this PhD project is that data science (including both advanced statistics and machine learning) can improve the accuracy of UT for corrosion measurement. Three types of application will be considered:

- (1) absolute thickness measurement from individual measurements, such as might be acquired through manual UT;
- (2) absolute and relative thickness measurement from permanently installed UT sensors considering individual measurements and collective measurements from a sensor over time;
- (3) absolute and relative thickness measurement from mechanically scanned UT sensors considering individual measurements, collective measurements from a scan, and collective scans over time.

In all cases, the methodology will be:

(1) to develop high-fidelity forward models of the UT measurement and validate against controlled experiments with known ground truth (e.g. obtained via laser profilometry);
(2) implement benchmark automated thickness measurement tools based on state-of-the-art classical methods (e.g. band-pass filtering, Hilbert envelope etc. pre-processing followed by arrival time estimation via peak finding, threshold crossing, Akaike Information Criterion etc.);
(3) train, test, and compare performance of machine-learning based solutions using Convolutional Neural Networks (CNNs) etc.

While technique development and training will be performed primarily using simulated data, testing will be performed on both simulated and experimental data.

Further Particulars

Candidate Requirements

Applicants must hold/achieve a minimum of a master's degree (or international equivalent) in a science, mathematics, or engineering discipline. Applicants without a master's 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.

If English is not your first language, you need to meet this profile level:

Profile E

Further information about [English language requirements and profile levels](#).

Scholarship Details

Minimum stipend of £17,109 p.a. plus an additional £5,000 industry top-up, will also cover tuition fees at the UK student rate. Funding is subject to eligibility status and confirmation of award.

To be treated as a home student, candidates must meet one of these criteria:

- be a UK national (meeting residency requirements)
- have settled status
- have pre-settled status (meeting residency requirements)
- have indefinite leave to remain or enter.

Informal enquiries

For informal enquiries, please email Prof Anthony Croxford, a.j.croxford@bristol.ac.uk

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

Application Details

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 Anthony Croxford.