BU STUDENTSHIPS 2023

PROJECT DESCRIPTION

PROJECT TITLE

I2AM-BirD: Innovative Integration of Advanced Materials for Bird-tracking tag antenna Design

PROJECT SUMMARY

A rare opportunity for a mechanical/materials graduate engineer to advance the study of wild birds at a thriving modern university and alongside an international market leader in the design and manufacture of bird tracking devices, in the lovely south coast county of Dorset.

This is an engineering PhD with an industrial partner and cross-disciplinary academic support. You will develop your own research project, working within a private company encompassing the disparate fields of wildlife biology and electronics/mechanical engineering, with access to first class academics and resources in Engineering and Life Sciences Departments at Bournemouth University.

Aims

The challenge of this PhD is to develop a novel tracking tag antenna using advanced materials, within environmental and welfare constraints of the application - a device attached to a free-living bird. Typically, external 'whip' antennas are used in bird tags, and they must be light-weight yet virtually unbreakable, able to survive extreme high and low temperatures, marine conditions, constant flexing and possible abuse from the bird. The new antenna design should be universal and scalable for use on birds from Wrens to Ostriches, and it must have minimal impact on the bird, whose welfare is paramount.

Existing bird tag antennas are primitive in their design and are typically made from multi-stranded steel cables covered with a heatshrink polymer. Nickel-Titanium (NiTi) wire (~0.2mm diameter), a super-elastic alloy, is used for antennas on smaller tags, but is not sufficiently robust to survive on larger birds, and thicker NiTi wire is too stiff and more prone to fatigue. This research opportunity is to develop bird tag antennas with the integration of advanced materials and manufacturing methods available to the research team at Bournemouth University. Potential avenues of research may include combining polymers to provide structure, with advanced materials such as NiTi, metamaterials or Graphene providing the necessary conductive element.

Although the radio-frequency (RF) electronics performance of an antenna is important to its function, the focus of this project is not antenna electronics. The aim is to optimise physical and mechanical properties of an antenna for a highly-specific and unusual application. The industrial partner (Lotek) will provide electronic/RF engineering support to ensure that any proposed novel antenna meets signal transmission requirements.

Facilities and guidance

The PhD candidate will be able to work at both partner locations – Lotek in Wareham or Bournemouth University. Initially it is expected that the student will be based mainly in Lotek.

Lotek will provide background information about the application, details of the requirements for a tag antenna and purpose-built test equipment for testing antenna designs. Lotek engineers and biologists will be keen to discuss practical ideas for antennas to meet electronic and bird welfare criteria. Lotek has manufacturing facilities for conventional tag antennas and could (depending on cost) tool-up for use of advanced materials.

At the Department of Design and Engineering at Bournemouth University, the I2AM-BirD project stands at the intersection of cutting-edge expertise and resources in advanced materials engineering. Our academics are dedicated to harnessing the power of innovation in materials to revolutionise bird-tracking tag antenna design. Drawing upon our comprehensive design and testing resources, we are committed to pushing the boundaries of what's possible. In collaboration with academics from the Department of Life and Environmental Sciences, we are ensuring that our advancements in bird-tracking technology have real-world impact and that we are bridging the gap between technological innovation and practical application. Their knowledge in avian research is invaluable, guiding us towards

creating devices that not only embody excellence in engineering but also seamlessly integrate into the intricacies of avian behaviour and ecology. Through this multidisciplinary collaboration, we are poised to shape a new era of bird-tracking technology that is both scientifically rigorous and technologically advanced.

ACADEMIC IMPACT

Although antenna design technology has seen considerable progress over the years, few advances have been made in antennas on devices for tracking living animals. This introduces many different and additional challenges than for more conventional antennas applications. For this reason, current design of bird tracking antennas still typically uses multistranded steel cable. The Department of Design and Engineering has been investing on advanced materials, advanced manufacturing and advanced mechanical testing labs, which integration will lead to the development of new bird tracking technology that responds to the challenges described in the project summary. The developed technology on its own will generate publications in peer-reviewed papers and international conferences on the fields of materials science and engineering. The testing phase will be used to track birds and outcomes from the research will be published in biology and ecology peer-reviewed journals and international conferences. It is likely that this will lead to generation of IP as well.

Since the company's formation in the early 1980s, Lotek has supplied many tens of thousands of tags for over 1,000 species. They export around 90% of their tags to research scientists, working in universities in over 130 countries all over the world. Their equipment is used by field zoologists, mainly in wildlife conservation research, and the development of the new technology will help researchers to get more reliable data. For example, one issue is making sure that the birds that are tagged are representative of the population as a whole as it may be more straightforward to catch some individuals than to catch others. This means that if a tag fails on those that are harder to catch (and probably more aggressive against the tag), then ensuring tags will not fail increases the chances of researchers to get more representative data on their populations.

SOCIETAL IMPACT

Besides species conservation and ecosystem preservation as mentioned in the project summary, migratory birds are a source of recreation for millions of bird watchers and enthusiasts who provide food and design backyard habitats to attract a variety of species throughout the year [1]. Bird tracking devices provide information that is vital for resource managers to plan conservation measures for migratory bird species into the future. Migratory birds can also bring threats to humans, for example by the dispersal of infectious diseases such as avian influenza [7]. Therefore, developing more reliable ways of tracking and understanding the movement patterns of birds is an important step in understanding the spread of disease and minimising its impacts.

PGR DEVELOPMENT OPPORTUNITIES

The PGR will receive mandatory training in Data Protection, Safeguarding and Cyber Security. The PGR will receive induction training at both Lotek and Bournemouth University. As well as the resources available through BU libraries, the student will have access to bibliographies and reports in Lotek, with key information relevant to this subject. Project milestones and planning will be supported by Dr Diogo Montalvão who has extensive supervisory experience. The PGR will be trained in the use of Advanced Manufacturing and Advanced Materials labs technologies by Dr Diogo Montalvão, Dr Amor Abdelkader and Ms Abigail Batley. The study will be designed by the PGR and supervised by Dr Diogo Montalvão (Lead supervisor, experimental testing and engineering), Professor Phil Sewell (integration of engineered systems with living beings), Dr Amor Abdelkader (advanced materials science) and Professor Richard Stillman (conservation ecology). The PGR will be encouraged to participate/network in faculty and BU research events to gain valuable experience in presenting their research to expert and non-expert audiences.

SUPERVISORY TEAM	
First Supervisor	Dr Diogo Montalvão

Additional Supervisors	Professor Phil Sewell, Dr Amor Abdelkader, Professor Richard Stillman
Recent publications by supervisors relevant to this project	Brown, S. and Stillman, R.A., 2021. Evidence-based conservation in a changing world: lessons from waterbird individual-based models. Ecosphere, 12 (7). Clarke, L.J., Hill, R.A., Ford, A., Herbert, R.J.H., Esteves, L.S. and Stillman, R.A., 2019. Using remote sensing to quantify fishing effort and predict shorebird conflicts in an intertidal fishery. Ecological Informatics, 50, 136-148. Min, X., Abdelkader, A. et al., 2019. A textile-based SnO2 ultra-flexible electrode for lithium-ion batteries. Energy Storage Materials, 16, 597-606. Qu, J., Zhang, K., Gamal, H., Wang, J. and Abdelkader, A.M., 2021. Triple-shell NiO hollow sphere for p-type dye-sensitized solar cell with superior light harvesting. Solar Energy, 216, 238-244. Afroj, S., Tan, S., Abdelkader, A.M., Novoselov, K.S. and Karim, N., 2020. Highly Conductive, Scalable, and Machine Washable Graphene-Based E-Textiles for Multifunctional Wearable Electronic Applications. Advanced Functional Materials, 30 (23). Noroozi, S., Ong, Z.C., Khoo, S.Y., Aslani, N. and Sewell, P., 2019. Dynamic characterisation of Össur Flex-Run prosthetic feet for a more informed prescription. Prosthetics and Orthotics International, 43 (1), 62-70. Aslani, N., Noroozi, S., Davenport, P., Hartley, R., Dupac, M. and Sewell, P., 2018. Development of a 3D workspace shoulder assessment tool incorporating electromyography and an inertial measurement unit—a preliminary study. Medical and Biological Engineering and Computing, 56 (6), 1003-1011. Akram, S., Babutskyi, A., Chrysanthou, A., Montalvão, D., Whiting, M.J. and Modi, O.P., 2021. Improvement of the wear resistance of EN8 steel by application of alternating magnetic field treatment. Wear, 484-485. Costa, P.R., Reis, L., Montalvão, D. and Freitas, M., 2021. A new method for ultrasonic fatigue testing of equibiaxial and pure shear cruciform specimens. International Journal of Fatigue, 152. Pereira, S., Carvalho, A., Reis, L., Freitas, M. and Montalvão, D., 2019. Characterisation and evaluation of the mechanical behaviour of endodontic-grade NiTi wires. Frattura ed Integrita Strutturale, 13 (49), 450-462.

INFORMAL ENQUIRIES
Please contact the lead supervisor on the following email for informal enquiries: dmontalvao@bournemouth.ac.uk
ELIGIBILITY CRITERIA
The BU PhD Studentships are open to UK, EU and International students. Candidates for a PhD Studentship should demonstrate outstanding qualities and be motivated to complete a PhD in 4 years and must demonstrate:

- outstanding academic potential as measured normally by either a 1st class honours degree (or equivalent Grade Point Average (GPA) or a Master's degree with distinction or equivalent
- an IELTS (Academic) score of 6.5 minimum (with a minimum 6.0 in each component, or equivalent) for candidates for whom English is not their first language and this must be evidenced at point of application.

ADDITIONAL ELIGIBILITY CRITERIA

In addition to satisfying minimum entry criteria, BU will look closely at the qualities, skills and background of each candidate and what they can bring to their chosen research project in order to ensure successful completion.

Applicants will be asked to submit an online application form and a proposal (c. 1500 words) outlining their understanding of the project for which they are applying, the approach they would envisage taking and what qualities they will bring to the research community.

Person Specification

You must be/have:

Good degree or equivalent in related discipline

Fascinated by materials engineering research and user experience.

Experience of research design and a sound understanding of and ability to apply appropriate research methodologies.

Expertise in relevant data analytical tools

An innovative and creative thinker.

Able to get on well with people with a range of different personalities.

Ability to prioritise and work to deadlines

Ideally, you should be:

Familiar with CAD/CAE, preferably in Solidworks/ANSYS

Ability to design and make simple electronic circuits

Ability to communicate well at all levels with external organisations

Interested in the natural world, especially birds.

During the PhD you will:

Develop in-depth knowledge of advanced materials.

Learn standard test methods, and develop new ones specific to this application.

Learn about the operation of an electronic equipment manufacturing company, from product engineering/design through manufacturing to the interface with customers.

Learn about life as an academic engineer involved in original research.

Empower your career potential by solving complex problems and making your mark on the World through interdisciplinary research.

Please note:

- Current BU Doctoral students are not eligible to apply for a Studentship
- Current MRes/MPhil students can apply, subject to satisfactory completion of their Research Degree prior to being able to take up the award

- PhD Studentships cannot be used to support BU staff to complete doctoral programmes

HOW TO APPLY

Please complete the online application form by **the date advertised.**

Further information on the application process can be found at: www.bournemouth.ac.uk/studentships