The Alan Turing Institute

National Oceanography Centre
ML Research Engineer

TINDSG-005

#machinelearning #datastudygroup

About the Organisation

We are the National Oceanography Centre (NOC) - the UK's centre of excellence for oceanographic sciences. We are a national research organisation, delivering integrated marine science and technology from the coast to the deep ocean, and are one of the top five institutions of its kind in the world. The NOC has entered a truly exciting time, moving to independent & charitable status as of 1 November 2019.

We are made up of a dynamic and vibrant community of staff covering a range of specialist fields, backgrounds, and experience. A community where each employee adopts a crucial role in furthering the aspirations, advancing the frontiers of science and knowledge through our excellent scientific research, knowledge sharing and contribution to the health of the oceans, with a focus in improving the world in which we live. Our work is balanced by our strong sense of purpose, values and behaviours and an unwavering commitment to a 'one NOC' approach.

Role Description and Responsibilities

Introduction

The project will be around the study of eddies in terms of detection, tracking, and modelling of their trajectories. Depending on the progress, the project can also be expanded into underwater gliders path planning.

The study of eddies plays a vital role for oceanographers in understanding and modelling the ocean. One area of study where a more accurate model of the ocean would contribute significantly towards, is in the understanding of the global ocean Meridional Overturning Circulation (MOC). The MOC is responsible for poleward heat transport, and deep storage of heat and carbon. Climate models generally predict that a slowdown of the MOC will occur this century, with dramatic regional and global climate changes.

Understanding, detecting, and tracking of eddies contribute not only to the oceanic sciences directly, but also to the environments of NOC's robots, such as gliders and autonomous underwater vehicles (AUVs), that are actively used for these scientific studies. Oceanographers who study eddies collect data by crossing them through with gliders to measure their temperature-salinity profile and other parameters which describe the behaviour, types, and properties of the eddies. For others, depending on the type of missions, glider pilots may want to avoid getting stuck in eddies, or use eddies to their advantage by diving with the current to significantly increase the endurance of the gliders for potentially up to multi-months and year-long missions. Path-planning of marine autonomous vehicles for environmental research could be significantly improved by determining the trajectory of eddies alongside detection and tracking.

TIN + DSG
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About the project

You, as an intern, will get to study and work with satellite and other remote sensing datasets, as well as operational, real-world robotics datasets that are extensively used in the marine science domains such as physical oceanography, marine biology, marine biogeochemistry, and climate research. There will be opportunity to get familiar with autonomous underwater vehicles, which are increasingly becoming an important line of development for critical strategies such as net zero, monitoring offshore windfarms, validation of forecast models, and climate change studies.

The use of machine learning and deep learning in eddy detection and tracking, and modelling the trajectory is a recent topic of research with high availability of open and free data, and with high potential for further contributions and novelties. The dataset(s) for the detection and tracking of eddies would include sea surface heights and/or sea level anomaly data, but other datasets are also available including global mesoscale eddy trajectory data, Argo floats data, as well as data from glider missions provided by us at National Oceanography Centre (NOC). Additionally, fusion of features generated from classical model-based techniques could be used to improve the tracking and modelling of eddies trajectories. Model validation can be done with the available historical and live or near real time data provided with these datasets.

Team and department

You will join our Command and Control (C2) team within the Marine and Autonomous Robotics Systems group (MARS). The team is currently made up of 8 people including software engineers and researchers. Our expertise ranges from the latest front-end technologies to AI algorithms, and we really value a diverse range of backgrounds and experience. The range of experience within the team allows us to be involved in a very broad portfolio of activities, from developing user-friendly UIs to designing abstract frameworks to enable the deployment of innovative AI systems to control un-crewed robots for oceanographic research.

The C2 team develops web-based systems to remotely control and interact with autonomous underwater and surface robots. Our systems control our robots that can be deployed anywhere in the world and facilitate the transfer and processing of scientific and engineering data in near real time. This data then contributes to different leading scientific programmes and international data centres, informing scientific endeavours from climate change studies to under ice exploration.

Internship project(s)

You will have access to and help improve the NOC's Machine Learning (ML) Framework which was developed to build and maintain an eco-system for sustainable and reproducible ML models. You will have easy access to live data through our open API ecosystem which allows for more effortless data exploratory work. Your contributions to the data streams can be easily integrated by feeding in additional features generated alongside the main remote sensing datasets during the research project. The project will also enhance NOC's Automated Piloting Framework (APF), which we have developed, by enabling eddies navigation algorithm for underwater gliders.

In terms of eddies detection and tracking, currently, scientists generally use probabilistic and model-based techniques. The data for a global mesoscale eddy trajectory are available widely for use with free and open access. Path planning for gliders, on the other hand, are mostly done manually. This is an exciting opportunity for you to contribute to a greater understanding of the ocean (with improved model of the ocean) and more accelerated scientific research

activities. These lead to the advancement of environmental oceanic studies of exploring the ocean, improve our ability in predicting the weather, the changing climate, as well as studying their impact on the economy, fishing industries, and humanity. Furthermore, a more cost-efficient scientific expeditions will also help in the Net Zero Strategy while leading explorations of innovative technologies for tackling climate change and its impact such as carbon capture technology, and development of modern strategies by studying the interconnected, chaotic, and dynamic oceans.

Expected Outcomes

Work on eddies detection, tracking, and modelling of the trajectories can be split into multiple deliverables such as the following:

1. Work with expert physical oceanographers to understand the current available datasets and methods of detection, tracking, and modelling the trajectory of eddies (i.e., probabilistic, and dynamic models).
2. Develop a baseline implementation either from widely used model-based techniques, current state-of-the-art machine learning solution for the problem, or both.
3. Study and perform data exploratory work with the available dataset(s).
4. Collaborate with scientists and engineers in developing solutions. This can be in the form of collaborative projects or running workshops.
5. Design, develop and prototype an eddies detection and tracking algorithm, providing their trajectories and other features of interest.
6. Write and publish research output to a journal or conference.
7. Publish results of features/targets of interest to the APF to enable a path planning for gliders for eddies navigation.

Work on studying and development on the detecting, tracking, and modelling of eddies would contribute to both the environmental science research, as well as directly to field research operations being done by scientists and engineers daily at NOC. The project can contribute significantly to an increased endurance of glider operations, as well as to mission and path planning by integrating the technology into our APF. A more accurate model of the ocean would also fundamentally improve our ability to pilot multiple gliders and AUVs simultaneously and run multiple missions concurrently.

The internship will be instrumental in the preparation of a Data Study Group challenge that will follow on and expand the intern's work with the organisation. The intern will have the opportunity to represent the organization during the Data Study Group.

Supervision and Mentorship

An intern working on this challenge would have the opportunity to work directly with and be advised by experts in the physical oceanography field, as well as robotics planning and control field.
There will be various opportunities for further collaborations, as the project involves both the environmental science and robotics aspects at the National Oceanography Centre.

Ideal Intern

The ideal candidate will:

- Have a good knowledge of machine learning algorithm development and research

- Ideally be knowledgeable in probabilistic modelling and reasoning and have experience of working with remote sensing datasets
- Having knowledge of robotic planning and dynamics is not a must but understanding of them would be beneficial
- Be passionate about learning new things, excited about working with leading researchers and collaborating in a multidisciplinary team
- Will value quality in the things that you do.

If you're interested in joining us, but don't tick every box above, we still encourage you to apply! We're building a diverse team whose skills, experiences, and background complement one another.

Internship Logistics

The internship will offer a minimum salary of £30,000 p/a pro rata.

Location: Southampton. The internship can also be done remotely with occasional site-visits for a tour around the site to meet the team and witness the development of a range of marine robotic systems, as well as for collaborative brainstorming and development sessions.

The internship start date is anticipated to be 1st September 2022, with a duration of 6 months and it will be full time, 37 hrs/week.

Contact details:

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The NOC is an equal opportunities employer and welcomes applications from all sections of the community. There is a guaranteed interview scheme for suitable candidates with a disability and we welcome applications from ethnic minorities currently under-represented. The NOC is an Investors in People organisation and has signed up to the Athena SWAN charter principles to take action to address gender equality.