**The RMS Beginners' Competition takes place every year at the annual, one-day meeting of the The Society of Electron Microscope Technology (SEMT). The aim of the competition is to encourage those relatively new to microscopy to present their work before an audience at a scientific meeting. The presentation slot is always a highlight of the meeting, giving entrants the chance to deliver a relatively short and well-thought-out talk in an economical style.**

**infocus is delighted to feature a summary of the talks given by three of the participants in 2019, and their reflections on taking part in the popular RMS competition.**

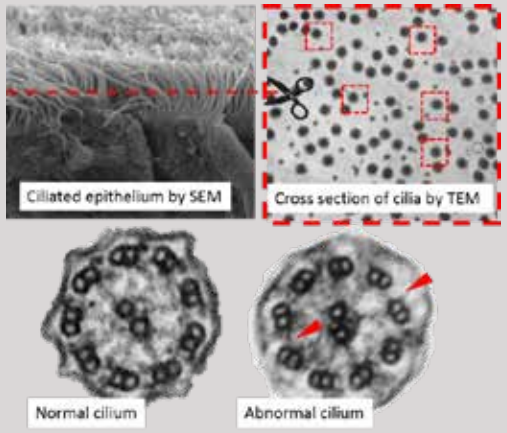
# Taking the stage:

## The RMS Beginners' Competition

# Andreia Pinto: Improving Primary Ciliary Dyskinesia diagnosis using Artificial Intelligence

Andreia L. Pinto, Dr Laurens Hogeweg, Dr Oliver Hamilton, Dr Ioannis Katramados, Dr Amelia Shoemark, Dr Thomas Burgoyne, Prof. Claire Hogg.

**Primary ciliary dyskinesia (PCD) is an inherited autosomal-recessive disorder of motile cilia that results in chronic lung disease, rhinosinusitis, hearing impairment and subfertility. The estimated prevalence of PCD is ~1 per 10,000 births, but it is more prevalent in populations where consanguinity is common. To diagnose PCD involves a combination of tests, and electron microscopy (EM) is essential for determining the type of ciliary ultrastructural defect. EM involves meticulous inspection of many ciliary cross sections, which is time-consuming and requires highly skilled and experienced diagnostic scientists. Machine learning offers an opportunity to improve diagnostic accuracy, reduce time to analyse samples, minimise the subjective element and significantly reduce costs.**





FUNDED BY NIHR | National Institute for Health Research

COSMONiO

Royal Brompton & Harefield NHS
NHS Foundation Trust

*left: the ultrastructure of a cilium, the abnormal cilium shown absent dynein (arrowheads) right: on-site deep-learning system Learner [the workstation] and NOUS [interactive platform].*

NOUS, by COSMONiO, is the on-site deep-learning system that is being trained to detect the difference between healthy and abnormal cilia. Different training approaches are being tested that include (i) Detection of cilia that are usable for diagnosis (ii) Classification of normal and abnormal cilia.

Over 10,000 EM images of cilia have been input to NOUS and it is showing consistently improved accuracy as the training datasets enlarge. When testing it against diagnostic specialists using blinded image datasets, an agreement of >75% in the classification of images was found. This is similar to the agreement measured between individual diagnostic specialists.

NOUS training is ongoing, and further datasets are being used to determine the sensitivity and specificity. Furthermore, it is currently being trialled alongside the current diagnostic protocol, with its accuracy being accessed meticulously to validate the system for future clinical use.

This project was funded by the NIHR (National Institute for Health Research), established in 2006 to improve the health and wealth of the nation through research. The NIHR is funded by the Department of Health and Social Care.

## My experience:

I heard about the Society of Electron Microscopy Technologies meeting shortly after starting my research project. I must say that the SEMT venue is by itself, stunning - the Natural History Museum is a place of wonders. Inside, embedded in its walls is the essence of many great important scientists, theorists and experimentalists; busy, ardent brains that questioned, wondered and disagreed, personalities that always worked towards change, in a world that is constantly changing. Given the chance to show our work in a place like this, for an audience of bright delegates, it's honouring but at the same time, intimidating. My experience presenting is not vast, but I do enjoy it. Presenting work I love and believe in gives me the chance to convince others how important and impactful it is, using my own words and feelings. I would not say it is easy, especially when many of those eyes pointing directly at me belong to people that have lived and experienced so much already, and have all the intellectual tools to judge the work and disrupt my confidence with the slightest remark.

Butterflies buzzed deep inside right before stepping on stage, but then my confidence rose. I took a deep breath and caught some looks from the audience - the more friendly ones - and I fixed onto the fourth wall, that wall of light that protects you from the faces over the limits of the stage (it's a good trick and I do recommend).

After that, all is easy, especially if one is as dazzled as I am with my own project, as I am lucky enough to be part of a project that is exciting, rewarding and has a prospect of a practical application that will benefit the lives of patients and health professionals. In an era where artificial intelligence is part of our daily lives - in our phones, during our medical appointments, searching for a job, watching our favourite shows - there is no way to avoid it. The best way is to make it our ally, to help us in the future, making our work more reliable and reproducible, not replacing us, because, in my opinion, a machine could never compete with the curiosity, creativity and critical thought of the human mind.

*Andreia Pinto.*

# Dain Son: Slimewatch Presentation Summary

Dain Son - University of Westminster

**Slimewatch was a collaborative art and science project carried out at the University of Westminster through generous funding from the British Phycological Society. The aim of the project was to explore the microphytobenthos of the intertidal Thames - our local ecosystem at the heart of London. The Slimewatch project was not only carried out for scientific purposes, but with the main goal to communicate our findings through public exhibitions.**

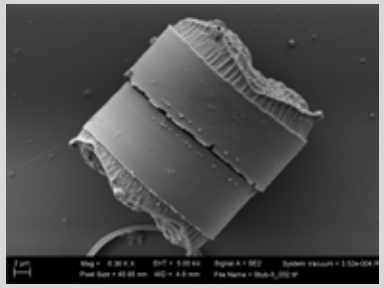
The exhibition pieces included various prints of micrographs captured through a light microscope and SEM. With the generous help of Dr Alex Ball, who scanned an entire SEM stub with one drop of mud sample fixed onto it, we were also able to display a whole SEM stub on a large screen, enabling visitors to move through the stub and zoom in and out through a laptop connected to the screen. This was the most valuable tool to help the lay audience get a better understanding of the intricacies of diatoms that cannot be truly appreciated through a single photograph.

*Dain Son: Slimewatch Presentation Summary.*

## My experience:

The presentation explored the different types of microalgae, diatoms and euglenoids, that were collected from the sampling site, then identified through the scanning electron microscope (SEM) at the Natural History Museum (NHM) through the help of Dr Alex Ball and Dr Eileen Cox. The presentation also touched upon how microscopy can be used as a means of communicating science to the lay audience in a captivating and unique way.

Leading up to the day of the presentation I was quite nervous after receiving the list of speakers that would also be presenting at the RMS Beginners Competition. I was the only undergraduate student presenting alongside PhD students from various universities and it would be my first time ever presenting to such a large audience with academics from various backgrounds. However, on the day of the SEMT conference I got to meet some of the presenters beforehand and was greeted with much warmth and welcome from the presenters and organisers of the conference, which put me at ease. I did get very nervous as the time came for me to speak but I felt that my presentation went very well and smoothly considering this was my first real 'public' speaking experience. Although I did not win the competition, I was very glad to have been able to participate in this event, thanks to Dr Alex Ball who first told me about it.



Public speaking can be very scary for many of us, especially if you are a young student without much experience. However, I am grateful for this opportunity as I now feel much more confident to speak to a large audience. I am also very glad to have taken part in this celebration of the possibilities that microscopy has provided for us as scientists.

# George Lewis: Measurements of 3D Nanoscale Magnetism

George Lewis, University of Cambridge

**Nanomagnetism underpins a huge amount of the technology present in modern life. Current research is looking to move away from traditional layered 2D materials and exploit the complex magnetic configurations that become possible in three dimensions.**

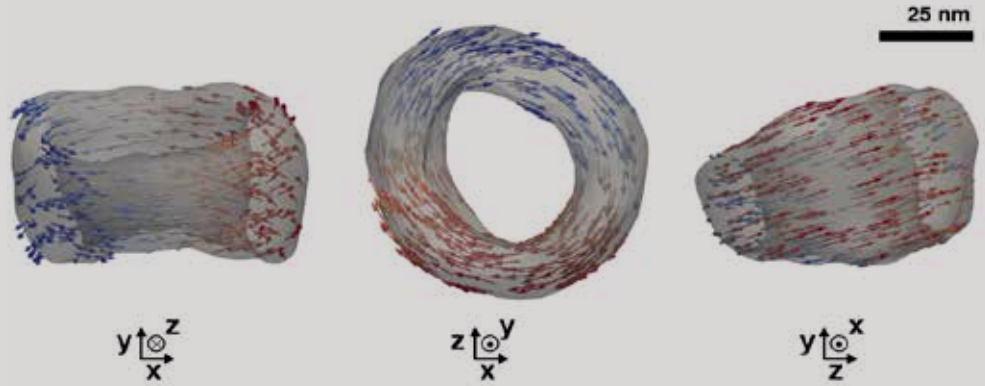



*Figure: Simulated magnetisation of a magnetite nanoring. With developments in electron holographic tomography, simulations like this could be directly compared against real data.*

Naturally this has led to a demand for techniques which can probe sample magnetisation at the nanoscale. In my presentation I discussed electron holographic tomography as an experimental method that could accomplish this, given the recent advances in compress-sensing based reconstruction techniques. I then went on to show that my initial project would be to generate simulated datasets (using the vortex state in magnetite nanorings as a test sample) and iteratively develop the reconstruction process as a proof-of-concept.

## My experience:

The RMS Beginner's competition in December 2019 was the first talk I had given outside of my institution as well as one of the first conferences I had ever been to. It was brilliant to have the opportunity to give a presentation only 2 months into my PhD as it really forced me early on to think clearly about how to communicate my work. A few months later I am now ready to submit my first research article on the topic that I presented, and I think that having presented my work at an early stage definitely helped me to formulate my ideas and decide what to do next.

Furthermore, it was great to hear about the work that other researchers were doing; I never knew before how much research went on behind the scenes in London's museums! I also really enjoyed talking to the representatives that had come from different industry partners and getting a different perspective on how microscopy research can be approached. Overall it was a really positive experience that I would definitely recommend to any new microscopy researchers.

*George Lewis.*