IET Report

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Background

Collaboration is crucial for research and software development at the cutting edge of AI for science. During my PhD journey thus far at the University of Edinburgh, I've had the opportunity to develop my own research focus and present work at national and international conferences, meeting new colleagues and making friends.

I was fortunate, with the financial support of the IET, to conduct academic visits to an international lab earlier in 2025. This report details the work achieved during the visits, both technical and community-building, and how this has both furthered my own studies and benefitted the wider community.

Technical background

Imaging is a foundational technology that underpins much of science and engineering, from medical imaging to remote sensing. In particular, the goal is to reconstruct images from raw sensor measurements, for example from MRI machines, satellites, microscopes or smartphone cameras, as fast and cheaply as possible, while maintaining high image quality. My PhD research at the University of Edinburgh focusses on unsupervised deep learning algorithms for solving real-world imaging problems, and has recently achieved state-of-the-art methods in crucial scientific domains: MRI [1] and satellite image reconstruction [2].

Open-source software

Alongside my research, I am a lead developer of DeepInverse (https://deepinv.github.io) [3], an open-source research software library for solving inverse problems with deep learning, and I co-lead the international contributor community.

The library was founded by Dr Julián Tachella, based in the Computational Imaging lab at ENS Lyon/CNRS, France. As part of the research visit, Julián and I spent time pair coding to iterate through crucial design choices for loss functions, generative models, advanced imaging physics, and training codes. The in-person collaboration allowed us to fix a backlog of user-submitted bugs. Working together side-by-side meant we could more easily resolve complex refactoring problems to alleviate technical debt and future-proof the library as we grow to encompass a larger set of use-cases and users.

Hackathon

Together with Julián and other lead developers of DeepInverse from various labs in Europe, we co-organised the second international DeepInverse hackathon in CIRM, Marseille, France. Bringing together a group of 35 researchers and practitioners from labs and companies in Europe to South America meant that we suddenly had 35 experts with whom to collaborate over advancing the state of open-source software for AI for imaging. Over 3 days, we achieved technical and non-technical aims.

1. Advanced highly-specialised functionalities and open-source tooling for AI for imaging problems. Because of the application of AI to imaging often requires high domain expertise, bringing these people into our community by creating interfaces with their software tools means that we can in turn reach new communities of potential users.
2. Community building. We created new connections both between the organising team and the participants, and amongst attendees themselves. For us, this has taught us a lot about users' needs and concerns, in the context of a highly fast-evolving research landscape. This has placed us in a better position to write code that is useful for real users, rather than merely for academic interest. For the participants, this has already resulted in fresh collaborations between researchers and practitioners who had never met before. Personally, it has already led to ongoing interesting conversations with such people about applying our AI models to new domains!

Research visit

The final aim of the visits to ENS Lyon, France, were to explore latest ideas in novel research. Namely, taking inspiration from existing work [4], we started initial experiments in applying the ideas from [4] to new application domains, and we started adapting methods to train the models from [4] for these new modalities – this is still ongoing work.

Summary

In conclusion, the international visits, supported by the IET, has allowed me to benefit:

1. My research: the cross-border collaboration allowed me to gain fresh perspectives where my immediate peers and colleagues don't have expertise, such as possible applications of our AI techniques to new domains; disseminating research through peer-reviewed code in open source software.
2. My studies: broadened my development as a PhD student and open up new contacts for further employment, and connected with experts across the spectrum of research and industry in AI for imaging;
3. IET: by connecting with fellow researchers at an international leading institutions and peer-learning, this builds the global imaging community and will inspire our community to maintain international relations in future.
4. Wider community: research into imaging benefits society-critical problems wherever images are used, from healthcare to the environment. However, imaging is often slow, expensive or non-robust (e.g. fails in the dark, or when a patient moves etc.). AI research for imaging can directly solve these issues.

References

[1] A. Wang, M. Davies, "Fully unsupervised dynamic MRI reconstruction via diffeo-temporal equivariance", IEEE International Symposium on Biomedical Imaging (ISBI), Apr 2025.

[2] A. Wang, M. Davies, "Perspective-Equivariant Imaging", ECCV TradiCV Workshop, 2024.

[3] J. Tachella, M. Terris, S. Hurault, A. Wang et al., "DeepInverse: A Python package for solving imaging inverse problems with deep learning", to appear in Journal of Open Source Science, 2025.

[4] M. Terris, S. Hurault, M. Song, J. Tachella, "Reconstruct Anything Model: a lightweight foundation model for computational imaging", on arXiv, 2025.