UNIVERSITY OF LEICESTER

Job Summary

Job Title: Research Associate in AI for Environmental Forecasting (SENTINEL project)
Grade: 7
Salary: £40,704 per annum, pro-rata if part-time
Department: School of Engineering
Hours/Contract: Full time or job share, fixed term from 01 January 2027 to 31 March 2028
Job Family: Teaching and Research
Reference: 14072

Role Purpose

To lead the AI development strand of the SENTINEL project. You will build the project's multi-modal training dataset and design, train and evaluate the Receptor Transfer Function (RTF) Learner – a physics-constrained deep learning system that combines generative AI downscaling of weather data, graph neural networks and explainable AI – to forecast community exposure to fugitive emissions 24–72 hours ahead. You will work collaboratively and independently as part of a research team to achieve defined milestones and produce high quality research as part of the wider programme.

About the SENTINEL Project

Air pollution is the UK's biggest environmental threat to public health, yet fugitive emissions – uncontrolled releases from landfill, water treatment, agricultural and industrial sites – remain almost impossible to forecast. Conventional dispersion models need to know how much is being emitted, and for fugitive sources that is rarely known.

SENTINEL (Source Emissions forecasting for NoTIficatioN of Exposure and Localised impact threats) is a new project funded by UKRI under Phase 1 of NERC's Artificial Intelligence (AI) for Environmental Science programme, and it turns this problem on its head. Rather than simulating a plume from an assumed source, SENTINEL learns the link between site operations, weather and what nearby communities actually experience, directly from real-world data. The aim is to build the UK's first physics-informed AI forecasting system for chemical fugitive emissions: predicting community exposure events and breaches of WHO health guidelines 24–72 hours ahead, so that site operators and public health agencies can act before people are affected. In short, SENTINEL aims to do for chemical exposure what machine learning has done for weather forecasting.

Phase 1 uses hydrogen sulphide (H_2S) emissions from a representative UK landfill site as a real-world testbed, backed by years of air quality monitoring, operational logs, meteorological ensembles and community odour reports. Our proof-of-concept 'nowcasting' model already predicts WHO health categories with 82.9% accuracy from weather data alone. SENTINEL will turn this into genuine multi-day forecasting using generative AI downscaling, graph neural networks and explainable AI, rigorously benchmarked against established dispersion models such as ADMS and the Met Office NAME model.

SENTINEL is designed as a two-phase programme. This post is part of Phase 1, which builds and validates the forecasting system. NERC will invite the most successful Phase 1 teams to apply for Phase 2, which would extend the project by a further 42 months to scale SENTINEL to multiple pollutants and types of industrial site, building towards a National Industrial Emissions Digital Twin – a UK-led capability for real-time environmental protection with the potential for global uptake. If Phase 2 funding is secured, there may be an opportunity to continue in the role, subject to funding.

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You will join an interdisciplinary team spanning AI, atmospheric dispersion, chemical fate and public health, led by Dr Tim Pearce with Dr Calvin Jephcote and Prof Mick Whelan in the School of Engineering at the University of Leicester, with links to the Institute for Environmental Futures and the NIHR Health Protection Research Unit in Chemical Threats and Hazards. You will work closely with project partners at the UK Health Security Agency (UKHSA) and the Met Office, and the project will draw on national computing infrastructure (the AI Research Resource and JASMIN) alongside the University's ALICE HPC. This is a rare chance to help shape a new field at the intersection of AI, atmospheric science and public health, and to see your research used by regulators and public health agencies.

Main Duties and Responsibilities

Research

- Build the harmonised SENTINEL training dataset by curating, quality-controlling and bias-auditing multi-modal data, including ECMWF and Met Office weather data, Environment Agency air quality measurements, site operational (SCADA) logs and community odour reports.
- Develop a generative AI downscaling module that super-resolves coarse weather grids to the scale of individual receptors, with probabilistic outputs to capture uncertainty.
- Design, train and optimise the RTF Learner (e.g. a graph neural network encoder with a conditional diffusion decoder), embedding physical constraints such as mass conservation into the training process.
- Apply explainable AI methods (e.g. SHAP) so that forecasts are transparent and can be trusted by site operators, UKHSA and regulators.
- Run model training at scale on national and University GPU/HPC facilities (e.g. the AI Research Resource, JASMIN, ALICE), writing well-documented, reproducible code with clear data provenance.
- Work closely with the Dispersion Modelling Research Associate to benchmark SENTINEL against established dispersion models (ADMS, Met Office NAME).
- To undertake a specific role in a research project or projects, taking responsibility for some element(s) of the planned research
- To lead in the collection, evaluation and interpretation of the research data in experimental design and performance, and work autonomously to attain project milestones.
- To contribute to the development of the choice of techniques, critiques, approaches, models and methods
- To contribute to the overall research programme using innovative research models, novel approaches and techniques.
- In agreement with the line manager, liaise with project collaborators to progress the research

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- To lead in writing up research findings for dissemination amongst the research team and broader international community, and develop ideas and contributions for future grants, technical outputs.
- To represent the research group by disseminating results/findings at national and international conferences and broader community.
- To contribute to research outputs as a co-author to journal articles, technical papers, monograph, book chapter.
- To develop and carry out a plan to extend an area of personal research, or contribute as a team member to the development of a broader programme, this may include contributing to the writing of research bids/grants.
- With the support of colleagues, identify opportunities to apply for fellowships and/or further project grants
- To provide guidance to other staff and students (involved in the research programme).
- To actively seek opportunities to carry out multi-disciplinary research with other research groups at the University or stakeholders external to the University, with the approval of the Principal Investigator (PI).

Professional Development

- Duties and opportunities to engage in work that support your own professional development.

Impact and Knowledge Exchange

- Network and contribute to the maintaining and furthering of the wider research programme and research area
- To contribute to industry collaborations
- To consult effectively on own specialism directly with people external to the University
- To engage positively and pro-actively in research impact

Leadership and Citizenship

- Guidance to other team members both research staff and students
- Pro-actively build networks and collaborations.
- Providing mentoring and coaching to Early Career Researchers and research students.

Internal and External Relationships

Regular meetings with members of the programme research group

Meeting members of the department for critical discussion of the research and exchange of new ideas and approaches that might benefit the research

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Liaison with external collaborators

Close day-to-day collaboration with the SENTINEL AI Research Associate

Liaison with project partners at the UK Health Security Agency (UKHSA) and the Met Office, and with the case-study site operator and regulators

Planning and Organising

You will be required to effectively manage your time to plan your research activity and to deliver on the priorities of the project:

- Prioritise tasks within agreed work schedules;
- Plan for specific aspects of research incorporating issues such as deadlines, project milestones and overall research aims;
- Adapt daily and weekly plans to accommodate new developments and be flexible to the changing priorities of the research project;

Qualifications, Knowledge and Experience

Essential

- PhD or equivalent in computer science, machine learning, data science, environmental data science, physics, engineering or a related quantitative discipline, or the equivalent professional qualification and experience *
- Demonstrable experience of developing and training machine learning or deep learning models on real-world, noisy or time-series data *
- Evidence of a contribution to peer-reviewed journal papers or equivalent e.g technical report/writing a piece of software *
- Evidence of proven analytical problem solving capability *
- Expertise in relevant approaches/models and analytical techniques and ability to develop new ones where required.

Skills, Abilities and Competencies

Essential

- Strong coding ability in Python, including modern AI and deep learning tools (e.g. PyTorch, TensorFlow or JAX) and the scientific Python stack (e.g. NumPy, pandas, xarray) *
- Good research software practice, including version control (e.g. Git) and reproducible workflows
- Willingness and ability to work with internal and external stakeholders*
- Evidence of continued development of subject expertise*
- Excellent communication skills – written and verbal evidenced by the ability to communicate complex information *

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- Evidence of working effectively as part of a team and the ability to work independently *
- Working towards independence and ability to be involved in collaborative research
- Evidence and commitment to Continuous Professional Development (CPD) for yourself, and encourage commitment to learn and develop in others
- Collegiate member of a research team

Desirable

- Coding ability in R
- Experience with graph neural networks, generative or diffusion models, physics-informed machine learning or explainable AI
- Experience working with weather data (e.g. ECMWF/ERA5, NetCDF/GRIB formats) and/or geospatial data and GIS
- Knowledge of atmospheric dispersion models such as Met Office NAME, CALPUFF or ADMS
- Experience of training models on GPU clusters or high performance computing (HPC)
- Budget management skills

**Criteria to be used in shortlisting candidates for interview*

Reason for Fixed Term Contract

The reason for the fixed term contract is stated in section 1.9 in the summary of contractual terms in your contract of employment.

Criminal Declaration

If you become an employee, you must inform your manager immediately, in writing, if you are the subject of any current or future police investigations/legal proceedings, which could result in a criminal offence, conviction, caution, bind-over or charges, or warnings.

Supporting University Activities

As a University of Leicester citizen, you are encouraged to support key university activities such as clearing, graduation ceremonies, student registration and recruitment open days. We encourage all staff as citizens to work flexibly across the University if required. If supporting these activities is likely to affect your workload, please speak to your line manager in the first instance

University Values

Inclusive - We are diverse in our makeup and united in ambition. Our diversity is our strength and makes our community stronger.

Inspiring - We are passionate about inspiring individuals to succeed and realise their ambitions. We challenge our community to think differently, to get involved, and to constantly embrace new ideas.

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Impactful - As Citizens of Change we will generate new ideas which deliver impact and empower our community
Freedom of Speech
The University is committed to upholding freedom of speech and academic freedom within the law throughout our recruitment processes. We ensure that all candidates are considered based on merit and suitability for the role, without regard to their lawful viewpoints or the expression of challenging or controversial ideas. Our recruitment policies and practices are designed to protect applicants from discrimination or adverse treatment on the basis of their opinions, and to foster an environment where open debate and diverse perspectives are valued as essential to our academic mission.
Equity and Diversity
We believe that equity, diversity and inclusion is integral to a successful modern workplace. By developing and implementing policies and systems that challenge stereotypes across all aspects of our work, we have a culture that recognises and values the diverse contributions of our staff which benefits everyone. Our strong values of inclusivity and equality support our efforts to attract a diverse range of high quality staff and students, and identify our University as a progressive and innovative workplace that mainstreams equality, diversity and inclusion.