PhD studentship:
Anomaly detection for the identification of volcanic unrest in satellite imagery.

**Supervisors:**
Pui Anantrasirichai, n.anantrasirichai@bristol.ac.uk, Department of Computer Science
Juliet Biggs, juliet.biggs@bristol.ac.uk. School of Earth Sciences, University of Bristol

**Closing Date for Applications: 1st August 2022**

The student will apply anomaly detection algorithms, which are widely used to detect credit card fraud or cyber-intrusion (Chalapathy & Chalwa, 2019) to the detection of volcanic unrest in satellite images. Recent improvements in the frequency, type, and availability of satellite images mean it is now feasible to routinely study volcanoes in remote and inaccessible regions, including those with no ground-based monitoring. In particular, Interferometric Synthetic Aperture Radar (InSAR) data can detect surface deformation, which has a strong statistical link to eruption (Biggs & Wright, 2020). However, the data set produced by the recently launched Sentinel-1 satellite is too large to be manually analyzed on a global basis. The ability of machine learning to automatically identify signals of interest in these large InSAR datasets has already been demonstrated (Anantrasirichai et al, 2018, 2019), but the dataset available for training is imbalanced and the characteristics of deformation that may lead to an eruption are poorly know.

The student will apply anomaly detection algorithms to the detection of volcanic unrest in satellite images. These algorithms are designed for situations where a labelled dataset of normal behaviour is easier to define than a set of data instances or synthetic models that covers all possible types of anomalous behaviour. In many cases, the ‘anomalous instances’ actually relate to catastrophic events whose characteristics may be inherently unpredictable. However, the characteristics of an anomaly is different for different application domains, and this approach has yet to be explored in the spatial domain of the satellite data. You will explore unsupervised machine learning methods incorporating optimal transport and deep neural networks, such as variational autoencoders (Wang et al., 2020), generative model (Sheynin, 2021) and self-attention mechanism (Zhang et al., 2021).
This project would suit a computer science or electrical engineering student with an interest in applying machine learning/deep learning and computer vision methods to satellite data for environmental applications and hazard monitoring. The student will be part of a European Research Council-funded team working on volcanic deformation (MAST). They will be a member of Bristol’s Visual Information Laboratory, Geophysics and Volcanology research groups and the UK’s Centre for the Observation and Modelling of Volcanoes, Earthquakes and Tectonics (COMET). The studentship is open to international candidates.

Application Details:
The studentship is open to UK or international candidates and provides a stipend and tuition fees for 4 years at the standard UKRI studentship rate.
If you have any questions, please contact Juliet Biggs (juliet.biggs@bristol.ac.uk) or Pui Anantrasirichai (n.anantrasirichai@bristol.ac.uk)
To apply to the University of Bristol you must apply online. You should select ‘Geology (PhD)’ as the programme in the drop down menu.
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References