

# Bachelor-/Masterthesis

## in the field of AI

### Developing an active learning model to annotate thermal anomalies for district heating monitoring

#### ■ Background

District heating networks are commonly used to transport heat over large distances to satisfy the thermal energy demand of end users. Decades of use cause the subterranean pipelines to fatigue, eventually inducing leakages with potentially catastrophic effects. As many networks lack modern forms of surveillance, airborne thermography has emerged as a means for widespread network monitoring. Underground leakages can be identified in thermal infrared (TIR) images as anomalies owing to the increase in temperature they generate at the surface. To identify such areas of interest, thousands of TIR images are acquired via Unmanned Aircraft System (UAS) and automatically analysed. However, most of the thusly identified thermal hotspots do not stem from actual leakages, but are instead caused by common urban features such as vehicles, building elements, streetlamps, manholes, and people. Programme efficiency could therefore be vastly increased by categorising all thermal anomalies automatically, for instance via machine learning models.

#### ■ Your contribution

While multitudes of TIR images have already been collected, the unlabeled data presents a difficult basis for the training of supervised learning algorithms. The aim of this thesis therefore lies in tackling the problem of data annotation by developing an active learning model for the given thermal dataset. A small amount of images must first be manually annotated. This data can then be used to train a model to infer labels so that it becomes capable, by iterative user queries, to generate as exact and extensive a dataset as possible.

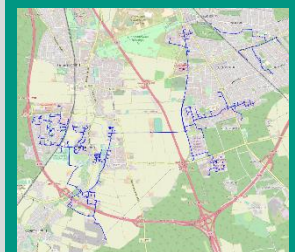
#### ■ Requirements

- independent, structured way of working with an enthusiasm for scientific research, coding, and developing models like the one described
- programming skills (particularly in Python) very helpful, albeit not explicitly required
- proficiency in English

#### ■ Interested?

Please contact Elena Vollmer ([elena.vollmer@kit.edu](mailto:elena.vollmer@kit.edu)) with your application.

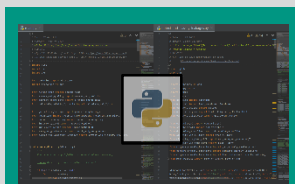
Starting date: as soon as possible



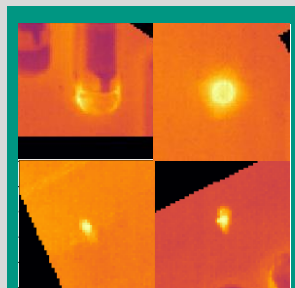
District heating network, displayed in QGIS



Exemplary thermal images acquired via Unmanned Aircraft System (UAS)



Python - the programming language used for this software development



Identified anomalies caused by common urban objects (cars, manholes, street lamps, people)