

Master's Theses in the Field of:

Trustworthy Classification of RF Signal Sources

Topic Description

Protection, surveillance and defence-related sensing systems need to detect and classify electromagnetic signal sources reliably. Such emitters may be radar systems on aircraft, drones or ships, or communication transmitters. They are often non-cooperative: they do not provide information to the observing system, so their type and behaviour must be inferred from received radio-frequency (RF) signals.

Radar and electronic-support systems (ES, passive observation of electromagnetic signals) form tracks with pulse descriptor words (PDWs; compact pulse descriptions), frequency, pulse width, angle of arrival (AoA) or spectral features. Artificial intelligence (AI) should not only name one class, but also show when several explanations are plausible or when a signal appears unknown. The topic combines conformal prediction, out-of-distribution (OOD) detection and explainable AI (XAI), and asks how uncertainty can be reduced by longer observation, sensor changes, another sensor or human escalation.



Possible Thesis Directions

Theses may use simulated or public radar/RF data. The goal is a compact demonstrator that analyzes signal tracks, suggests plausible emitter classes, makes uncertainty visible and supports simple decisions under uncertainty.

The scope is adapted to background, available data and duration; prior knowledge of the application domain is helpful but not required.

- 1) **Trustworthy hypothesis sets:** build an AI model that returns several plausible explanations instead of one label; study calibration, noise robustness and unknown emitters.
- 2) **Active ambiguity reduction:** estimate when additional observations help and derive rules to wait, measure again, reconfigure, use another source or escalate.

Requirements

- Interest in AI, signal processing, radar/RF data or cognitive sensing
- Good basic Python skills; helpful: machine learning, time-series analysis, PyTorch/scikit-learn, uncertainty estimation or simulation

Contact persons / Joint supervision

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Start

by arrangement