

Master Thesis Opportunity at CAS

How Much Does the Sensor Matter? Multi-Modal, Multi-Terrain Trajectory Prediction for Connected E-Bikes

Motivation:

Future urban streets will be shared by cars, pedestrians, and an exploding number of e-bikes. For an automated vehicle to keep these riders safe, it must anticipate where the e-bike is going next -- a trajectory-prediction problem. Increasingly, the e-bike can broadcast its own position from an V2X onboard unit, a smartphone, or a dedicated GNSS receiver. But these sensors differ enormously in noise, and nobody has measured how that difference propagates into prediction quality, or how it changes across terrains such as city, forest trails, and mixed university campus environments.

This thesis tackles exactly that gap. Using an existing real-world dataset of 22 riders instrumented with three positioning modalities across three terrains, you will build and evaluate trajectory-prediction models and quantify, for the first time, how onboard sensor choice and terrain shape the predictability of a connected e-bike.

What You'll Do:

You will own a focused, publication-driven research project:

- **Data Pipeline:** Turn the existing multi-sensor e-bike into clean, time-aligned trajectory windows for honest evaluation.
- **Model Development:** Implement a set of AI trajectory predictors models such as a physics baseline, a Kalman filter, an LSTM encoder-decoder, and one Transformer or Mamba model.
- **Core Analysis:** Measure prediction error broken down per sensor and per terrain.
- **Research Output:** Produce a master's thesis and a conference-paper submission to ICRA or IROS, with reproducible experiments.

Who We're Looking For:

- Strong Python skills; hands-on experience with a deep-learning framework (PyTorch).
- Familiarity with time-series / sequence models (LSTMs, Transformers).
- Comfort working with noisy real-world sensor data and a careful, evaluation-minded mindset.
- Interest in intelligent vehicles, e-bike safety, or cooperative mobility; clear scientific writing.

Why Apply?

You will work at the intersection of machine learning, and vulnerable-road-user safety on a dataset that is already collected --- so you spend your time on models and analysis, not months of fieldwork. The scope is deliberately sharp and novel, giving a realistic path to a strong ICRA/IROS publication and a thesis you can defend with confidence. Join us in making connected micromobility safer.

Ready to take off? Apply now! Send your application to john.rockiasamy@kit.edu. ASAP!

Contact for more Info @

