

GNSS-DENIED LOCALISATION FOR OUTDOOR ROBOTS WITHOUT GPS

MSc thesis project at ITC-EOS in collaboration with Demcon

Help robots find their way when reliable access to global navigation satellite systems (GNSS) is not available. Research, develop, implement, and find and push the limits of GNSS-denied localisation algorithms.

Most outdoor robots have access to precise location information from a GNSS such as GPS or Galileo and rely on this to plan their navigation. However, there are situations where GNSS localisation is compromised:

- Reception issues
- Jamming
- Spoofing

Now the robot will need an alternative **absolute positioning system** that does not rely on satellite reception. This is called **GNSS-denied localisation**.

There are vision-based solutions...

Previous work done by other research groups, replicated and adapted in internships by UT students at Demcon, shows the feasibility of methods based on **matching local camera observations to prior satellite images**.

- Tom Postmus, “GPS-denied localisation for UAVs”
- Desirée Pietersma, “GPS-denied localisation for UGVs”

These algorithms work pretty well already in an off-line processing step, and on RGBD-data in daylight and similar conditions to the satellite imagery.

... but there are open questions, too

Before a real robot can navigate in a real environment without the aid of GNSS localisation, we still must consider a number of open issues:

1. What is the robustness against **different conditions** (seasons, weather) and changes in the environment?
2. How should these algorithms be **integrated** in a full sensor fusion or even Simultaneous Localisation and Mapping (**SLAM**) system?
3. In which way can the localisation be run **on-line on a real robot**?
4. Can the position **accuracy** be estimated?
5. How to localise **at night**?

Not all questions can be answered in a single MSc thesis research project, but we should make good progress in learning more about this type of localisation.

What will you do in this assignment?

You will take the existing work and integrate it into a full “localisation pipeline.” The choice of sensors may already constrain the system to daylight, or vision-based methods. However, you will use that system to answer as many of the open questions about performance and robustness as possible.

An algorithm is useless without knowing its limitations in real-world applications.

In order to write a proper research paper (or MSc thesis) about this topic, you have to go further than designing the system and showing that it works for some dataset. You will try to find the situations and conditions where the system **does not work anymore**.

But how?

Demcon engineers have experience with many modern autonomous navigation algorithms and packages and robot simulators. In this Master’s thesis project, you will not only research GNSS denied localisation, but make a working system and test it on real datasets and hopefully **apply it on a real-life autonomous exploration robot**.

You will be supervised (or guided) by a staff member of the Earth Observation Science group of the ITC faculty, but also spend 1 day a week at Demcon, collaborating with their engineers to also focus on the practical applicability and larger integration outside of academia.

You are an MSc student in Robotics, EE, CS, AM—or another programme but think you can and want to do this assignment.

It will help if you already have experience in at least some of these things:

- ROS 2
- Optimisation, SLAM
- Programming (python and/or C++)
- Image processing

Interested?

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