# Master Project “Postprocessing of IMU and GNSS Data”

A flight experiment saves sensor data. One file is IMU data. One file is GNSS data. The Pulse per Second (PPS) of the GNSS resets the internal clock of the IMU. Thus, the measurements can be synchronized. However, an ambiguity for the integer second remains and needs to be resolved.

Format of IMU Data file:

* Message Counter, Range 0 … 255
* Sample Time in seconds (reset at each PPS)
* Angular increment for Gyro X
* Angular increment for Gyro Y
* Angular increment for Gyro Z
* Velocity increment for Accelerometer X
* Velocity increment for Accelerometer Y
* Velocity increment for Accelerometer Z
* Temperature
* Status

The format of the GNSS is not yet known. It will contain the following data

* GPS Week number
* GPS Second of week
* Position in ECEF
* Velocity in ECEF
* IMU\_X001.dat is without additional errors. IMU\_X002.dat is with noise. IMU\_X003.dat adds bias to the IMU.
* GNSS\_X001.csv is without error and GNSS\_X002.csv is with error

Goal:

Development of a postprocessing software that reads the files from IMU and GNSS and estimates the 6DOF navigation information (position, velocity, attitude).

For that the sensor data fusion of GNSS and IMU is needed in two steps. First while sitting on ground a “gyro compassing” or a similar method needs to be done in order to get the initial attitude. As first guess it can be assumed that IMU Z axis point up. From the data, the time of lift-off needs be detected. From that point on (or a few seconds before) a navigation filter needs to process the sensor data to get the flight state.

Requirements:

* The software shall be written in Matlab R2022b
* All functions shall have unit tests using the Matlab unit test frame work
* The code shall follow the “Modelling and Coding Guidelines”

Tasks:

* Develop functions for reading IMU and GNSS data files
* Develop function for gyro compass alignment. This can also be achieved by zero velocity updates and Earth rate measurements (see refs).
* Develop Kalman filter function for processing the data during flight

References:

1. Trigo, Guilherme Fragoso (2020) [Low-Cost Failure-Tolerant Hybrid Navigation Designs for Future Space Transportation Systems.](https://elib.dlr.de/140137/) Dissertation, Universität Bremen.
2. Steffes, Stephen R. (2013) [Development and Analysis of SHEFEX-2 Hybrid Navigation System Experiment.](https://elib.dlr.de/82946/) Dissertation, University of Bremen.