1. Title: **PERFORMANCE ASSESSMENT OF VISION-BASED NAVIGATION TECHNIQUES**

2. Supervisors:

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3. Description

3.1. Context

GNSS (Global Navigation Satellite Systems) systems are widely used for navigation. However, in certain environments such as urban areas or inside buildings, the reception of GNSS signals can be degraded or impossible. To overcome these limitations, it is interesting to combine the position information from GNSS with other sensors, in a hybrid navigation approach. GNSS/IMU hybridization is widely used and described and the associated performance of the existing solutions is known.

In certain applications, like autonomous vehicle or airport ground navigation, some additional sensors can be considered for the remaining limitations of the hybridized solution (low-cost IMU, strong multipath). Vision based navigation techniques represent a strong candidate to be combined within the existing hybridization solutions.

Even if the literature introduces several works related to video navigation solutions or video/GNSS/IMU hybridization solutions, few of them provide a performance assessment of the navigation parameters estimated by the video system.

The work during the internship will focus in particular on the characterization of the performances of visual SLAM solutions for estimation of navigation parameters. The study will consider using two data collect platform developed by ENAC TELECOM Team: A terrestrial robot JACKAL and a golfcart equipped with navigation sensors.

3.2. Objectives

The objective of the internship is to propose a analysis and a characterization of the performance of visual SLAM techniques. Performance will be assessed considering variations of parameters such as camera parameters, environment conditions and SLAM algorithm settings.

If time allows, a possible study of a solution of Video/GNSS/IMU hybridization will be conducted and the performances will be analyzed.

3.3. Work plan

A proposed work plan for the internship is as follows:

- State of the art of video based navigation and focus on SLAM
- Review of existing SLAM solutions

- Review of the status of the data collect platform and contribution to their development
- Definition and realization of image data collect
- Provision of an analysis and performance assessment study

3.4. References

[1] Raúl Mur-Artal, J. M. M. Montiel and Juan D. Tardós. ORB-SLAM: A Versatile and Accurate Monocular SLAM System. IEEE Transactions on Robotics, vol. 31, no. 5, pp. 1147-1163, 2015

[2] J. Vezinet, "Study of Future On-board GNSS/INS Hybridization Architectures", 2014.

4. Remarks

This work can be performed in collaboration with other researchers and students working on similar topics. A PhD thesis founding has been requested to study Video/GNSS/IMU Hybridization solution so the internship could be a good introduction.

5. Period
- Starting date: 1 st March 2024 (flexible)
- Duration: 6 Months (flexible)

6. Department

SINA/TELECOM/SIGNAV

The internship is proposed by the SIGNAV (SIGnals for NAVigation) research group. SIGNAV is one of three research groups of the TELECOM team in the SINA (Sciences et Ingenierie de la Navigation Aerienne) department at ENAC (Ecole Nationale de l'Aviation Civile).

7. Location

The internship will take place at main campus of ENAC in Toulouse, France. Adress: 7, avenue Edouard Belin BP 31055 Toulouse Cedex 4, building F.

8. Candidate's profile

Master student in electrical/telecommunications/electronic engineering with background in estimation theory and image processing. Knowledge in GNSS, aerospace systems or robotics will be appreciated.