INTERNSHIP

TARGET BASED LIDAR - CAMERA CALIBRATION USING PCL LIBRARY

INTERNAL DOCUMENT

10/01/2021

Company presentation

NAVYA is a leading French name in autonomous driving systems. With more than 250 employees in France (Paris and Lyon) and in the United States (Michigan), NAVYA aims at becoming the leading player for the supply of autonomous driving systems for the transportation of passenger and goods. Since 2015, NAVYA has been the first to market and put into service autonomous mobility solutions.

The AUTONOM® SHUTTLE, main development axis, was launched in September 2015 and more than 130 units have been sold as of June 2019, notably in the United States, France, Germany, Switzerland, Japan and Australia. The AUTONOM® TRACT, whose first road tests will start shortly, is dedicated to transporting goods.

Internship description

- ✓ The intern will work within Sensors team in the Perception pole, its main purpose will concern improvement of the camera – Lidar calibration process. This kind of calibration algorithm implies extracting features from both images and lidar point clouds. This internship will be focused on **extracting features from 3D point clouds**.
- ✓ **RANdom SAmple Consensus** – RANSAC[1] - is a key algorithm to extract features from 3D point clouds. Using a standardized and robust RANSAC algorithm is key to improve quality of our target based camera – lidar calibration code. Thereby, we have identified **PCL - Point Cloud library**[2].
- ✓ The goals of this internship will be to **evaluate PCL**, **write** PCL based RANSAC **building blocks** and **integrate them into** our camera – lidar **production code**.
- ✓ The internship can be split into the following main substeps:
  - Understand most relevant articles[3,4,5] related to RANSAC
  - Write basic python scripts to familiarize with RANSAC algorithm using 2D point cloud data
  - Use pclpy - PCL: Point Cloud Library for Python – to prototype a script to detect planes in 3D Point cloud data
  - Use PCL C++ library to prototype a code to detect planes in 3D point cloud data. Sample data from the online knowledge database will be used for validation
  - Discover our camera – lidar calibration code through use cases, next explore sources through code reviews
  - Refactor existing C++ calibration code using PCL based code blocks
  - Write unit tests and update repository documentation to improve software robustness and quality respectively
  - Evaluate performance on real use cases with replay diagrams
  - Use pclpy to detect a cube using k-means clustering and RANSAC in 3D Point cloud data[4,5] (optional)
  - Test the code developed on real shuttle at production site (if relevant)

Required experience: Junior

1 https://en.wikipedia.org/wiki/Random_sample_consensus

2 https://pointclouds.org/

3 Kim, Eung-su, and Soon-Yong Park. Extrinsic Calibration between Camera and LiDAR Sensors by Matching Multiple 3D Planes. *Sensors* 20.1 (2020): 52.

4 Saval-Calvo, Marcelo, et al. Three-dimensional planar model estimation using multi-constraint knowledge based on k-means and RANSAC. *Applied Soft Computing* 34 (2015): 572-586.

5 Pusztai, Zoltan, and Levente Hajder. Accurate calibration of LiDAR-camera systems using ordinary boxes. *Proceedings of the IEEE International Conference on Computer Vision Workshops*. 2017.

Technical skills & human qualities

Main skills:

- ✓ Passionate by code development and/or robotics
- ✓ A specialization in computer vision would be appreciated
- ✓ Comfortable with maths and numerical algorithms
- ✓ Good knowledge of C++ programming (standard C++14)
- ✓ Standard knowledge of Python
- ✓ Good communication skills
- ✓ Rigor and spirit of synthesis
- ✓ Fluent in English is a plus

Desired skills:

Familiar with an IDE (Subblime, QtCreator, Visual Studio, CLion ...)
Git source versioning
Basic notions with CMake
RTMaps

Type of contract: 5 or 6 months internship

Start date: April 2021 (to be specified)

Working site: 7 place de la Défense, 92400 Courbevoie, France

Salary: Depending on experience, to be negotiated
50% coverage of the transport ticket

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