2018-00557 - Depth-map reconstruction from structured light without matching

Contract type: Internship agreement
Renewable contract: Oui
Level of qualifications required: Master's or equivalent
Fonction: Internship Research
Level of experience: Recently graduated

About the research centre or Inria department

The Inria Sophia Antipolis - Méditerranée center counts 37 research teams and 9 support departments. The center's staff (about 600 people including 400 Inria employees) is composed of scientists of different nationalities (250 foreigners of 50 nationalities), engineers, technicians and administrators. 1/3 of the staff are civil servants, the others are contractual. The majority of the research teams at the center are located in Sophia Antipolis and Nice in the Alpes-Maritimes. Six teams are based in Montpellier and a team is hosted by the computer science department of the University of Bologna in Italy. The Center is a member of the University and Institution Community (ComUE) "Université Côte d'Azur (UCA)."

Context

Depth-map reconstruction from structured light without matching

Blu Manta: we are a young technology start-up developing the latest state-of-the-art machine learning technologies. Our mission is to develop highly embedded softwares able to transform raw signal data into user experience. The first goal of our company is to address the 3D face authentication use case, by proposing innovative methods to reconstruct the depth map coming from optical sensors.

Level: Master Level.
Compensation: SMIC.

Bibliography


Assignment

Description: structured light sensors are some of the current 3D technologies (e.g. face authentication, augmented reality, scene and object scanning). These sensors are composed of an infra-red (IR) projector, which projects a known pattern, and an IR camera, which acquires the same
pattern. The displacements between the original set of patterns and the ones captured by the IR camera provides an image with 3D coordinates whose triangulation problem is solved by finding a correspondence between each camera and projector pixel [1].

This problem is usually solved with a local stereo matching approach, which correlates blocks of pixels in the projected and acquired image. However, a matching-block algorithm is either computationally expensive or limited in performance [2]. Other recent methods successful apply machine learning algorithms transforming the matching problem into classification/regression problem [3]. The objective of this project is to apply state-of-the-art machine learning techniques (e.g. deep learning techniques) to extract the depth information of scene without using any matching algorithm. The main hypothesis is then to reduce the complexity while producing high-quality depth maps.

Main activities
Tasks involved:

- Producing a report on the state-of-the-art, including the main standard matching-block techniques and complexity / depth map precision trade-off. As a final step, it will be chosen a possible candidate among these techniques with the best precision (independently from its complexity).
- Data managing to generate train/test data: how to transform the available data to be compatible with a ML approach? The idea would be to get the reference image (from the IR projector), the acquired image (from the IR camera) and to create ground-truth depth maps by using the previous identified block matching algorithm.
- Implementing the reconstruction of the depth map by using state-of-the-art deep learning techniques (e.g. convolutional neural networks)
- Evaluating the performance / complexity of the systems on the testing set while providing some qualitative analysis on the main difference between other reconstruction approach (e.g. standard block matching, structure.io[1], etc.)

[1] https://structure.io

Skills
Basic programming, preferably in Python, MATLAB, OpenCV, C

Benefits package
- Restauration subventionnée
- Transports publics remboursés partiellement
- Sécurité sociale
- Congés payés
- Aménagement du temps de travail
- Installations sportives

Remuneration
Salary : SMIC