Post-doc Position

Event camera registration on 3D point clouds

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Place : ICB Lab UMR CNRS 6303, Institut Marey – Université de Bourgogne, Dijon

Duration: 1 year

Context: This Post-doc position is offered thanks to the international ANR/FWF EVELOC project, 2024-2028 (Event-based Visual Localization). This project is the result of strong collaboration between Amiens and Dijon (France) with TUG-Graz (Austria). The goal of this project is to develop new image processing and computer vision algorithms for event cameras. Event-based cameras represent a groundbreaking advancement in vision sensors, capturing the essence of a 3D scene through an asynchronous approach. Similar to the human eye, these neuromorphic cameras exclusively register variations in light intensity within a scene, diverging from the conventional time-indexed frame acquisition of traditional cameras (Fig 2.a). In contrast to their counterparts, event-based sensors boast remarkable attributes, including ultra-low latency (on the order of microseconds), minimal energy consumption (mere tens of milliwatts), an extensive dynamic range exceeding 120 dB, significantly reduced data generation (10 to 1000 times less), and robust functionality in low-light conditions [2]. These properties open the way to new applications such as tracking and localizing fast-moving cameras in a scene. In this post-doc we will assume that a 3D point cloud of the scene is available (Fig 1.) and we will try to register the camera on this cloud to estimate its pose.

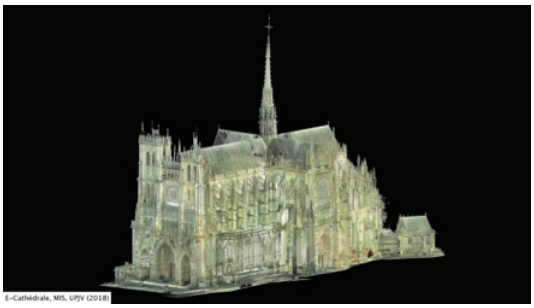

Fig.1. 3D model of Amiens cathedral (MIS – UPJV)

Fig.2. (a) Image event, (b) Event camera observing a colored 3D point cloud. Image adapted from [1].

Objectives: While 2D/3D registration between color camera and colored 3D point cloud is a widely studied topic [3], the issue remains an open problem when the camera acquires event information. Indeed, due to the different modalities between the image and the point cloud, conventional approaches cannot be applied. Some new approaches exist but require 2D RGB, 2D Event, 3D event clouds, 3D RGB clouds [4]. Here we suppose that

we only have 2D events and colored 3D point clouds. Thus, in this postdoctoral research, we will develop innovative approaches to estimate the pose of an event camera in a 3D point cloud.
We will investigate several solutions:

- Generation of 2D color images from event images [5] for mono-modal color registration [6]
- Generation of 3D point clouds from event data for mono-modal event registration
- Direct multi-modal 2D/3D registration [4]

Expected profile: The candidate should have a Ph.D. in a related area with demonstrated ability to conduct high-quality research in computer vision, machine learning, robot vision and have a track record of publications in top journal and/or conferences.

The PostDoc will integrate the ICB laboratory UMR CNRS 6303, Université de Bourgogne, Dijon, and have research stays in Amiens (France) and at TUG-Graz (Austria) will be planned.

Application: Please send an email to cedric.demonceaux@u-bourgogne.fr, renato.martins@u-bourgogne.fr and pascal.vasseur@u-picardie.fr and attach only the following documents to your application:

- A letter of motivation describing your research interests (max. 1 page)

- Curriculum vitae (including two contact details - referees with name, position and email)

- PDF copy of your PhD (if available) and PDF list of main publications

Application deadline: 20 December 2024

References:

[1] Gallego, G., Lund, J. E., Mueggler, E., Rebecq, H., Delbruck, T., & Scaramuzza, D. “Event-based, 6-DOF camera tracking from photometric depth maps”. IEEE transactions on pattern analysis and machine intelligence, 2017.

[2] Gallego, G., Delbrück, T., Orchard, G., Bartolozzi, C., Taba, B., Censi, A., ... & Scaramuzza, D. “Event-based vision: A survey”. IEEE transactions on pattern analysis and machine intelligence, 2020.

[3] Zhang, Ray, et al. "A new framework for registration of semantic point clouds from stereo and RGB-D cameras." 2021 IEEE International Conference on Robotics and Automation (ICRA). 2021.

[4] Wan, Zhexiong, et al. "RPEFlow: Multimodal Fusion of RGB-PointCloud-Event for Joint Optical Flow and Scene Flow Estimation." IEEE/CVF International Conference on Computer Vision (ICCV). 2023.

[5] Pini, S., Borghi, G., & Vezzani, R. “Learn to see by events: Color frame synthesis from event and rgb cameras”. arXiv preprint arXiv:1812.02041, 2018.

[6] Li, Jiaxin, and Gim Hee Lee. "DeepI2P: Image-to-point cloud registration via deep classification." IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2021.