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Event-aided Visual Navigation

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1 Research motivation

Visual navigation, or computer-vision-based navigation, is the task of guiding a robot towards a goal using a camera as the main exteroceptive sensor. The use of a camera in navigation, especially aerial navigation, is very appealing due to its low cost, light weight and compactness. Visual navigation is an old problem in computer vision and robotics research communities. Successful approaches have been applied to both aerial and ground robot navigation[2, 1]. One of the major challenges in visual navigation is robot localization errors which may lead to robot drift over time. Such errors could be due to illumination changes between two camera frames, motion blur, etc. In this thesis we want to address the visual navigation problem by leveraging data provided by a second sensor: event camera.

2 Problem statement

Event cameras have known a growing interest in robotics in the last few years [3, 4]. While standard cameras capture pixel matrices at a fixed rate, event-based cameras asynchronously measure per pixel brightness changes, referred to as events[1]. Event cameras such as Dynamic Vision Sensor (DVS) [5] have several benefits over standard cameras: (1) high dynamic range which is evaluated at 120db versus 60db for a standard camera, (2) high temporal resolution with sub-millisecond timing precision, (3) low power consumption which is evaluated at 23mW and (4) low motion blur. Regarding these properties, event cameras can be adopted as a complementary sensor in conditions that are challenging for standard cameras such as outdoor navigation with varying lighting conditions, high illuminated environments, high-speed navigation and long term navigation. In this thesis we want to address the impact of event cameras on visual navigation in the above-mentioned conditions. Do events have a real added value on localization accuracy? How much can event-aided navigation diminish the robot drift overtime?

[1] https://youtu.be/LauQ6LWTkxM?t=30

3 Research scope

In order to answer the above-mentioned questions, the candidate will first implement a state-of-the art visual navigation algorithm. Tests will be conducted with Unmanned Aerial Vehicles (UAVs) in both simulated and real (indoor and outdoor) environments. Experiments in challenging scenarios will also be carried out with and without event camera in order to evaluate its impact on navigation.

4 Admission criteria

The PhD position is proposed by the International Center of Artificial Intelligence of Morocco, of the Mohammed VI Polytechnic University. Applicants with excellent curriculum must be holders of a Master, an engineering or an equivalent recognized degree in Computer Science or Applied Mathematics. Experience with 3D computer vision and robotics is desirable but not required. In addition, they should have skills in Programming (Python and C++) and good communication skills in English. Particular attention will be given to the suitability of this research project with the applicant's background.

References

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