MAP-i Thesis Proposal

Title: Development of robotic vision systems using special cameras

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1 Introduction

Robotic vision is an open research area that focuses on providing a digital visual representation of the surrounding world for robots that base their artificial intelligence on the interaction with the environment.

Common video devices that are currently being used in most of the robotic applications can only provide significant visual information up to a certain extent. That is, in situations where the environment is not fast changing over time, a fair resolution for a video device is sufficient for capturing good enough images for processing them in real time and gathering information about the environment.

However, in environments where the robots or objects of interest moves too fast, working at 30 frames per second with a regular video camera is no longer enough. **High speed cameras** can be used for solving this problem. Nowadays, we have cameras that can give up to 1000fps. One of the huge challenges is the development of algorithms that can process the acquired images in a controlled time so that this type of cameras can be used by autonomous mobile robots.

High dynamic range cameras can also be used for developing video systems of robots that have to operate in an outside environment or other where can occur high changes in the illumination. The most recent technology allowed the development of cameras with two CCDs (or CMOS) sensors that at the same time can acquire images with, for example, different exposure times. It is a challenge to develop algorithms to calibrate and merge these image data with time-constraints to be used in robots.

Another type of cameras that brings an important contribution to the improvement of the vision systems are the **infrared cameras**. The infrared cameras can be used for night vision or to detect objects based on their temperature (ex. people) by autonomous mobile robots.

Moreover, all the robotic projects will benefit from the usage of **3D sensors**. By giving access to the depth information of an object in the image, such sensors reduce significantly the effort and time spent in some of the most common image processing techniques, such as differentiating between background and an object or gathering information about texture, just to mention a few.

2 Objectives

The aim of this PhD is to develop time-constrained computer vision algorithms for autonomous mobile robots, based on the use of special cameras. The algorithms to be developed should start by the image acquisition, passing through camera calibration and detection of objects of interest. Moreover, algorithms of sensor fusion should be developed to integrate the information gathered from several sensors, if used for the same application.

Such algorithms will be used in several applications, namely robotic soccer, autonomous driving, domestic assistants and industrial automation. The University of Aveiro currently holds several robotic projects on which the algorithms can be tested, as well all the equipment mentioned before.