Self-calibration of colormetric parameters in vision systems for autonomous soccer robots

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Abstract. Vision is an extremely important sense for both humans and robots, providing detailed information about the environment. In the past few years, the use of digital cameras in robotic applications has been significantly increasing. The use of digital cameras as the main sensor allows the robot to capture the relevant information of the surrounding environment and take decisions. A robust vision system should be able to reliably detect objects and present an accurate representation of the world to higher-level processes, not only under ideal light conditions, but also under changing lighting intensity and color balance. To extract information from the acquired image, shapes or colors, the configuration of the colormetric camera parameters, such as exposure, gain, brightness or white-balance, among others, is very important. In this paper, we propose an algorithm for the self-calibration of the most important parameters of digital cameras for robotic applications. The algorithms extract some statistical information from the acquired images, namely the intensity histogram, saturation histogram and information from a black and a white area of the image, to then estimate the colormetric parameters of the camera. We present experimental results with two robotic platforms, a wheeled robot and a humanoid soccer robot, in challenging environments: soccer fields, both indoor and outdoor, that show the effectiveness of our algorithms. The images acquired after calibration show good properties for further processing, independently of the initial configuration of the camera and the type and amount of light of the environment, both indoor and outdoor.

1   Introduction

Nowadays, digital cameras are used as the main sensor on robots and allow them to acquire relevant information of the surrounding environment and then take decisions about the actions to take. We can point out some areas of application of these robots, as the case of the industry, military, surveillance, service robots and more recently, vehicles for assisted driving.

To extract information from the acquired image, such as shapes or colors, the camera calibration procedure is very important. If the parameters of the camera are wrongly calibrated, the image details are lost and it may become