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Robust Motion Detection in Real-Life Scenarios

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To my loving parents, Manolo y Fina, for walking with me in the life way, helping me to face up difficulties and magnifying my happiness. Everything I have with both of you is worth it

Ester

To Azucena, for her unconditional love and understanding

Angel

Preface

Our knowledge of the surrounding world is obtained by our senses of perception. Among them, vision is undoubtedly the most important for the information it can provide. In artificial systems, this discipline, known as Computer Vision, mainly tries to identify physical objects and scenes from captured images to be able to make useful decisions. For that, the processing and analysis of images, video sequences, views from multiple cameras or multi-dimensional data like a medical scanner, are carried out.

In this context, motion plays a main role since it provides a stimulus for detecting objects in movement within the observed scene. Moreover, motion allows obtaining other characteristics such as, for instance, object's shape, speed or trajectory, which are meaningful for detection and recognition. Nevertheless, the motion observable in a visual input could be due to different factors: movement of the imaged objects (targets and/or vacillating background elements), movement of the observer, motion of the light sources or a combination of (some of) them. Therefore, image analysis for motion detection will be conditional upon the considered factors. In particular, in this manuscript, we have focused on motion detection from images captured by perspective and fisheye still cameras. Note that, as cameras are still, egomotion will not be considered, although all the other factors can occur at any time.

With that assumption, we propose a complete sensor-independent visual system which provides a robust target motion detection. So, first, the way sensors obtain images of the world, in terms of resolution distribution and pixel neighbourhood, is studied. In that way, a proper spatial analysis of motion can be carried out. Then, a novel background maintenance approach for robust target motion detection is implemented. On this matter, two different situations will be considered: (1) a fixed camera observing a constant background where interest objects are moving; and, (2) a still camera observing interest objects in movement within a dynamic background. The reason for this distinction lies on developing, from the first analysis, a surveillance mechanism which removes the constraint of observing a scene free of foreground elements during several seconds when a reliable initial background model is obtained, since that situation cannot be guaranteed when a

robotic system works in an unknown environment. Furthermore, on the way to achieve an ideal background maintenance system, other canonical problems are addressed such that the proposed approach successfully deals with (gradual and global) changes in illumination, the distinction between foreground and background elements in terms of motion and motionless, and non-uniform vacillating backgrounds, to name some.

The methods proposed in this book provide important advances with respect to state-of-the-art computer vision approaches to motion detection. Our algorithms allow a good environment adaptation of the system as it properly deals with most of the vision problems when dynamic, non-structured environments are considered. All these contributions are validated with an extensive set of experiments and applications using different testbeds of real environments with real and/or virtual targets.

Castellón de la Plana, Spain, June 2012

Ester Martínez-Martín
Angel P. del Pobil

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