Object recognition and tracking from mobile platforms

J. Pauli
Fraunhofer IITB, Fraunhofer Str. 1, 76131 Karlsruhe
pauli@iitb.fraunhofer.de

Introduction

The purpose of savety robots may be to navigate towards and operate within hazardous sites in order not to endanger the savety of emergency response workers. An essential task of security robots is the monitoring of critical areas in order to relieve and reduce the number of surveillance persons. Machine-vision is essential in both fields of robotic applications, e.g. in savety robotics to enrich the situational awareness of the staff of the control station through image stabilization and carpeting, or in security robotics to recognise and track suspicious-looking persons or vehicles and thus arousing attention of special service agents.

Capabilities

Fraunhofer IITB developed vision procedures for object recognition (Figure 1), georeferencing (Figure 2), image stabilization and image carpeting (Figure 3), and object tracking (Figures 4), which are needed in mobile platforms such as ground vehicles (e.g. tanks) or areal vehicles (e.g. helicopters). Basic image features like gray value corners or line segments are extracted serving as basis for estimating projective transfor-mations between consecutive images along the image sequence. Parameter estimation is done by a random sampling approach working at several levels of resolution. The transformation is applied pixel-by-pixel to the whole image which enables the realization of two further procedures. On the one hand, pieces of consecutive images can be fitted together for creating a panorama (image carpeting or mosaicking) which enriches the situational awareness. On the other hand, the over-lapping regions of consecutive images can be stabilized and changes therein can be detected easily which enables the tracking of objects moving relatively to the movement of the camera platform. Tracking takes place selectively, that is, from a changing area a feature vector is extracted and based on that the underlying object is classified as relevant or not relevant for being further considered or not. A statistical classifier is learned in advance, which especially determines a small set of most discriminative types of features automatically from an originally extensive archive of features. Interestingly, in applications of selective tracking, different types of object features are essential depending on distances between camera and object, e.g. silhouette features at large distances, and shape features at short distances.Therefore, during the online phase an automatic change from one type of feature vector to another is included in the recognition and tracking procedure, given that the mentioned distances are changing significantly during the surveillance process.

Applications

The mentioned vision procedures proved robust and efficient in realized surveillance systems for car and helicopter platforms.

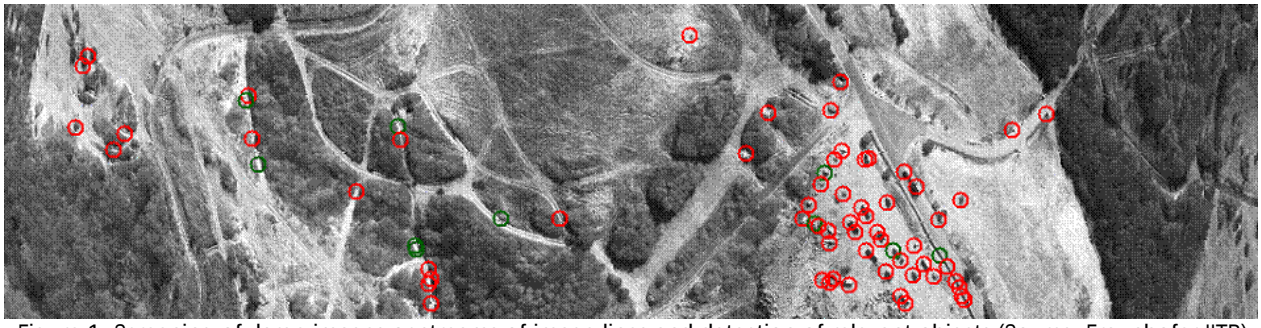

Figure 1: Screening of large images or streams of image lines and detection of relevant objects (Source: Fraunhofer IITB).

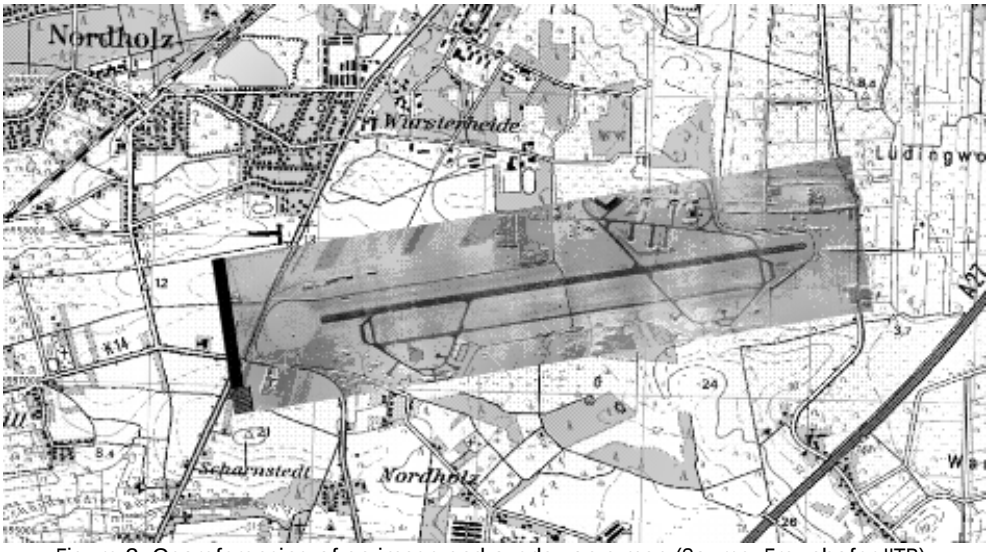

Figure 2: Georeferencing of an image and overlay on a map (Source: Fraunhofer IITB).

Figure 3: Stabilizing, mosaicking, carpeting of images (Source: Fraunhofer IITB).

Figure 4: Relative motion detection, e.g. people tracking from a camera-equipped helicopter (Source: Fraunhofer IITB).