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Editorial

Scene understanding and behaviour analysis

1. Motivation

Scene understanding and behaviour analysis have become two popular topics in Computer Science which combine abilities such as perception, signal analysis and interpretation. Hence, they involve joining efforts and sharing knowledge from different research areas such as Computer Vision, Pattern Recognition, Machine Intelligence, Software Engineering or Cognitive Sciences. Scene understanding underlies many abilities such as visual search, visual exploration and attention guidance, 3D object classification or human behaviour description and recognition. However, many other abilities such as spatio–temporal processing or multi-sensor fusion can also rely on this topic. To work in situations which were not initially taken into account, scene understanding is mainly influenced by Cognition, adding to the typical functionalities of generic computer vision, certain cognitive cues related not only to the ability to learn, adapt and develop new algorithms for analysis and interpretation, but also to anticipate events. Besides, scene understanding is also relevant for Human–Robot Interaction, as it also implies to extract information related to the scene which will be meaningful for human operators. Finally, it is also closely related to Robotics, as robots can understand the scene through perception and action. This Special Issue constitutes a collection of original works on these topics, which can be grouped on three research areas (perceptive image organization and attention, scene understanding, and human behaviour analysis).

2. Special issue overview

Visual attention depends on data-driven, bottom-up factors but also on task-dependant top-down factors. In the context of the bottom-up attention, the paper by Belardinelli et al. describes the importance of moving object extraction and prioritization in the processing of dynamic scenarios. Their method succeeds in extracting meaningful moving objects from the background and identifying other less interesting motion patterns. On the other hand, Bonev et al. demonstrate that the complexity of image information and task demands interact. In this paper, they describe an information-theoretic approach to understand eye-movement patterns.

The papers by Falomir et al., Antunez et al. and Marton et al. address the problem of scene understanding based on objects. Real world heterogeneous scenes contain objects of a large variety of forms, surfaces, colours and textures. In order to deal with their challenges, Falomir et al. propose the use of qualitative distances and image descriptions for representing indoor scenarios. Antunez et al. propose a part-based approach for automatic object detection, where the object and the image are represented by combinatorial maps. The search of the object to be detected in the 2D image is performed using a novel error-tolerant submap isomorphism. Marton et al. describe a multi-modal approach that employs a novel training strategy for ensembles of strong learners. This approach not only outperforms the best member but also the best classifier trained on the concatenation of features.Both approaches remain local, and do not account the interdependence among parts of the scene. Pictorial structures have arisen as a fundamental parts-based model for some vision problems, such as articulated object detection. However, the form of classical pictorial structures limits their applicability for global problems, such as semantic pixel labelling. The paper by Corso describes an extension of the pictorial structures approach to overcome this limitation. This model extends the classical form in two ways: first, it defines parts directly based on pixel-support rather than in a parametric form, and second, it specifies a space of plausible parts-based scene models and permits one to be used for inference on any given image. The problem of scene understanding can be also addressed using images, without considering the objects in the scene. In these cases, it is crucial to extract the relevant images from the video sequence. Vázquez-Martín and Bandera propose a key frame detector that not only considers the frame content to quantify appearance changes on the sequence, but also the temporal accumulation of evidence.

Shao et al. propose a multi-part sparse representation method for pedestrian tracking to be used in random crowded scenes. Ferryman et al. and Clapés et al. present automatic video surveillance frameworks. The paper by Ferryman et al. describes a robust and efficient method for detecting abandoned objects in surveillance scenes. The framework is based an online novel threat assessment algorithm which combines the concept of ownership with automatic understanding of social groups in order to infer abandonment of objects. Clapés et al. propose a surveillance system for user identification and object recognition based on multi-modal RGB-Depth data analysis. The system robustly recognizes users and objects, updating the system in an on-line manner. Automatic understanding of customers' shopping behaviour and acting according to their needs is relevant in the marketing domain and is attracting a lot of attention lately. The paper by Popa et al. describes a multi-level framework for the automatic assessment of customers' shopping behaviour. Khoshhal and Dias link the behaviour analysis with the outer scenario, proposing a novel approach for modelling human interactions based on existent relationship characteristics between body parts motions and environmental parameters.

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