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Editorial

Introduction to the Special Issue on Innovative Applications of Computer Vision

The computer vision and pattern recognition field has been very active and is witnessing a multitude of techniques being developed for a variety of applications. The challenge has been to successfully develop robust vision systems that can work effectively in real-world situations. The special issue presents seven diverse applications of computer vision and pattern recognition. The papers presented in this special issue were selected from the 36 papers that were presented (and selected from 90 submitted papers) in a single track at the 5th IEEE Workshop on Applications of Computer Vision (WACV2000) held in Palm Springs, California, in December 2000.

The first paper in this special issue is by Appel and Navab on the registration of technical drawings and calibrated images for industrial augmented reality. The paper presents an algorithm to fully integrate technical drawings, calibrated images and as-built 3D models. The new algorithm requires only a few correspondences between points on a technical drawing and multiple images in order to estimate a metric planar transformation between the drawing and the world coordinate system. It describes the mathematical relationship between this transformation and the set of homographies needed for merging the technical drawing with all the calibrated images. The technical drawings are superimposed on the photogrammetric images, thus significantly improving the industrial planning process.

The second paper by Joyeux et al. is on the tracking and map reconstruction of line scratches in degraded motion pictures. It describes a working system for automatically detecting and removing line scratch artifacts from digitized old and grainy black and white films. It has a mix of application-specific requirements and approaches using techniques such as Kalman filtering over multiple frames and a Bayesian restoration technique to achieve the reconstruction of damaged areas in motion picture films.

The third paper by Ortiz et al. is on a vision system for tracking underwater cables at video rates. The operating conditions, guiding a stable underwater vehicle, and environmental conditions such as sand, algae, rocks, etc. surrounding the cables make their detection and tracking a difficult problem. The paper describes a method based on image segmentation, cable detection (position and orientation) and comparison of measurements with prediction. If the measurements and prediction for the region-of-interest do not agree, a recovery mechanism

is activated. Results are shown on several sequences of varying quality.

The fourth paper by Beveridge et al. presents an approach for automated velocity picking in semblance velocity images (velocity vs. time images) for geophysical data interpretation. Velocity picking is one of the important steps used to develop a map of the earth's crust from acoustic data collected on the surface. The authors present a two-step process where in the first step the intensity peaks are found in the semblance velocity image and in the second step a local search method, guided by the median of the result of the first step, is used to find a locally optimal subset of peaks that represent the most coherent curve through the image. The authors claim performance accuracy comparable to that of the human expert.

The fifth paper by Liu and Vemuri is on the efficient multimodal image registration. Both the rigid motion and non-rigid deformation cases are considered. The paper presents a combination of techniques for multimodal registration, combining a local frequency image representation based on Gabor wavelets with a quasi-Newton and a PDE-based morphing technique that estimates the non-rigid alignment. Examples are presented using computed tomography (CT) and magnetic resonance (MR) scan images.

The next paper by Russakoff and Herman is on head tracking using stereo. The authors propose an approach for head tracking by using stereo depth images instead of conventional intensity images. First, the stereo depth images are used for human figure segmentation, taking advantage of the characteristic that the stereo depth data are insensitive to color, shadow, or lighting variation. To address the problem that the depth data are sensitive to image textures, a surface validation procedure is applied in the segmentation algorithm. Then local edge detectors are employed on the extracted foreground to find the occluding shoulder edges that are used for fitting a simple torso model. The location and orientation of the head are easily estimated by the model parameters. Because the procedure can be performed on each frame separately, it is less sensitive to rapid movements or temporary occlusions than conventional approaches. The experiments show that this model achieves good results in locating the head.

The last paper by Bradski and Davis is on motion segmentation and pose recognition using a motion history gradient method to represent motion in an image sequence. This paper

extends the earlier motion template approach, Motion History Image (MHI), by calculating optical flow motion orientations directly from the MHI. A new motion segmentation method is further developed based on segmenting layered motion regions that are meaningfully connected to movements of the object of interest. The proposed method is compared with other optical flow methods. An example of motion gesture recognition in conducting music is used to demonstrate the utility of the approach.

Developing practical computer vision and pattern recognition systems that can work effectively in real-world situations continues to present challenges to vision scientists and engineers. We expect many new applications will emerge in the future and there will be more effective solutions of existing problems. This special issue offers a collection of techniques that are found to be useful for solving real-world problems.

In conclusion, we want to acknowledge our gratitude to the Program Committee and the other reviewers for their careful evaluations of the papers. We would also like to thank the authors who worked under a tight schedule.

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Guest Editors

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