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Editorial

Special issue: Omnidirectional vision and camera networks

Omnidirectional vision refers broadly to the development of sensors for capturing very wide-field-of-view imagery and algorithms for processing such imagery. This topic has been the focus of much recent activity in the machine vision community, as practitioners have recognized the benefits of a field of view that encompasses most of a user's (or robot's) visual field. These benefits include increased robustness in camera parameter estimation; increased accuracy in estimating global features, such as vanishing points and epipolar geometry; reduced ambiguity between rotation and translation in ego-motion estimation; efficient lighting acquisition; and of course the large field of view in its own right, with obvious benefits for video surveillance and tracking, for example.

Development of omnidirectional sensors includes new lens and mirror designs, as well as of camera networks. Development of algorithms includes deriving new camera models and their calibration; methods for 3D reconstruction, ego-motion estimation, and SLAM; dedicated feature extraction methods; and multi-camera object tracking.

This special issue arises from papers presented at the Workshop on Omnidirectional Vision, Camera Networks and Non-Classical Cameras, held on May 16, 2004, in conjunction with the 8th European Conference on Computer Vision in Prague, the Czech Republic.

The workshop featured 15 oral presentations. We decided to invite journal versions of a selected set of workshop papers, to be subjected to the ordinary CVIU review process. We made the selection with the advice and consent of the workshop program committee.

The resulting papers span a rather representative range of topics in omnidirectional vision, including camera networks, feature extraction in non-pinhole images, and theoretical aspects of non-traditional cameras. Of the eight papers invited, six were submitted and passed through the review process. Erdem and Sclaroff solve the general camera placement problem, given a floorplan, by a binary optimization. Sinha and Pollefeys recover the calibration of a network of pan-tilt-zoom cameras. The automatic camera calibration allows creation of high-resolution mosaics. Briggs et al. use an omnidirectional camera for robot navigation. They create a 1D circular image, formed by averaging the scanlines of image panoramas, for which they suggest a family of operators for extracting scale-space features. Schindler investigates how the construction of a straight line of given orientation angle and the measurement of distances along this line are mapped to the non-Euclidean log-polar image plane. The proposed principles are applied to line and circle detection problems. Barreto extends the well-known unifying model for catadioptric systems to incorporate dioptric systems with radial distortion and also provides a new representation for the image plane. Ramalingam et al. introduce a general structure-from-motion approach for a highly general imaging model, where cameras are modeled as unconstrained sets of projection rays.

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