EMARO Computer Vision – Assignment subjects

1. Rubik's cube as a calibration pattern in weak stereocamera calibration

Detect characteristic points on the Rubik's cube in the image from 2 cameras. Use color analysis for approximate cubes' squares positioning and the Hough transform to establish better estimation of squares' corners. Compare characteristic points in two images and calculate parameters of the epipolar geometry for the camera rig. Mark resulting epipolar lines on the images.

2. Computation of disparity map for two images using SSD algorithm

Characteristic points in two images are marked manually. Subsequently they are used to estimate epipolar geometry parameters for the camera rig used for taking the images. In the next step the parameters are used to rectify both images. Then the disparity map is calculated using a classical SSD algorithm.

3. Computation of disparity map for two images using dynamic-programming approach

Characteristic points in two images are marked manually. Subsequently they are used to estimate epipolar geometry parameters for the camera rig used for taking the images. In the next step the parameters are used to rectify both images. Then the disparity map is calculated using a dynamic programming algorithm (computed in x-d or x-y space)

4. Traffic analysis with the optical flow approach

Detect large moving objects (vehicles) on the road using the optical flow. Assume horizontal orientation of the camera. Establish position of lanes and the vanishing point (could be done semi-automatically by letting user to choose characteristic points on the lines separating lanes). Compare each vehicle width with the corresponding lanes width and filter-out smaller vehicles (bikes and motorcycles).

5. Object tracking using the Kalman filter

Track an object (hand, face, ball) in the image sequence using the Kalman filter. Propose a motion model comprising displacement, rotation, velocity and acceleration. Image measurements are performed using the color analysis and the results of prediction phase are used to limit object search perimeter. Test the solution in different parameters and environments (eg. similar objects present in the image, partial and temporal total occlusions could happen)

6. Object tracking with using the particle filter

Track an object (hand, face, ball) in the image sequence using the particle filter. Propose a motion model comprising displacement, rotation, velocity and acceleration. Image measurements are performed using the color analysis. Test the solution in different environments (eg. similar objects present in the image, partial and temporal total occlusions could happen)

7. Object recognition by the MAP estimation, based on a 3-D generic object model.

Design and implement a MAP estimation for 3-D object recognition, based on its 3-D generic model, that represents a simple object (such as cube box). Assume a cycle of following steps: hypothesis prediction, projection to the image plane, matching with image segments, hypothesis update.

8. Detection and localization of a 2-D contour.

Detection and localization of a 2-D contour (for example a human head profile) in an image, where many object instances of different sizes can exist.
For this purpose apply the Hough Transform, generalized for 2-D contour localization adopting scale and rotation tolerance. Before that - detect edge chains using Canny operator and smooth the directions of edge elements by considering its neighbour elements.

9. Texture detection and classification

Detect non-homogeneous image regions of small size (e.g. 16x16 pixel) by designing some homogeneity criterion. Reduce number of pixel values. Compute the intensity co-occurrence matrix for blocks in 4 directions. Compute the set of statistic features on base of intensity connection matrices. Create a minimum-distance (or other) classifier for recognition of textures from 10 classes. Detect regions in the image of similar texture.