Fusing monocular information in multi-camera SLAM.

Multimedia material description

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`whiteboard.mov` (13.7MB): This movie shows the mapping process of the "White board" experiment. We show both image sequences and the top view of the produced 3D SLAM map. The images are captured by a stereo head of 330mm baseline, mounted on a robot that uses odometry for motion predictions. Both the fixed baseline and the odometry information allow the observability of the scale factor. The left camera acts as the master, detecting and initializing landmarks. The right one is initialized with 1° uncertainty in the 3 orientation DOF. The initialization process used is IDP. Rays are drawn in red or magenta and single Gaussians in pale or dark blue. We use 3σ bound ellipsoids for the 3D map and 3σ expectation ellipses in the images. The estimations are drawn in magenta and dark blue. If a successful match and update is applied to any of these estimates, these colors are changed to red and pale blue. This shows the reduced set of points that are used for the SLAM updates at each frame. The plot in the right-bottom corner shows the evolution of the self-calibrated extrinsic angles. The same plot shows the 3σ bounds of the angles estimated by the EKF, showing a consistent estimation.

Player information: Multi-platform, H-264 codec. Quicktime player available at `http://www.apple.com/quicktime/player/`

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`whiteboard-einf.mov` (4.4MB): This movie shows the mapping process of the "White board" experiment, with emphasis on the self-calibration process. We show both image sequences and the top view of the produced 3D SLAM map. The initialization process used is IDP. Rays are drawn in red or magenta and single Gaussians in pale or dark blue. We use 3σ bound ellipsoids for the 3D map and 3σ expectation ellipses in the images. The estimations are drawn in magenta and dark blue. If a successful match and update is applied to any of these estimates, these colors are changed to red and pale blue. This shows the reduced set of points that are used for the SLAM updates at each frame. The plot in the right-bottom corner shows the evolution of the self-calibrated extrinsic angles. We draw the expectations $\mathcal{E}_1$ and $\mathcal{E}_\infty$ of newly initialized IDP rays in green and yellow respectively. Particularly, $\mathcal{E}_\infty$ is useful for illustrating the evolution of the calibration process by showing different shrinking rates in the vertical (pitch) and horizontal (yaw) axes. At frame 0, initial uncertainties of 1° result in a big, round $\mathcal{E}_\infty$ ellipse. After the first updated landmark from the left camera (frame 2), the uncertainty in pitch decreases and the $\mathcal{E}_\infty$ ellipse becomes flat. Successive updates further refine the calibrated angles. The yaw angle takes longer to converge, but the tiny yellow ellipse after some 40 frames shows that the calibration is almost complete. The portion of the green ellipse on the right side of the yellow one corresponds to negative disparities and is not searched for matches. This portion is bigger as parallax increases.

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Contact information: `jsola@laas.fr` `cooperativeSLAM.mov` (21MB): This movie shows the mapping process of the Cooperative SLAM experiment. Two cameras mounted on top of bicycles move independently and map the same area. The movie shows the image sequences with superimposed SLAM information and a top view of the produced 3D map. The left camera is the master and the right one the slave. They start parallel to each other, looking forward. The master takes some advantage and the slave follows it at a close distance, meaning that the master camera is visible from the slave's viewpoint. We draw a virtual model of the master camera in the slave image. Two constant velocity models are used to predict the motions, so the scale factor is only determined by the initial baseline (which is of 75cm). Landmarks are initialized using IDP. We use 3σ bound ellipsoids for the 3D map and 3σ expectation ellipses in the images. IDP rays are drawn in red or magenta and Euclidean landmarks in pale or dark blue. The estimations are drawn in magenta and dark blue. If a successful match and update is applied to any of these estimates, these colors are changed to red and pale blue. This shows the reduced set of points that are used for the SLAM updates at each frame. Long term observations of very distant landmarks (*e.g.* landmarks 4 and 118 are beyond 50m) allow a drastic reduction of angular drifts. Landmarks are printed with a legend XXX-YY in yellow where XXX is the identifier and YY is the ZNCC score in %. The score remains very high after significant appearance changes thanks to the affine warping applied.

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