Essential Matrix Estimation and Non-linear Optimization

Task 1 – Essential Matrix Estimation

While the fundamental matrix represents the relative orientation of an image pair for the uncalibrated case (i.e. without information about the interior orientations resp. camera intrinsic), the essential matrix covers the calibrated case. Using algebraic projective geometry, the epipolar geometry of a calibrated camera pair can, thus, be expressed by the essential matrix ***E***.

a) Use the data **bh.dat**, which provide corresponding images coordinates as well as object points. Use this information to compute the *calibration matrices* ***K1*** and ***K2*** for each of the cameras.

b) Based on the computed calibration matrices estimate the *essential matrix*, that relates the two views.

c) Resolve the *fourfold ambiguity* of the essential matrix by selecting the geometrically plausible solution.

d) Compute and plot the *epipolar lines* from the essential matrix.

Task 2 – Non-linear Optimization

Singular value decomposition (SVD) provides an optimal solution with respect to the algebraic error. The goal, however, is to obtain a solution optimal with respect to the geometric error. The algebraic solution can serve as a starting point for further non-linear optimization.

a) Compute the geometric error based on the solution from Task 1.

b) Perform a non-linear optimization by means of the *indirect optimization* using a built-in function of your choice (Levenberg-Marquart, etc.).

c) Re-calculate the geometric error.