

## Two-view Reconstruction

The goal of this assignment is to obtain a two-view reconstruction for a pair of frames. To achieve this you will implement a feature-matching algorithm that takes the SURF descriptors (similar to SIFT descriptors but with a 64 element descriptor). This is followed by a RANSAC approach to estimate the fundamental matrix. All other functionality is provided to you by the Matlab function `StartTwoViewReconstruction` and its derivative functions. All needed files are provided in `AssignmentTwoView.zip`.

### Feature matching

In the first part of the assignment the function

```
[idxs] = PutativeMatchSURF(features1, features2)
```

will be implemented. The function has the feature descriptors from both images as input and should output the indices for all matching features. The matching metric for the feature descriptors is the Euclidian distance of the descriptors. If available on your system you can use the `pdist2` function from Matlab for improved computational performance.

### Fundamental Matrix Estimation

In the second part of the assignment you will implement a fundamental matrix RANSAC estimation leveraging the normalized 8 point algorithm. The function should be implemented in the Matlab function `FRANSAC(matchedPoints1, matchedPoints2, probSol, threshold)`.

To recap the class and what has to be implemented here are the main steps of such an algorithms are:

- 1) Select a random minimal set from all potential correspondences
- 2) Compute a solution from the minimal samples
  - a. This step first normalizes the sample points using the Hartley normalization:
    - i. Shift the points mean to the origin, i.e.  $[0,0]^T$
    - ii. Normalize the mean distance of the points to be  $\sqrt{2}$
  - b. Then the 8-point algorithm computes the solution of the fundamental matrix from the eight sample correspondences. The epipolar constraint provides you with the linear equations for the estimation. The constraint is given by  $m^T F m' = 0$  with  $m = [x, y, 1]^T$  being a point in

the second image and  $m'=[x',y',1]^T$  being the corresponding point in the first image. Then the linear form of the constraint for the normalized points is given by:

$$(xx',xy',x,yx',yy',y,x',y',1) \begin{pmatrix} f_{1,1} \\ f_{1,2} \\ f_{1,3} \\ f_{2,1} \\ \vdots \\ f_{3,3} \end{pmatrix} = 0$$

Please note, that the fundamental matrix can be estimated using an SVD of the resulting system matrix. In addition you will need to enforce the rank 2 constraint for the fundamental matrix.

- 3) Evaluate all normalized matches with the estimated normalized fundamental matrix and count the inliers.
- 4) Evaluate if the current fundamental matrix is the best so far seen fundamental matrix. If it is store it and recompute the number of trials needed.
- 5) Start over with 1) if not enough trials have been performed.