Computer Vision Exercise 6

Structure from Motion & Model Fitting

Tasks

1. Scene reconstruction with SfM
   - DLT (Essential matrix)
   - Testing decompositions
   - Map extension

2. Model Fitting
   - Least-squares
   - RANSAC

SfM

- Initialization (Relative pose)
- Point Triangulation
- Absolute Pose estimation

Not covered:

- Feature matching
- Robust estimation (Model fitting)
- Bundle adjustment

SfM

SfM

Initialization

$$\hat{x} = K^{-1}x$$

$$\hat{\boldsymbol{x}}_1 E \hat{\boldsymbol{x}}_2 = 0$$

Same approach as for P (DLT)!

SfM

Initialization – Constraints on E

$$U, S, V^T = svd(\hat{E})$$

$$E = U \begin{bmatrix} 1 & & \\ & 1 & \\ & & 0 \end{bmatrix} V^T$$

SfM

Initialization – Finding the right decomposition

Decomposing E gives 4 possible relative poses

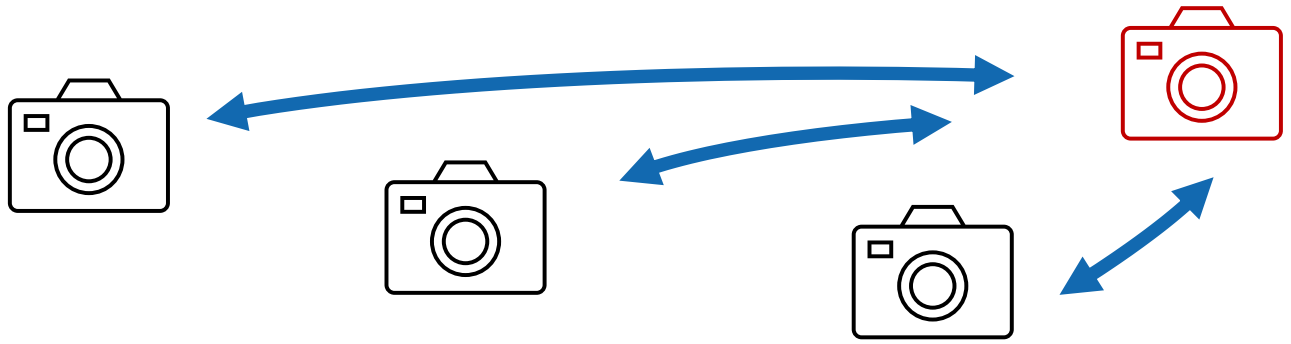
$$(R_1, t), (R_1, -t), (R_2, t), (R_2, -t)$$

Try each one to see where points end up in front of the cameras

SfM

Map extension

For each new image, call the point triangulation with every previous image



Model Fitting: Line Fitting

- Given a point set with noise and outliers, estimate the parameters: $y = kx + b$
- Implement least-squares solution
- Implement RANSAC (300 iterations)

1. randomly choose a small subset from the noisy point set ;
2. compute the least-squares solution for this subset;
3. compute the number of inliers, if the number exceeds the current best result, update the estimation