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

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

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

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
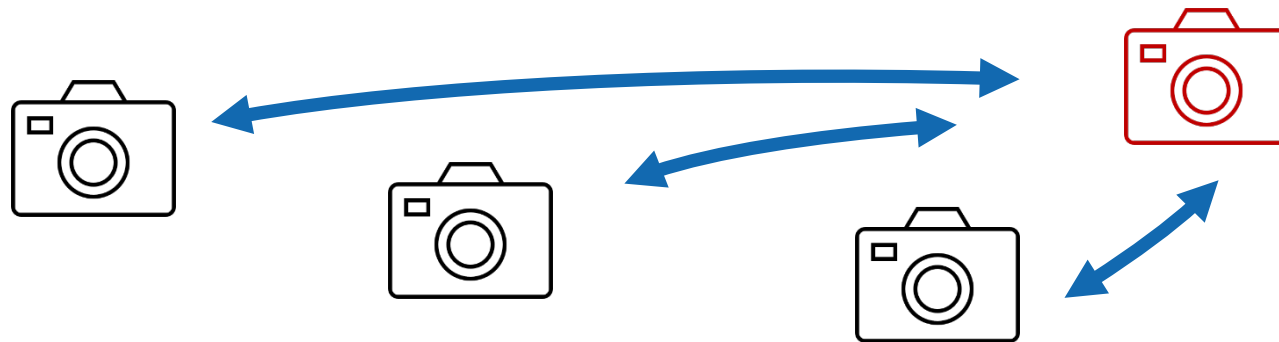
Decomposing E gives 4 possible relative poses

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

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

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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