

# The Gold Standard method

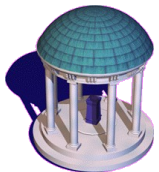


- An initial estimate of  $F$  using the normalized 8-point algorithm.
- Extract two camera matrices

$$P = [I \mid 0] \quad \text{and} \quad P' = [[e']_{\times} F \mid e'] \quad \text{with } e' \text{ obtained from } F$$

- Estimate the 3D positions of the real-world points, from the correspondences and  $F$ .
- Project the 3D points back to image planes using the estimate of the camera projection matrices
- Minimize the difference in the real points and the backprojected points

by varying  $P$  and  $P'$  and the coordinates of the 3D points (and thus also implicitly by varying  $F$ ).





## The Gold Standard method

Minimize a geometric distance (cost):

$$\sum_i d(\mathbf{x}_i, \hat{\mathbf{x}}_i)^2 + d(\mathbf{x}'_i, \hat{\mathbf{x}}'_i)^2 \quad \text{subject to } \hat{\mathbf{x}}'^T \mathbf{F} \hat{\mathbf{x}} = 0$$

Minimize cost using Levenberg-Marquardt

summary:

Initialize: normalized 8-point,  $(P, P')$  from  $F$ , reconstruct  $X_i$

$$P = [I \mid 0], P' = [M \mid t], X_i$$

$$\hat{\mathbf{x}}_i = P X_i, \hat{\mathbf{x}}'_i = P' X_i$$

Iterate over  $P'$  and  $X$  to minimize the cost function

$3n$  (for each point) + 12 (for  $P'$ ) parameters.

Once  $P' = [M \mid t]$  is found, compute  $F = [t]_{\times} M$ .

