Multiple View Geometry
in computer vision

Chapter 9: Epipolar Geometry and the Fundamental Matrix

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Overview clubje

- Part 0, The Background
- Part 1, Single View Geometry
  - Chap 6, Defined camera matrix P, internal, external camera parameters
  - Chap 7, Estimated P using $\mathbf{X}_i \leftrightarrow \mathbf{x}_i$
  - Chap 8, Estimate P using $\mathbf{x}_i$ and various pieces of information about $\mathbf{X}_i$
- Part 2, Two View Geometry
  - Chap 9, Define Fundamental matrix F using P and P'
  - Chap 11, Estimate F using $\mathbf{x}_i \leftrightarrow \mathbf{x}'_i$

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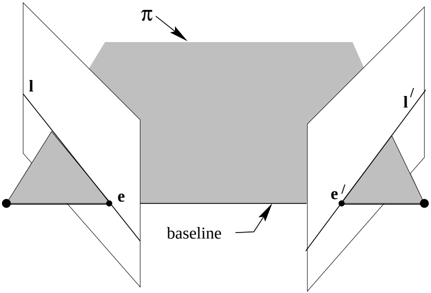
Overview Chap 9

- The Fundamental matrix F describes the intrinsic projective geometry between two views.
- Camera matrices can be determined from F up to a projective transformation by F
- The Essential matrix E is a specialization of F for calibrated cameras

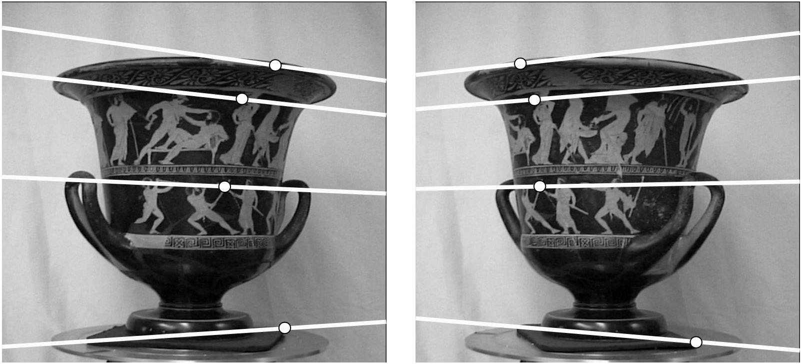
Epipolar geometry

- The two camera centers C and C', and scene point define an *epipolar plane* π.
- The intersection of π with the two image planes result in two *epipolar lines* $\mathbf{l}$, $\mathbf{l}'$.
- Point $\mathbf{x}'$ corresponding to the same unknown scene point $\mathbf{X}$ as $\mathbf{x}$, lies somewhere on $\mathbf{l}'$.
- Epipoles **e**, **e** result from the projection of the camera centers on the image planes.



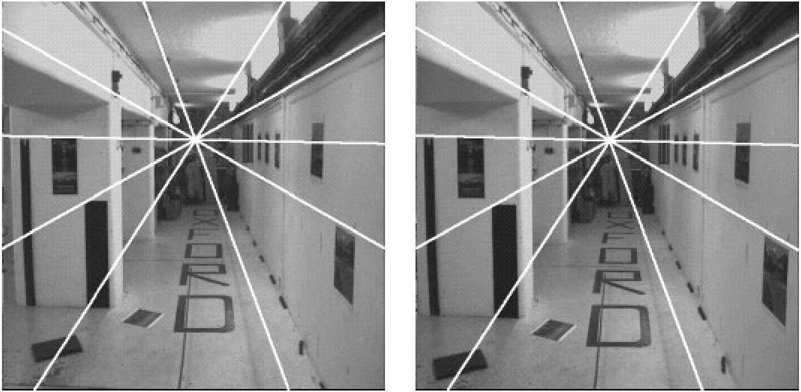
Epipolar geometry

Example:



Epipolar geometry

Example with little rotation, the epipoles are visible:



Fundamental matrix

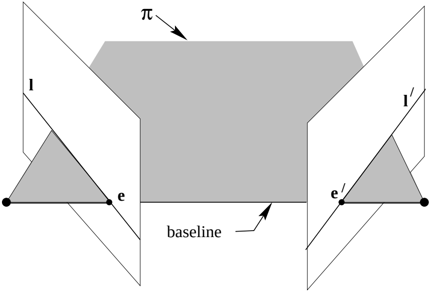
- The Fundamental matrix F describes the mapping from $\mathbf{x}$ $\mathbf{l}'$ and $\mathbf{x}'$ $\mathbf{l}$:

$$\mathbf{l}' = F\mathbf{x}$$

$$\mathbf{l} = F^T\mathbf{x}'$$

- F can be computed from the internal and external parameters:

$$F = [P'\mathbf{C}]_\times P' P^+$$



End

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