

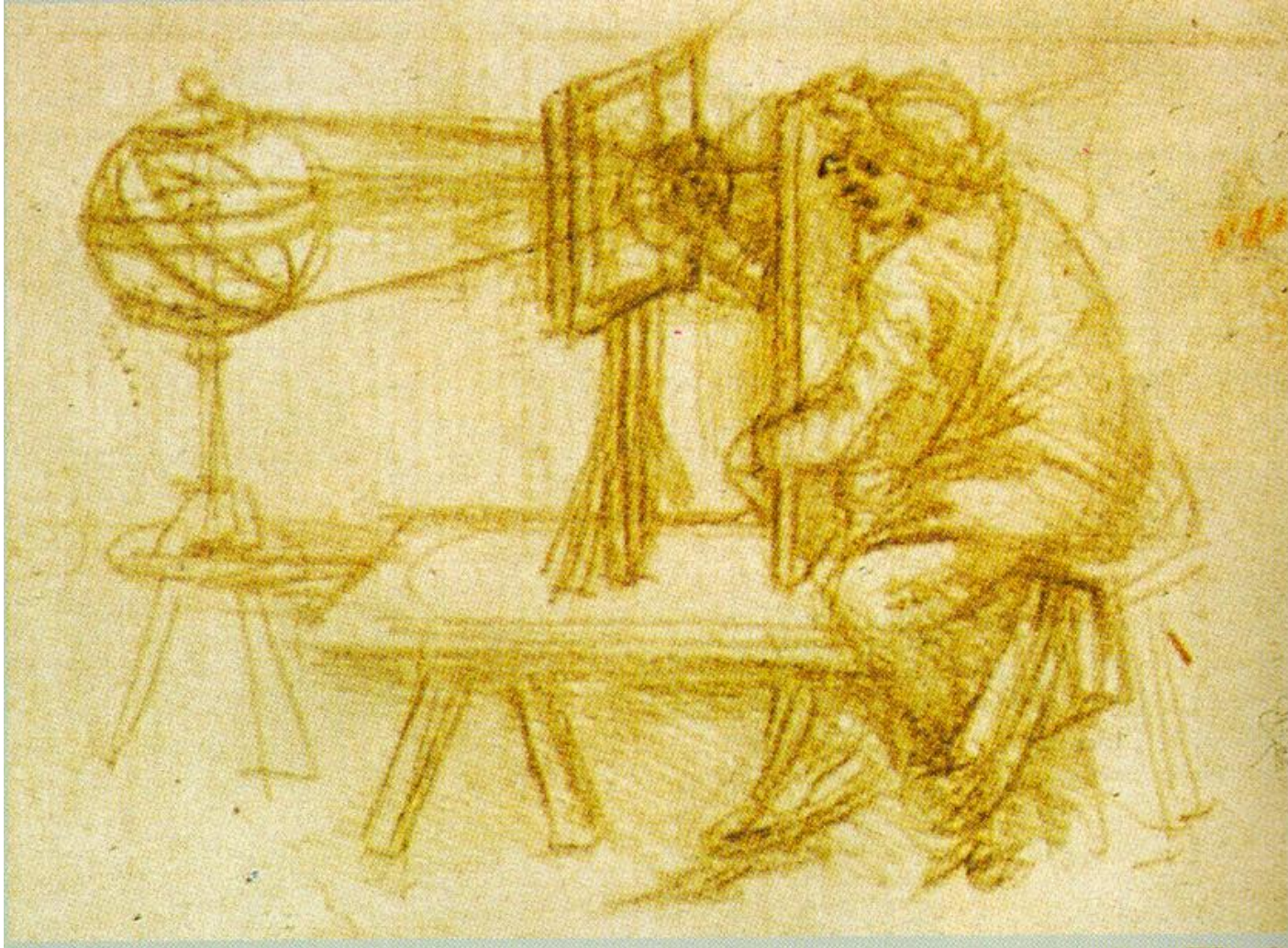
Computer vision at Cambridge

A changing perspective

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Part I: A perspective



Part I: Review of earlier work (2000)

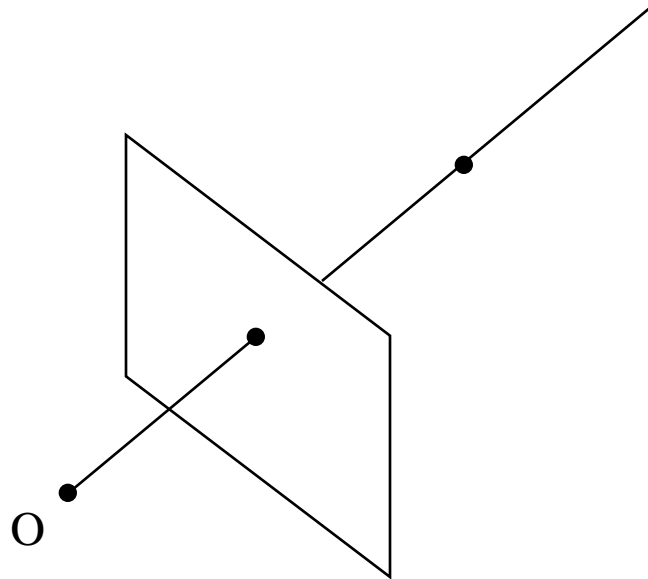
- 3D model acquisition from uncalibrated images
 - projective and epipolar geometry
- Outline (or silhouette) is the dominant image feature
- Real-time visual tracking of articulated structures in multiple views
- Generic mathematical (geometrical) framework and practical implementation.

3D model acquisition

Photorealistic models from uncalibrated images of architectural scenes

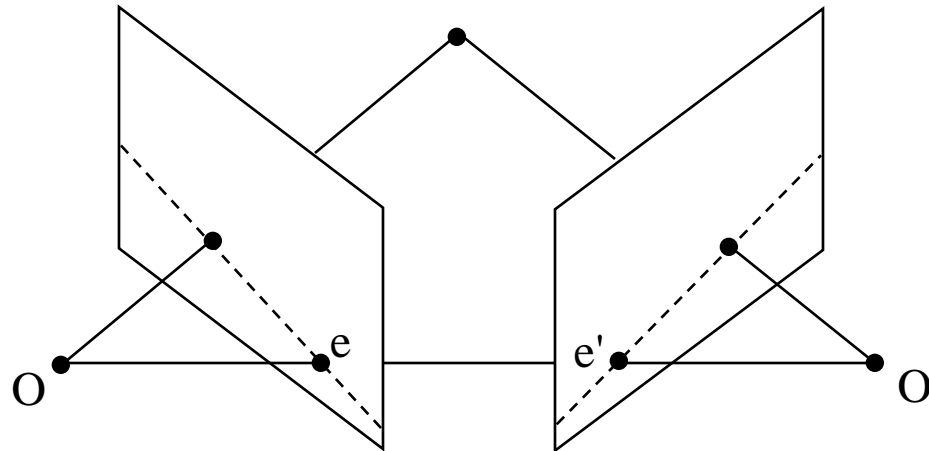


Ambiguity in a single view



$$\begin{bmatrix} \lambda u \\ \lambda v \\ \lambda \end{bmatrix} = \mathbf{K}[\mathbf{R} \quad \mathbf{T}] \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$$

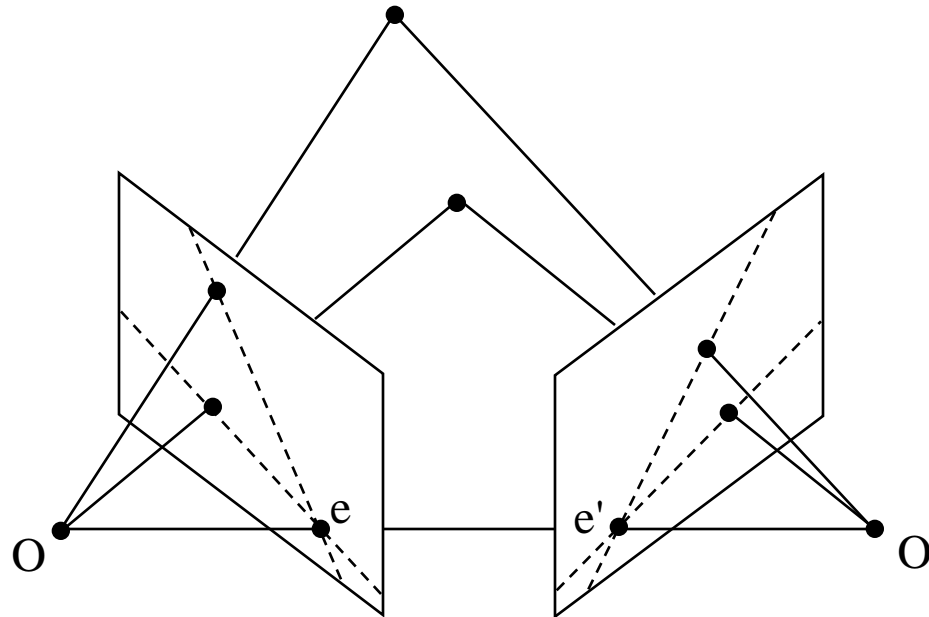
Stereo vision



$$\begin{bmatrix} \lambda u \\ \lambda v \\ \lambda \end{bmatrix} = \mathbf{K} \begin{bmatrix} \mathbf{R} & \mathbf{T} \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} \lambda u' \\ \lambda v' \\ \lambda \end{bmatrix} = \mathbf{K}' \begin{bmatrix} \mathbf{R}' & \mathbf{T}' \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$$

Epipolar geometry



$$\begin{bmatrix} u' & v' & 1 \end{bmatrix} \begin{bmatrix} F \\ \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} \end{bmatrix} = 0$$

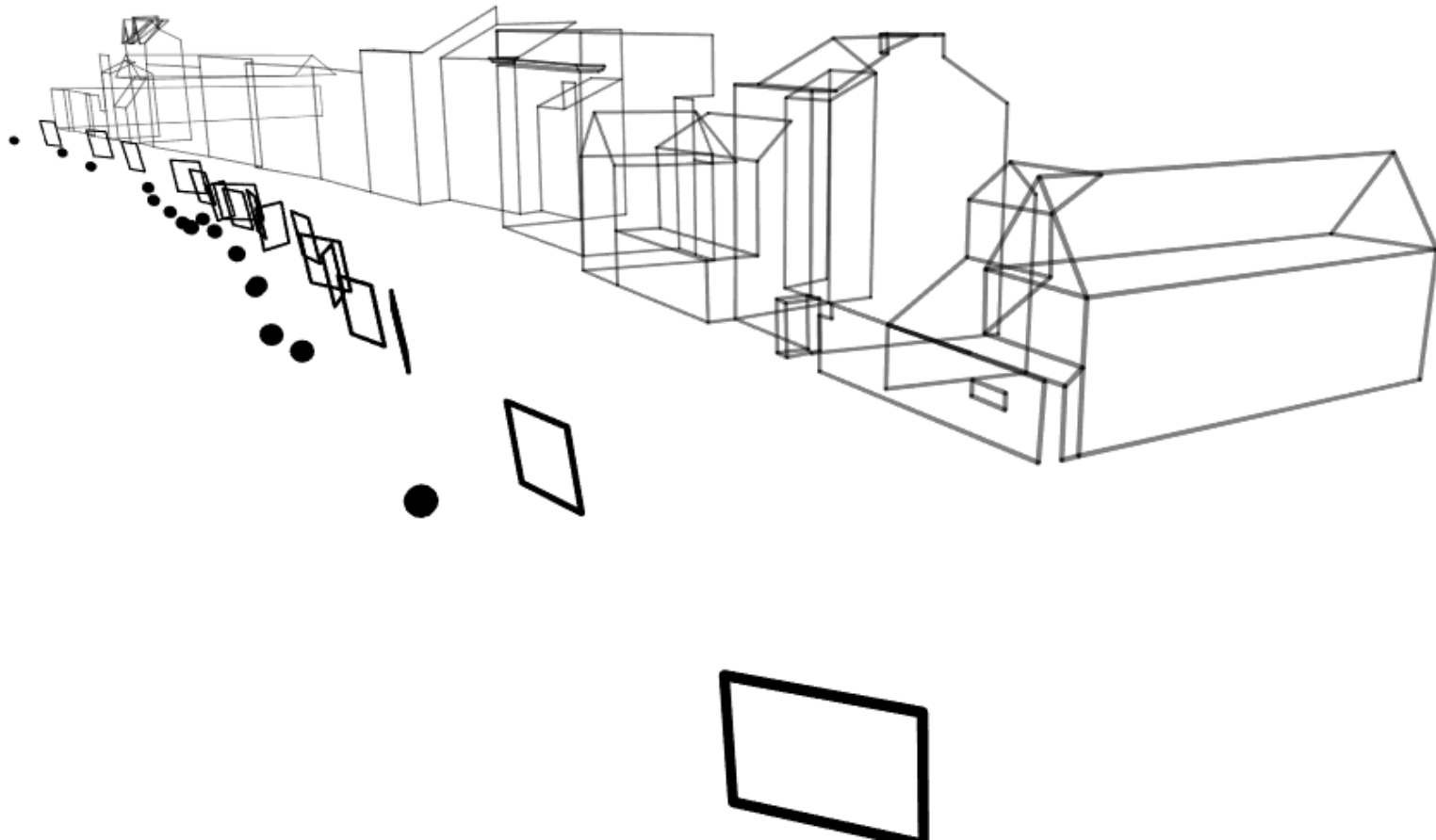
Trumpington Street Data



Camera pose determination



3D reconstruction



Reconstruction texture mapped



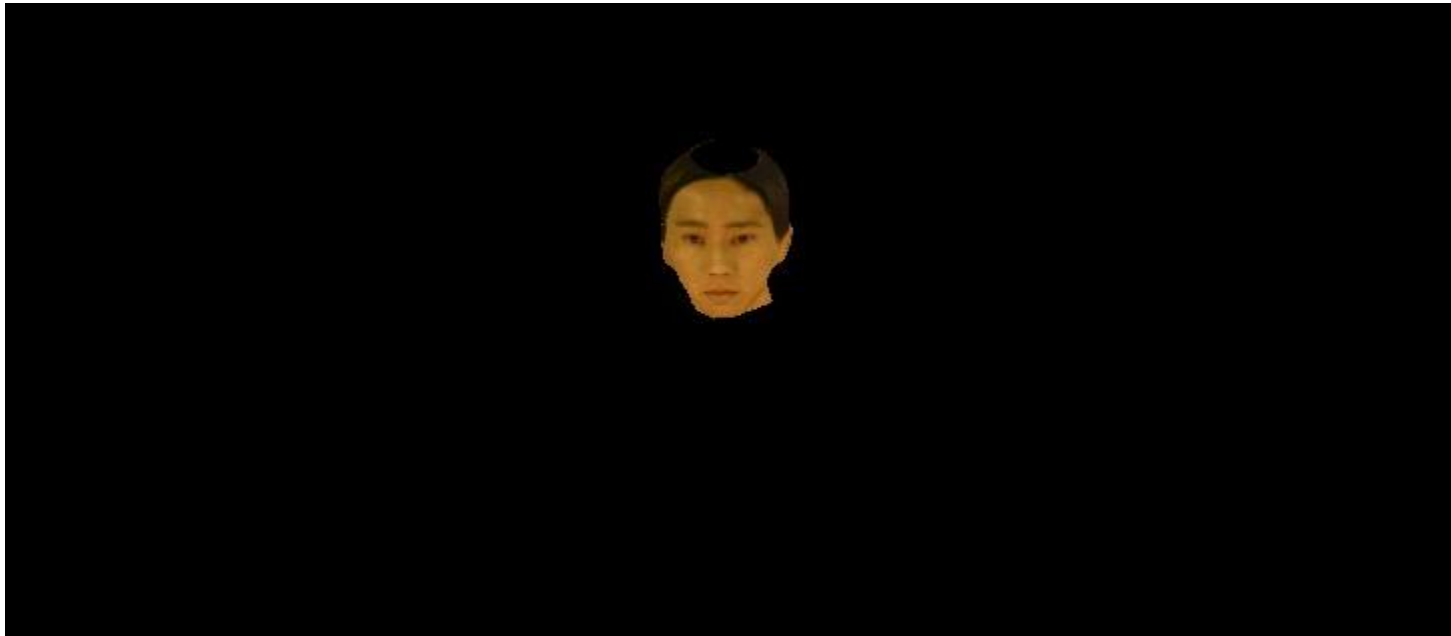
Summary of previous work

- 3D model acquisition from uncalibrated images
- Outline (or silhouette) is the dominant image feature
- Real-time visual tracking of articulated structures in multiple views
- Generic mathematical (geometrical) framework and practical implementation.

Shape from profiles



Automatic 3D model acquisition



Shape and motion from profiles



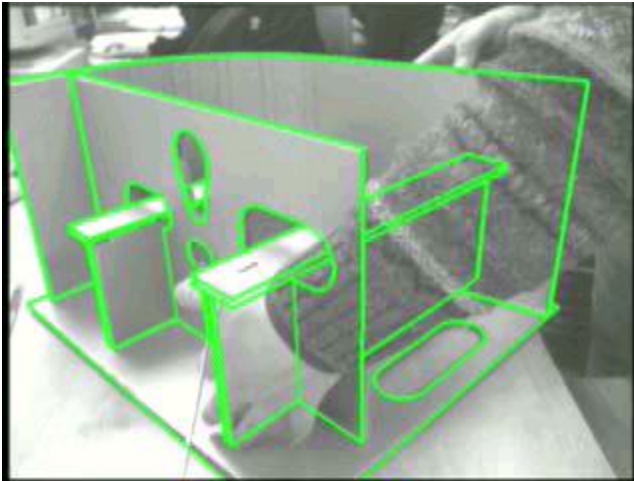
3D model acquisition



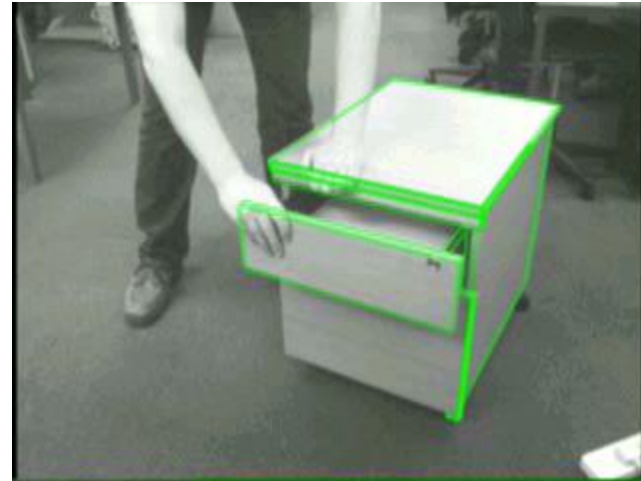
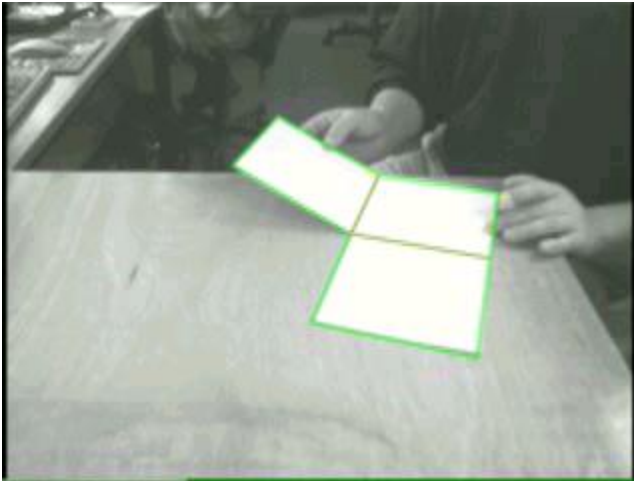
Outline and Motivation

- 3D model acquisition from uncalibrated images
- Outline (or silhouette) is the dominant image feature
- **Real-time visual tracking of articulated structures in multiple views**
- Generic mathematical (geometrical) framework and practical implementation.

Real-time tracking using 3D models



Articulated structures



Tracking curved surfaces



Summary of previous work

- 3D model acquisition from uncalibrated images
 - Review of Projective and Epipolar geometry
- Outline (or silhouette) is the dominant image feature
 - Extension to curved surfaces
- Real-time visual tracking of articulated structures in multiple views
- Generic mathematical (geometrical) framework and practical implementation.

Problems?

- Matching over wide baseline and disparate views
- Tracking is easy but initialisation is hard
- Modelling is difficult

Changing perspective – themes

- Recognition: detection/segmentation/correspondence
- Large amounts of training data
- Machine learning - supervised and unsupervised methods
- Statistical/bayesian framework to exploit prior knowledge
- Inference using belief propagation