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Basic epipolar geometry

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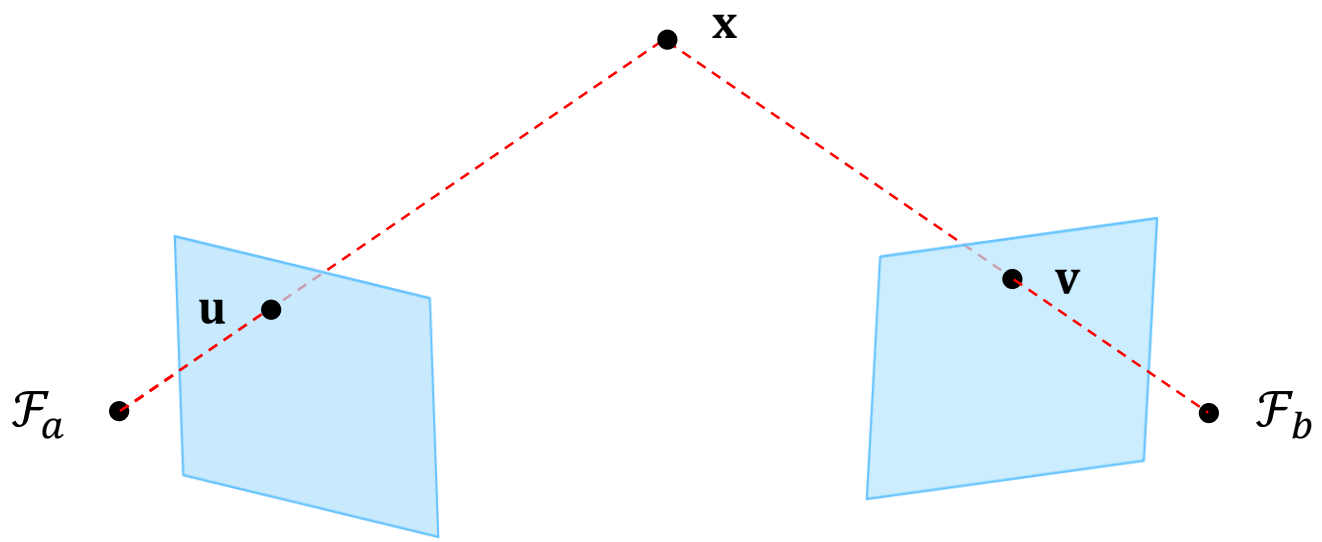
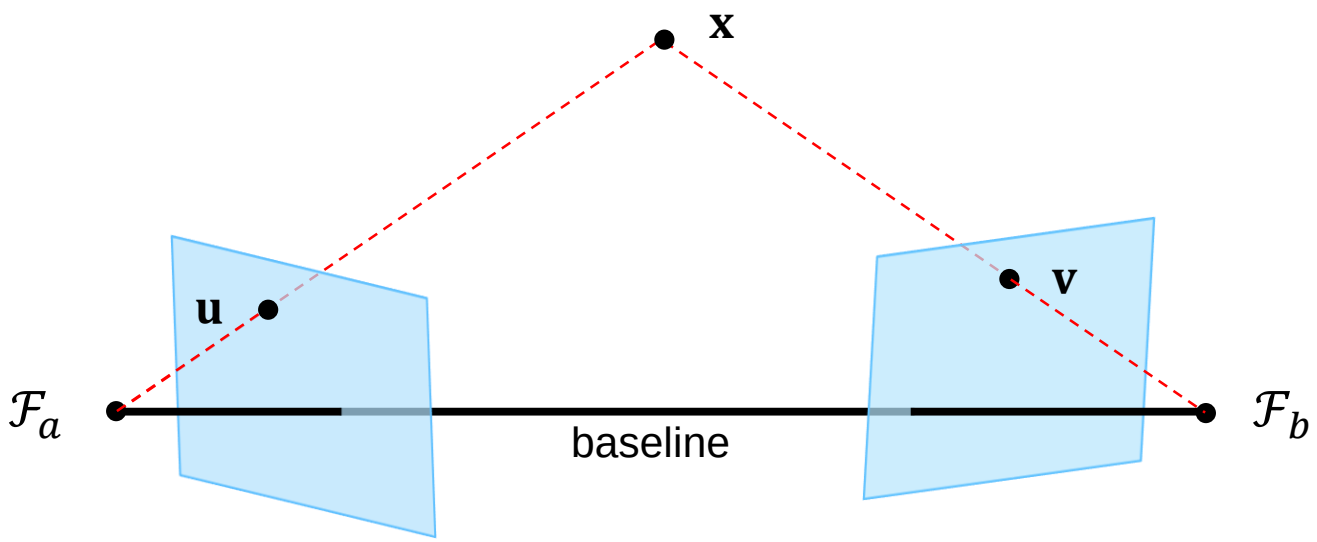
Introduction



Two perspective cameras observing the same scene point, puts a strong constraint on how the two cameras must be positioned and oriented, both relative to the scene and each other

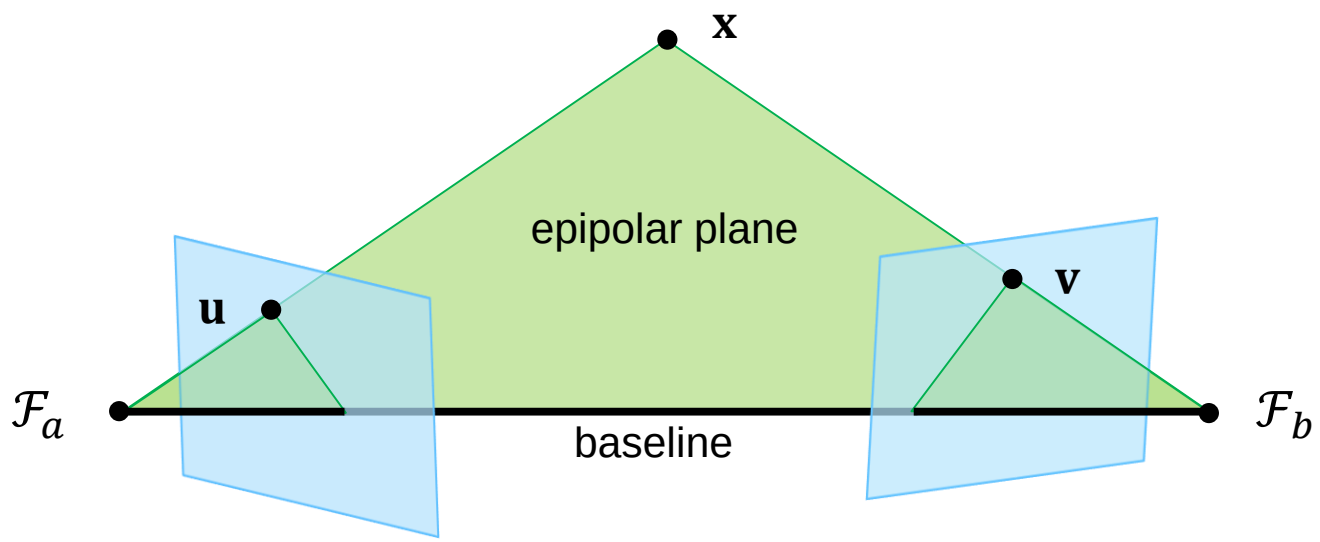
This two-view geometry is commonly known as **epipolar geometry** and it comes naturally with some new geometrical constructs

Epipolar geometry



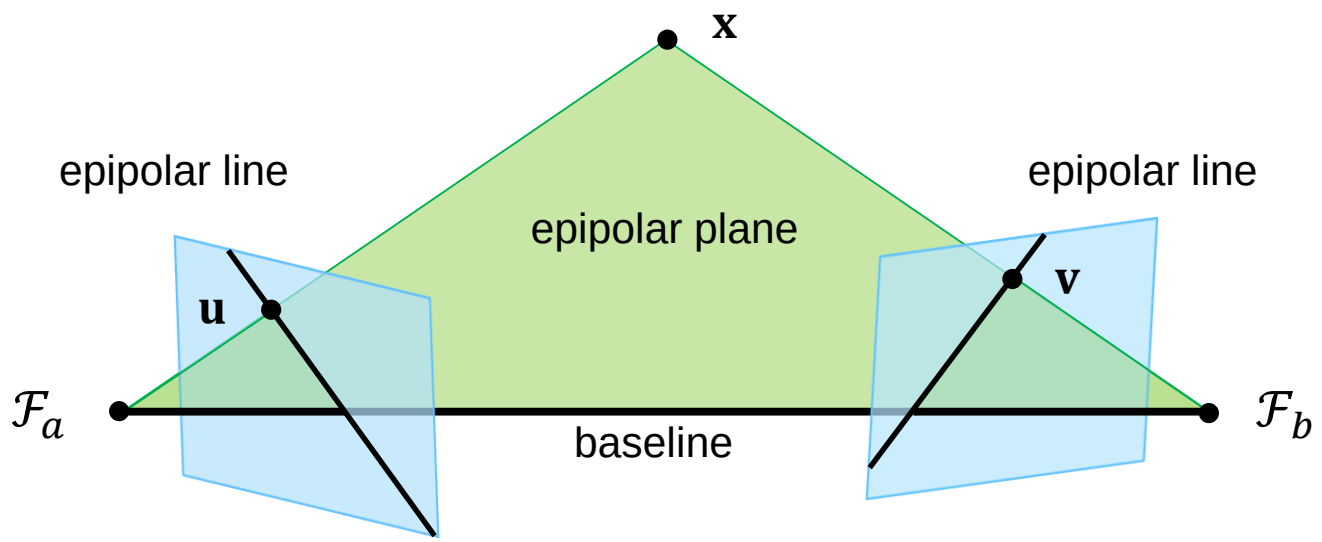
- The **baseline** is the line joining the two camera centers

Epipolar geometry



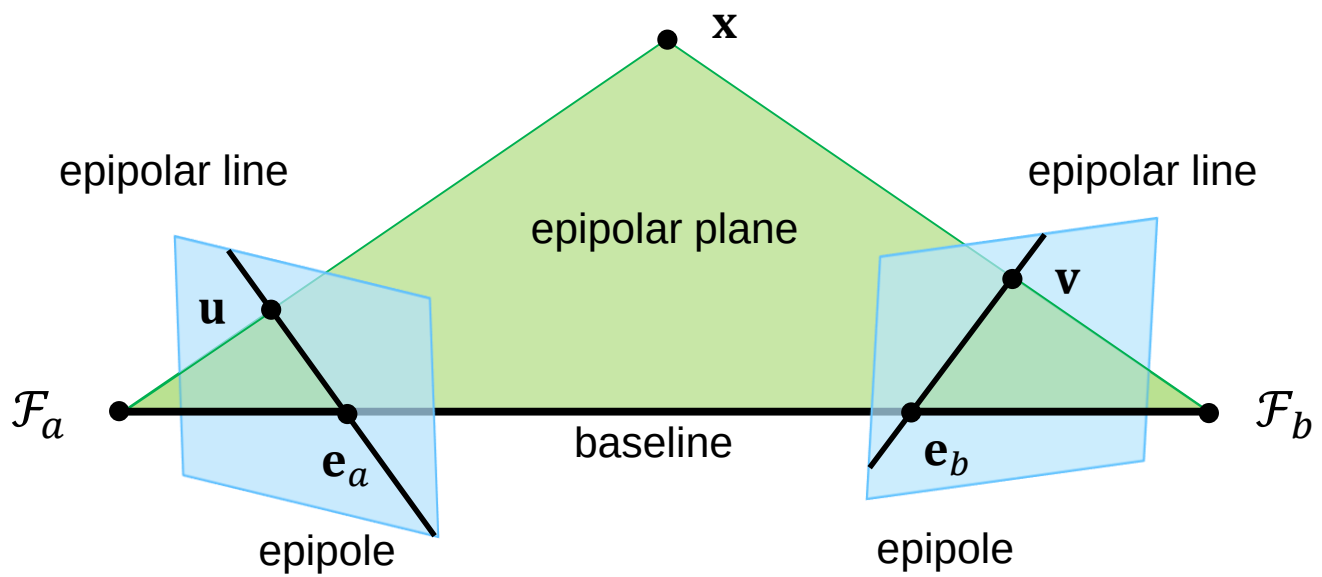
- The **baseline** is the line joining the two camera centers
- The **epipolar plane** is the plane containing $\mathbf{x}$ and the two camera centers $\mathcal{F}_a$ and $\mathcal{F}_b$

Epipolar geometry



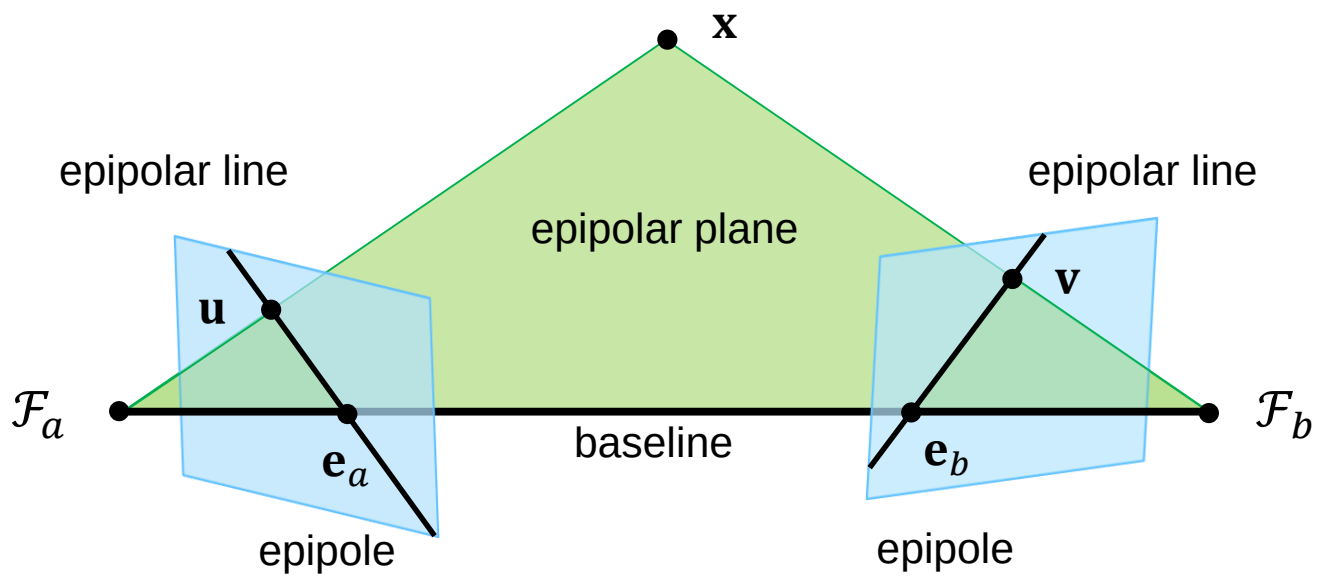
- The **baseline** is the line joining the two camera centers
- The **epipolar plane** is the plane containing $\mathbf{x}$ and the two camera centers $\mathcal{F}_a$ and $\mathcal{F}_b$
- The **epipolar lines** are where the epipolar plane intersect the image planes

Epipolar geometry



- The **baseline** is the line joining the two camera centers
- The **epipolar plane** is the plane containing $\mathbf{x}$ and the two camera centers $\mathcal{F}_a$ and $\mathcal{F}_b$
- The **epipolar lines** are where the epipolar plane intersect the image planes
- The **epipoles** are where the baseline intersects the two image planes

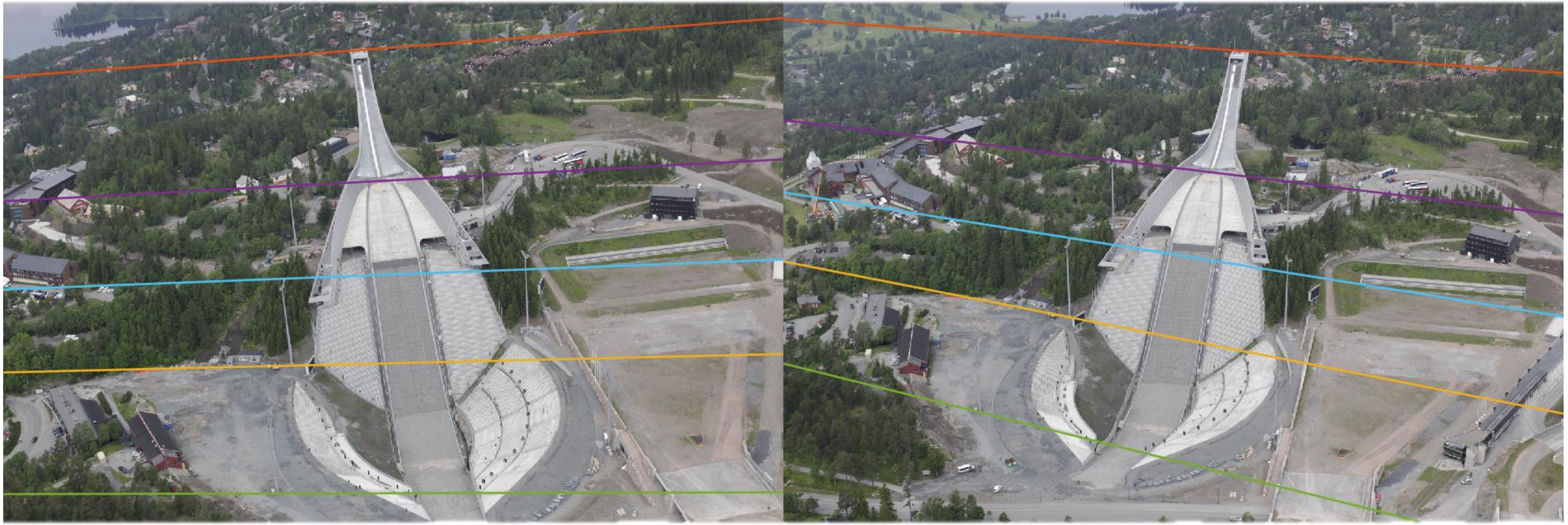
Epipolar geometry



- The **baseline** is the line joining the two camera centers
- The **epipolar plane** is the plane containing $\mathbf{x}$ and the two camera centers $\mathcal{F}_a$ and $\mathcal{F}_b$
- The **epipolar lines** are where the epipolar plane intersect the image planes
- The **epipoles** are where the baseline intersects the two image planes
- The baseline and epipoles are uniquely defined by the two cameras
- The epipolar plane and epipolar lines depends on the observed point $\mathbf{x}$

Example

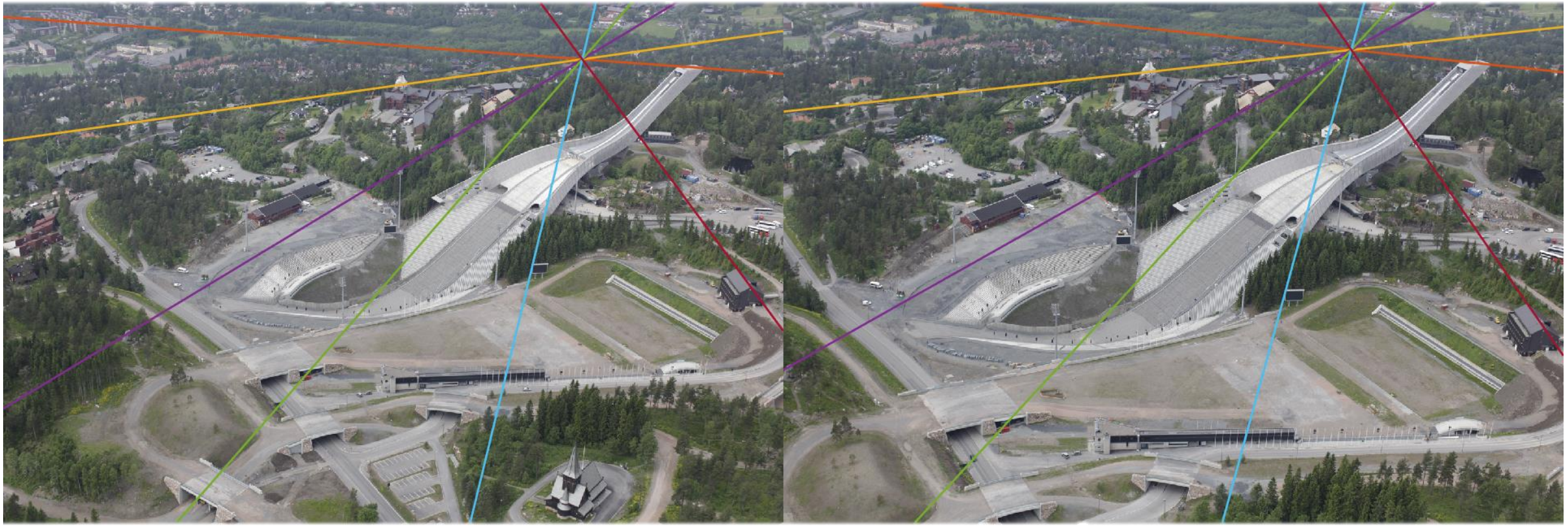
Example



- Corresponding points lie on corresponding epipolar lines
- Both epipoles are outside of the visible part of the image planes

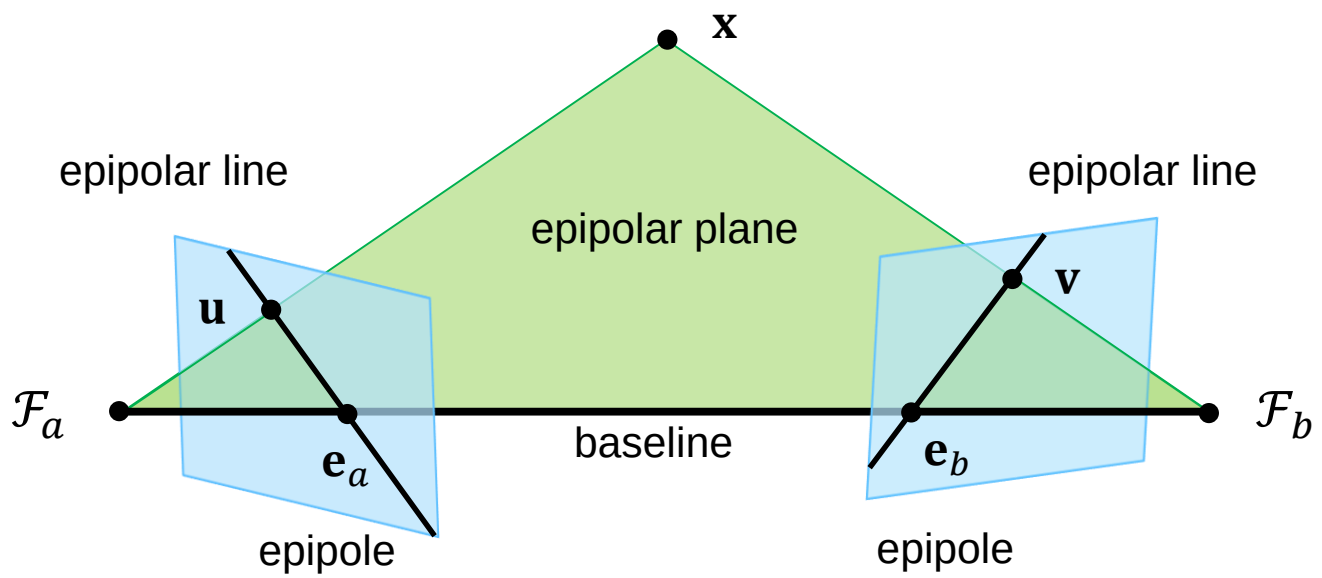
Example

Example



- Corresponding points lie on corresponding epipolar lines
- Both epipoles are visible as the intersection of epipolar lines

Summary



The geometry of two cameras observing the same scene is known as epipolar geometry

It naturally introduces new geometrical constructs as seen in the illustration

Supplementary material

Recommended

- *Richard Szeliski: Computer Vision: Algorithms and Applications 2nd ed*
  - Chapter 12 “Depth estimation”, in particular the introduction and section 12.1 “Epipolar geometry”

- *T. V. Haavardsholm: A Handbook In Visual SLAM*
  - Chapter 3 “Camera geometry”, in particular section 3.2 “Epipolar geometry”