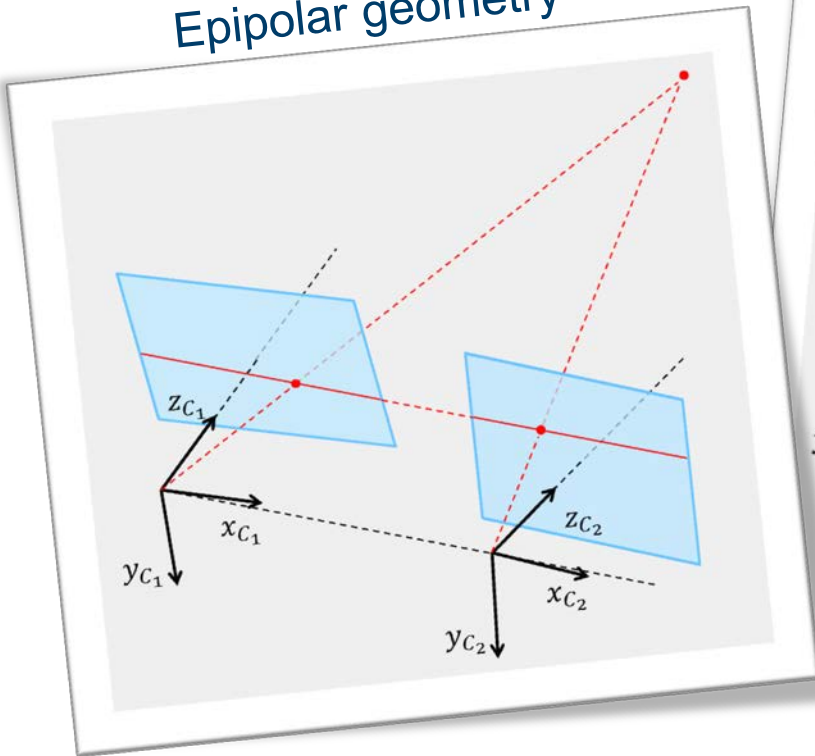# Lecture 6.1
Basic epipolar geometry
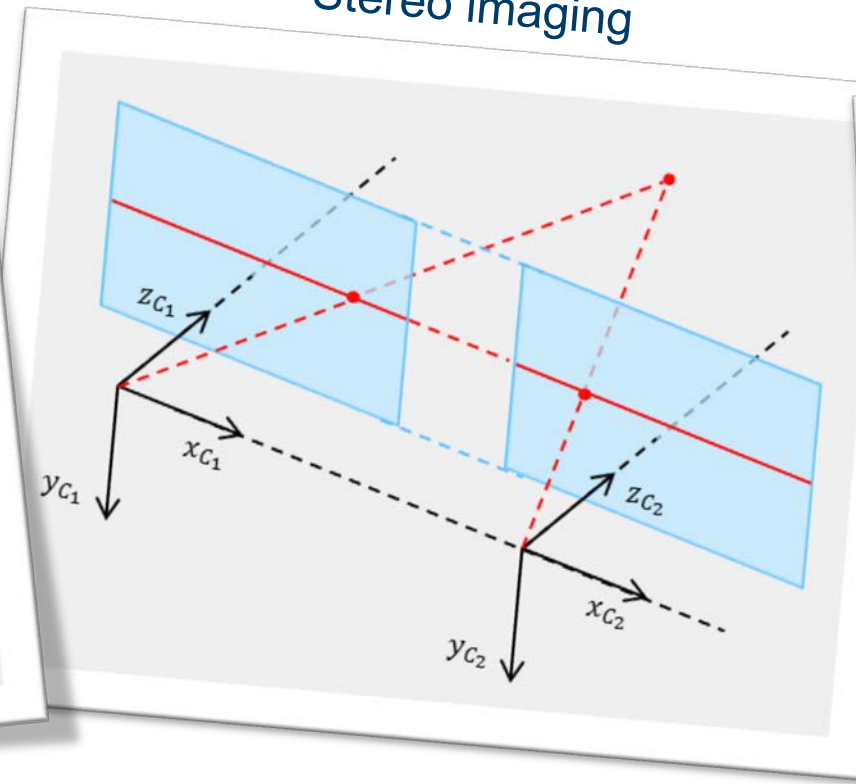
Thomas Opsahl

Weekly overview – Stereo imaging

Epipolar geometry

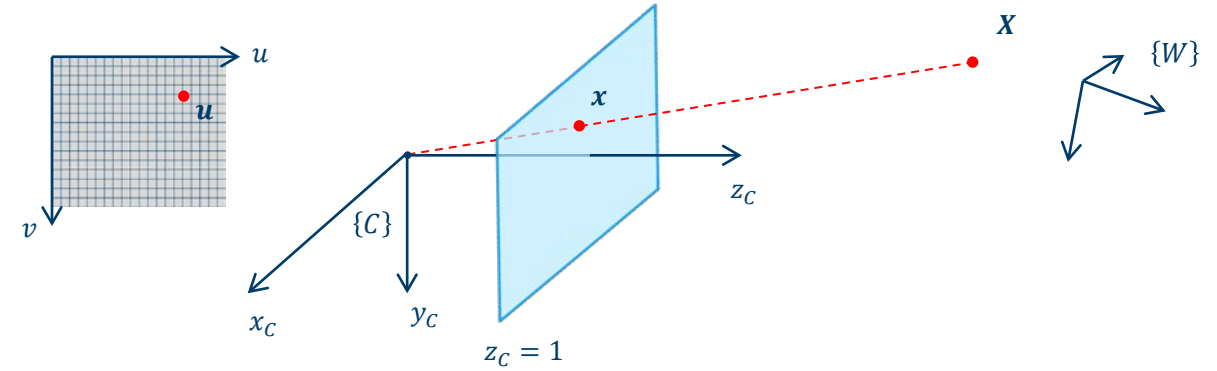Stereo imaging

Stereo processing

Introduction

- Single-view geometry
  - Camera model $P\widetilde{X} = \widetilde{u}$
  - Finite projective camera $P = K[R \quad t]$
  - Undistortion
  - Estimating P from 3D-2D correspondences
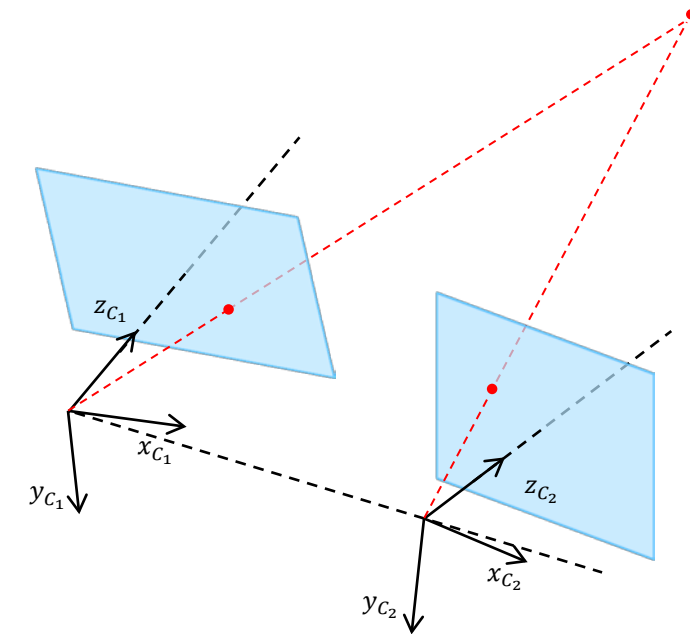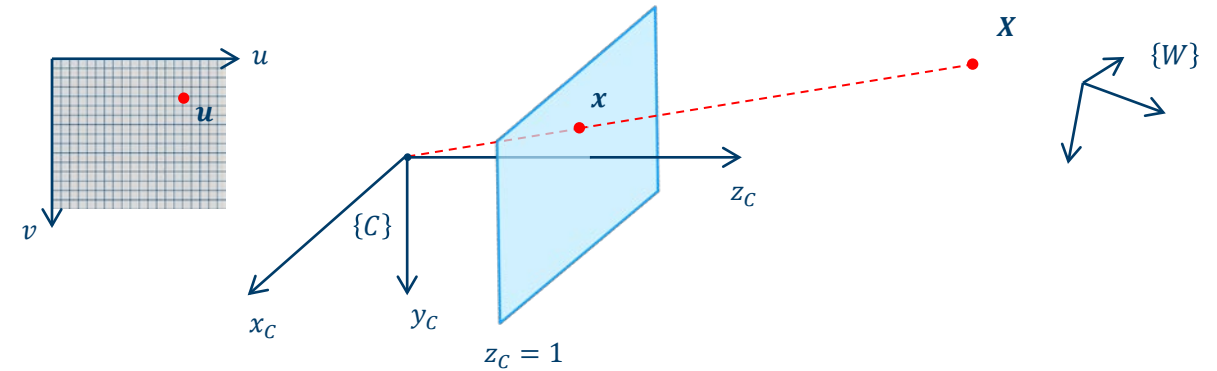 - Calibration
  - PnP

Introduction

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  - Camera model $P\widetilde{X} = \widetilde{u}$
  - Finite projective camera $P = K[R \quad t]$
  - Undistortion
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  - Calibration
  - PnP

- Two-view geometry
  - Epipolar geometry is the geometric relationship between two perspective cameras
  - Two camera models $P_1\widetilde{X} = \widetilde{u}_1$, $P_2\widetilde{X} = \widetilde{u}_2$
  - Next week - General two-view

Introduction

- Single-view geometry
  - Camera model $P\widetilde{X} = \widetilde{u}$
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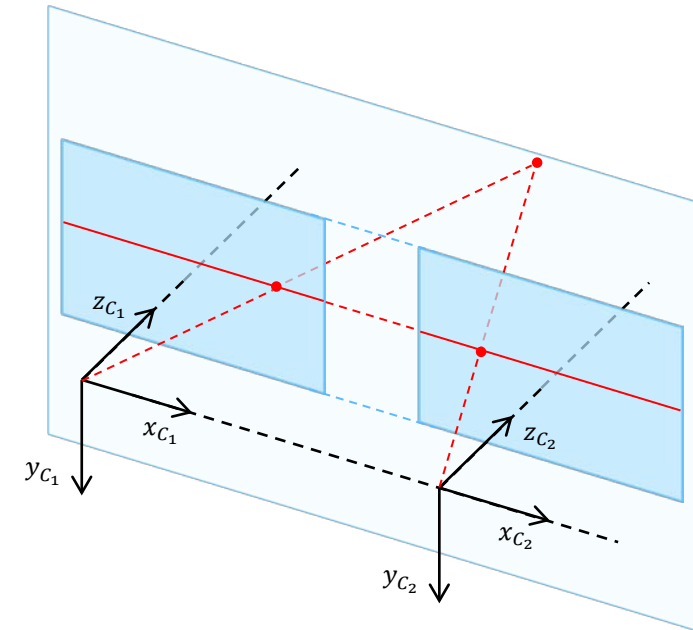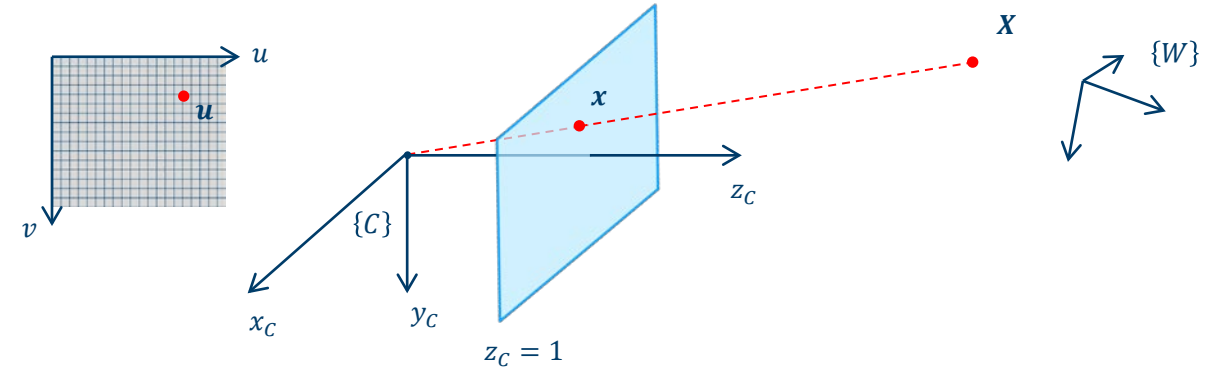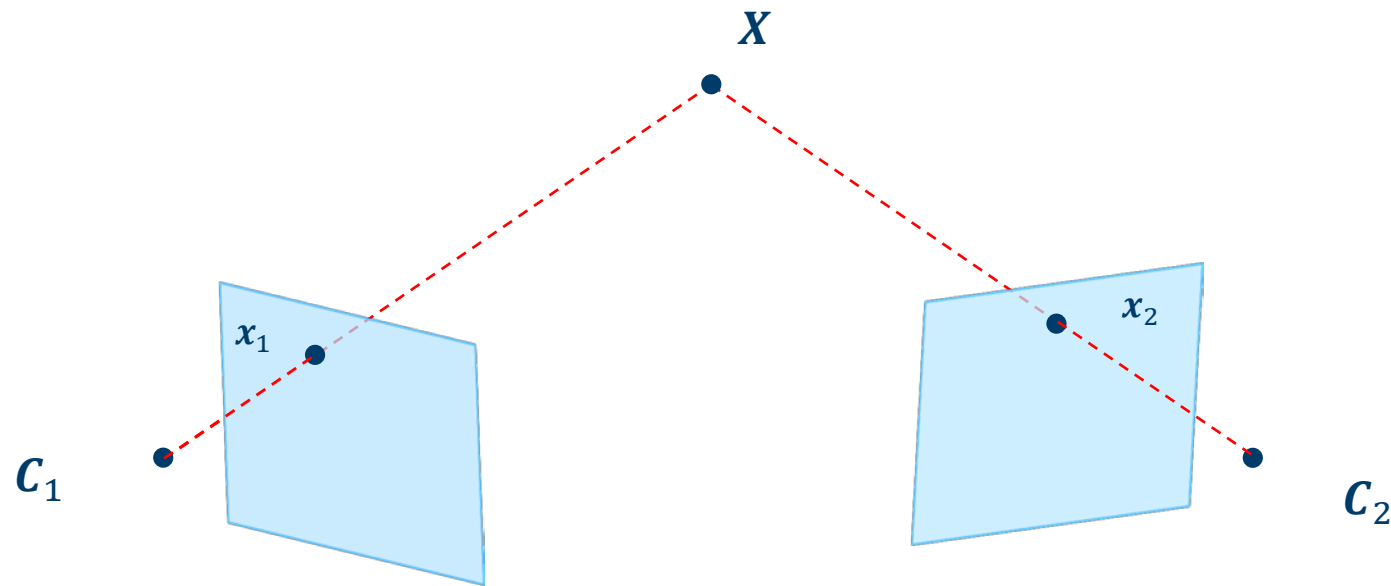 - Calibration
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- Two-view geometry
  - Epipolar geometry is the geometric relationship between two perspective cameras
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  - Next week - General two-view
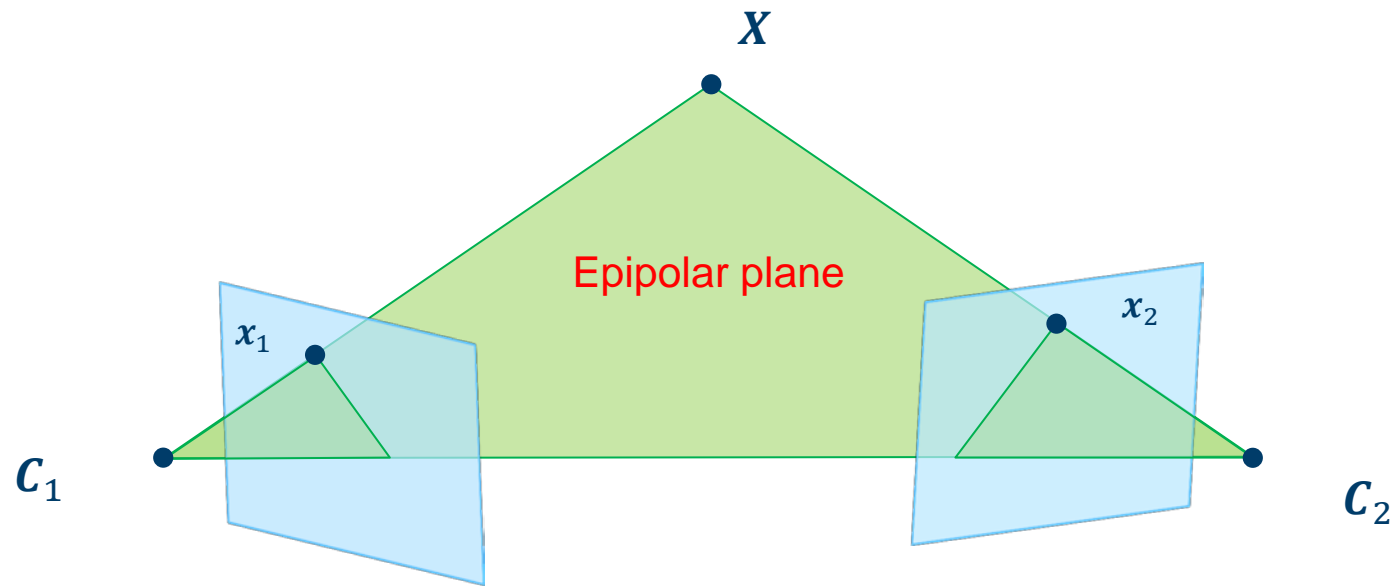 - This week - Stereo view

Epipolar geometry

- Two-view geometry involve several new geometrical entities compared to single-view geometry

Epipolar geometry

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- The **epipolar plane** is the plane containing X and the two camera centers C_1 and C_2

X

Epipolar plane

x_1

x_2

C_1

C_2

Epipolar geometry

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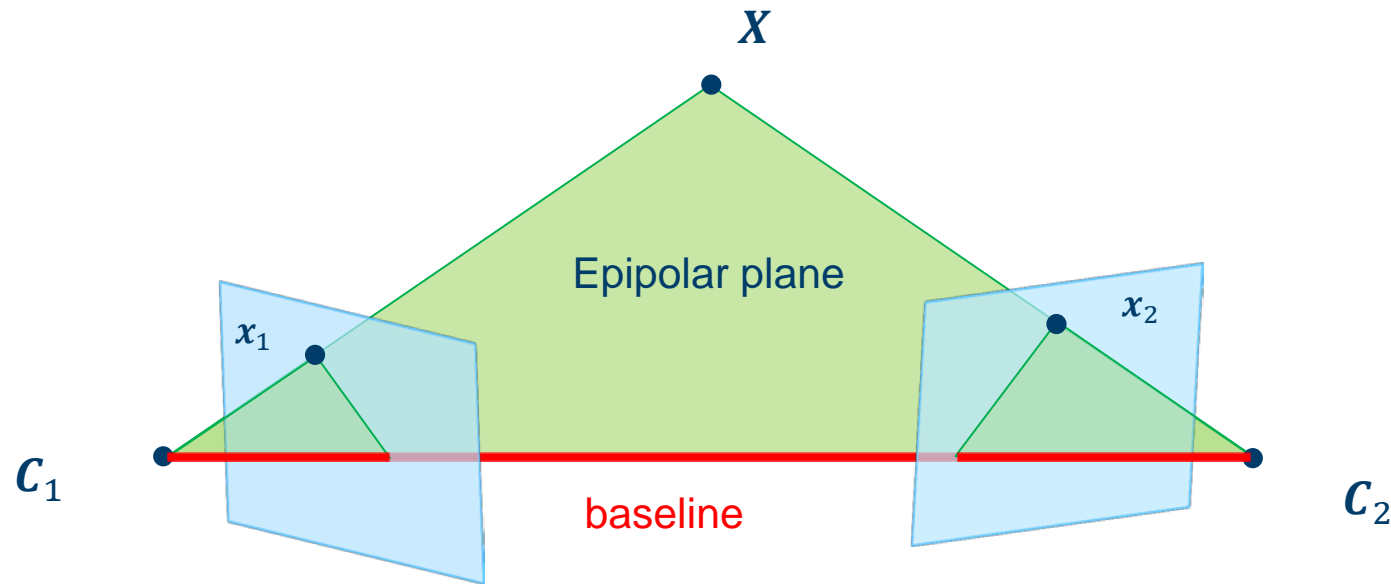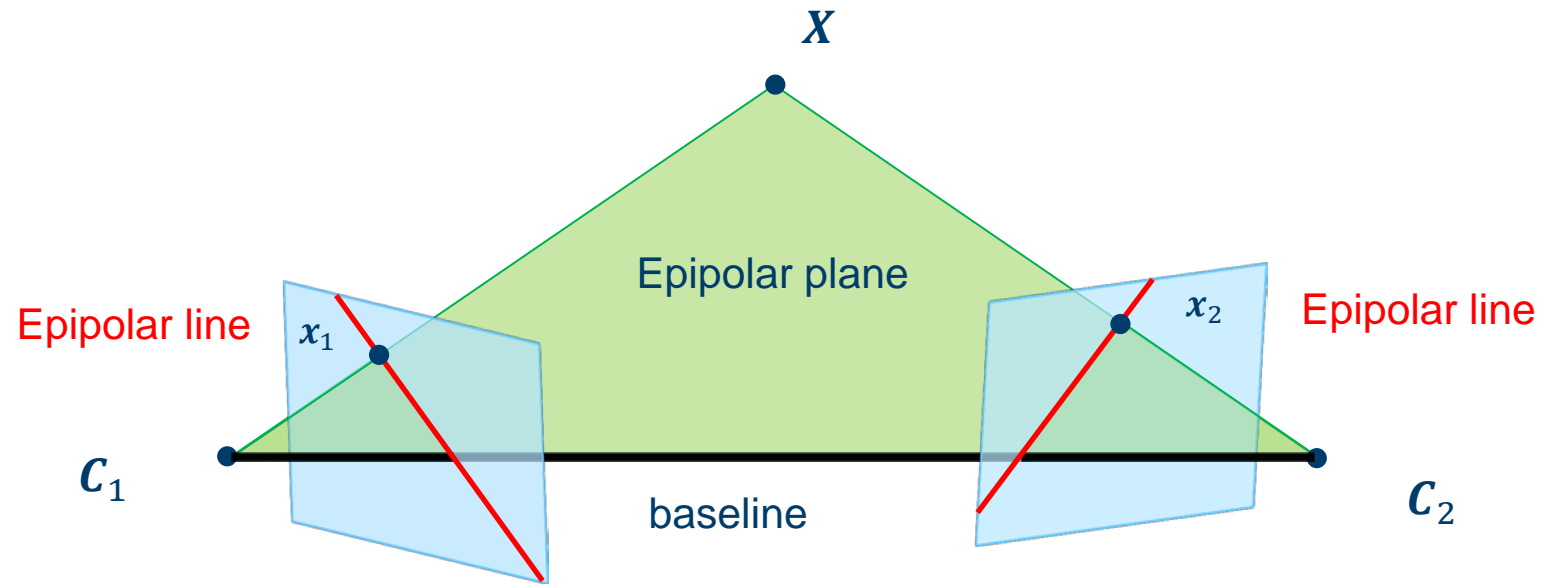- The **baseline** is the line joining the two camera centers

Epipolar geometry

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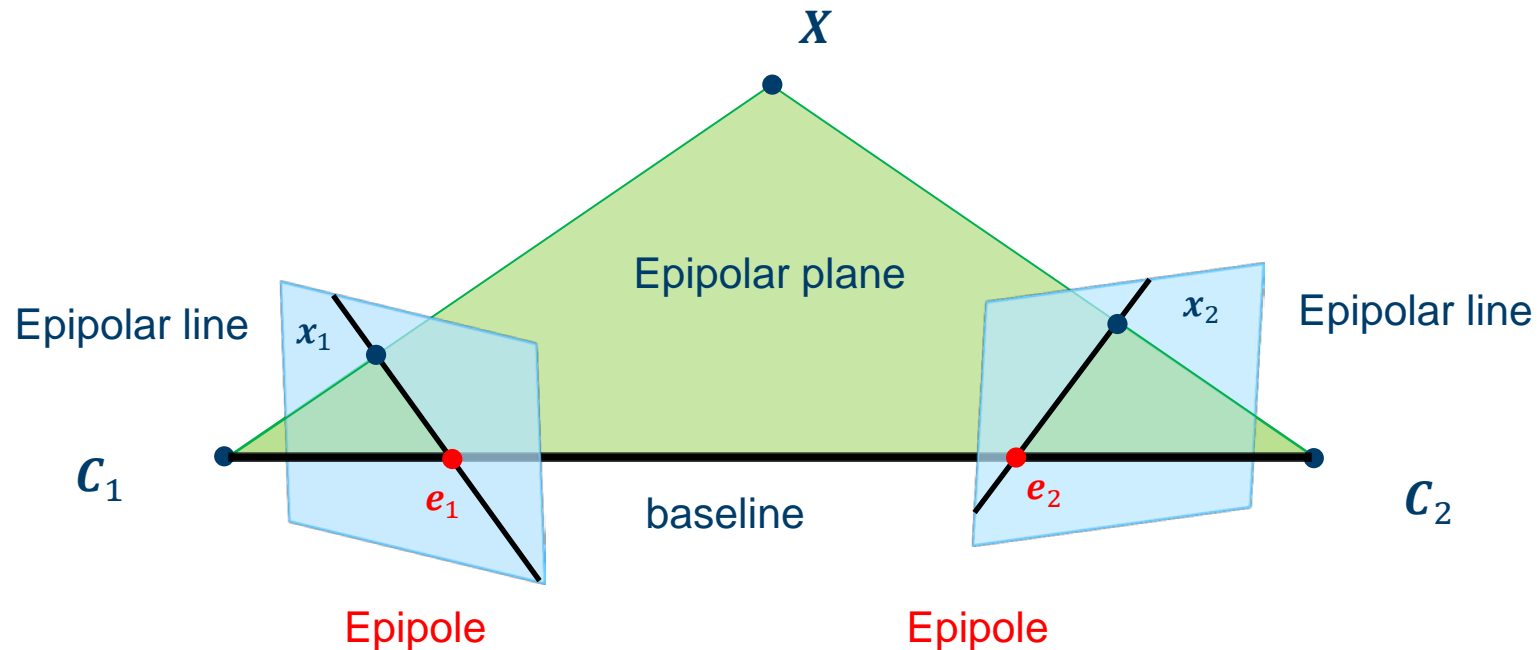
Epipolar geometry

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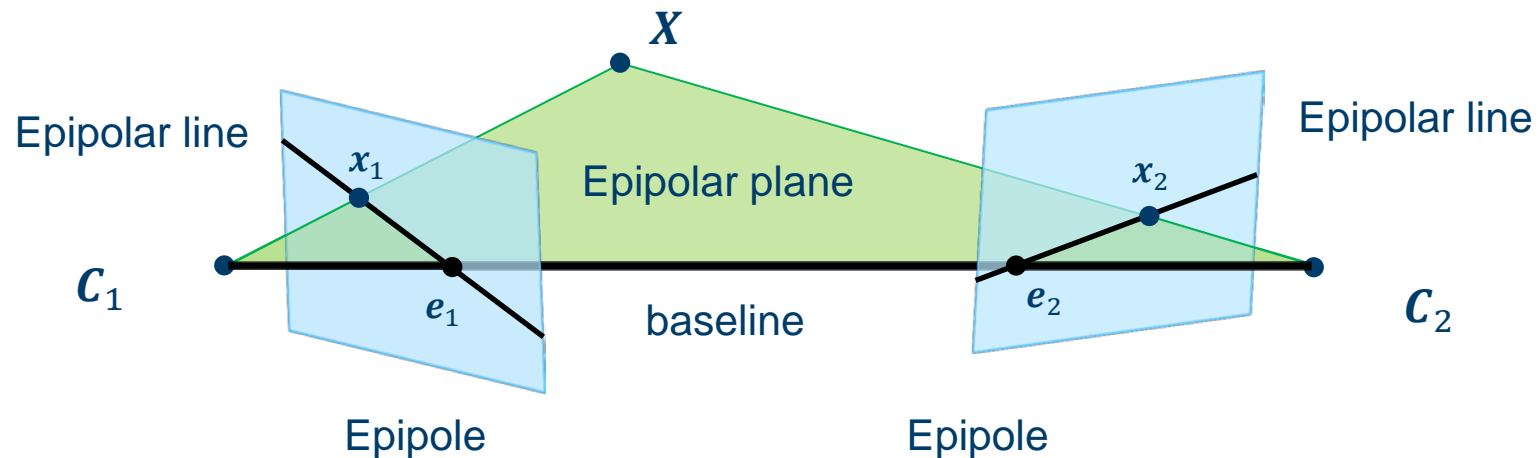- The **epipoles** are where the baseline intersects the two image planes
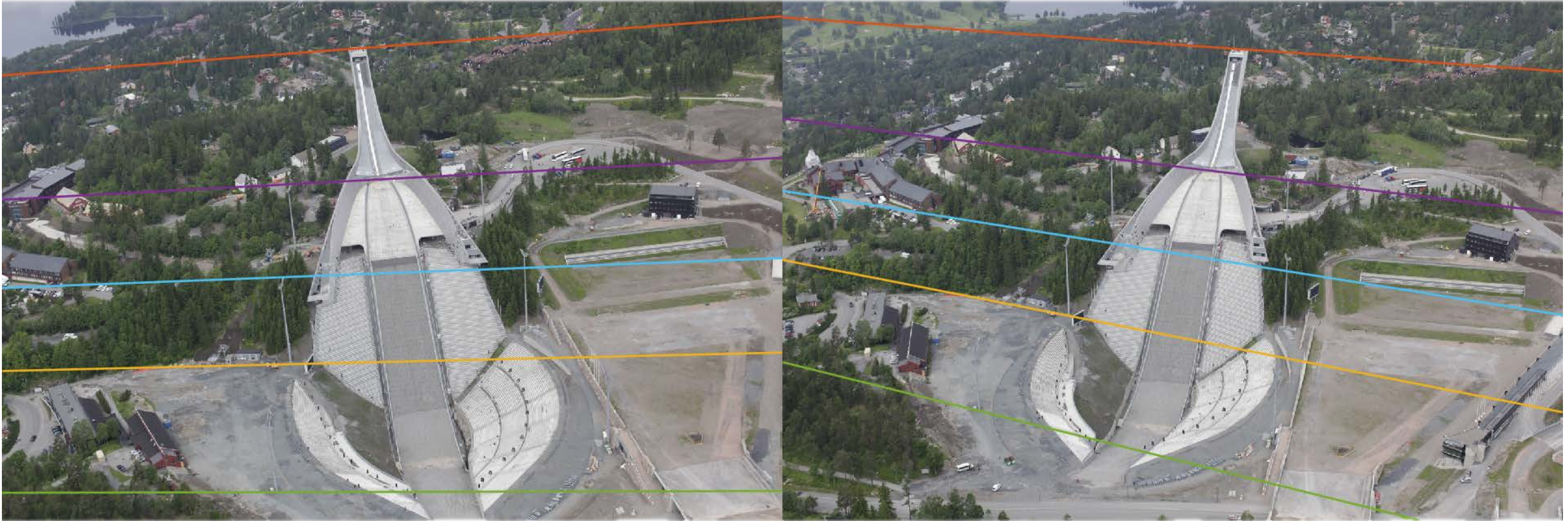
Epipolar geometry

- Two-view geometry involve several new geometrical entities compared to single-view geometry
- The **epipolar plane** is the plane containing X and the two camera centers C_1 and C_2
- The **baseline** is the line joining the two camera centers
- 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 camera matrices P_1 and P_2
- The epipolar plane and epipolar lines depends on the observed point X
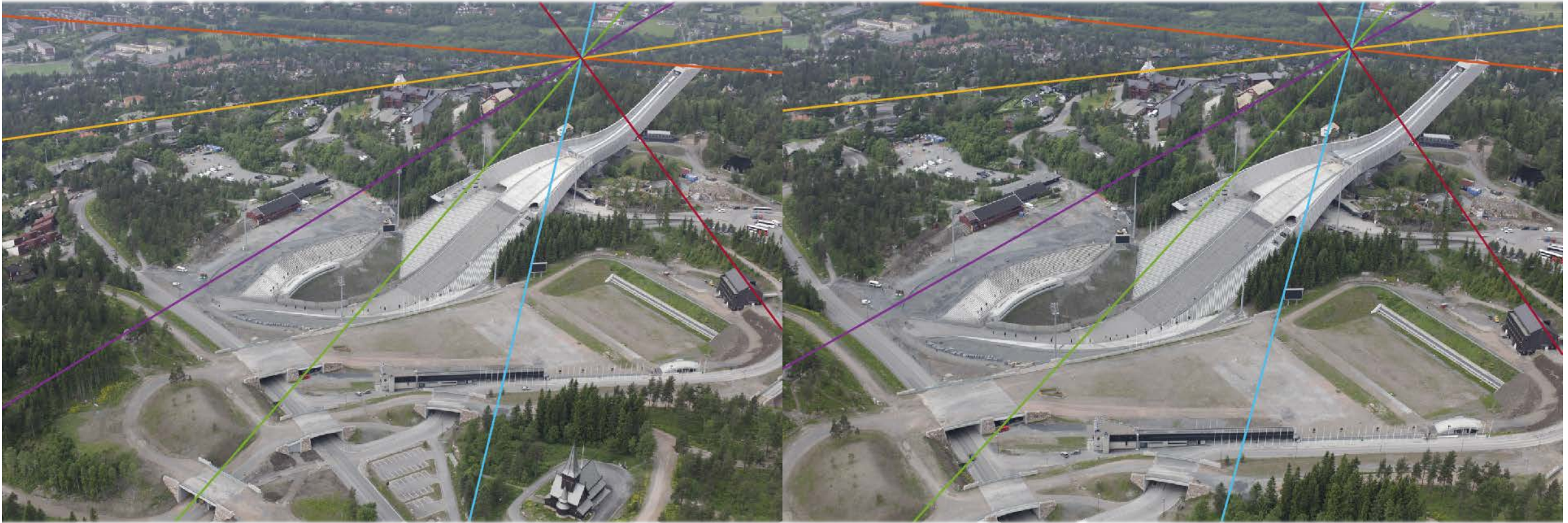
Example

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

- Epipolar geometry
  - Epipolar planes
  - Epipolar lines
  - Epipoles

- Topics ahead
  - Stereo imaging
  - Representing epipolar geometry
  - Estimating epipolar geometry
  - 3D from epipolar geometry
  - Relative pose from epipolar geometry
  - More views…

- Additional reading:
  - Szeliski: 11 introduction & 11.1