

Lecture 1.1

Optical Sensing – Introduction

ENV408: Optical Sensing & Modeling for Earth Observations

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- Optical sensors – what do we use them for?
 - Examples & focus
- What are the main processing steps before information extraction?
 - Passive sensors (camera)

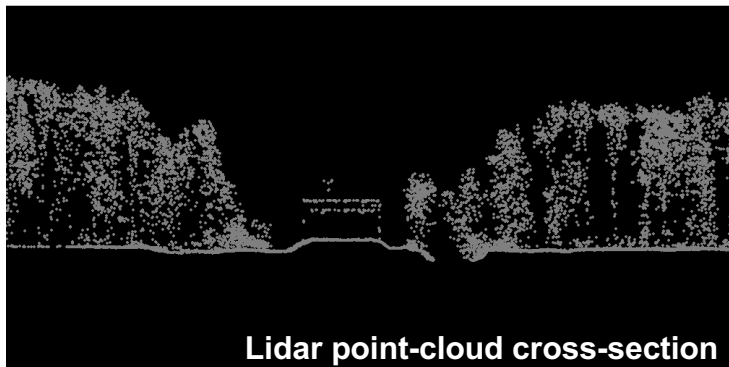
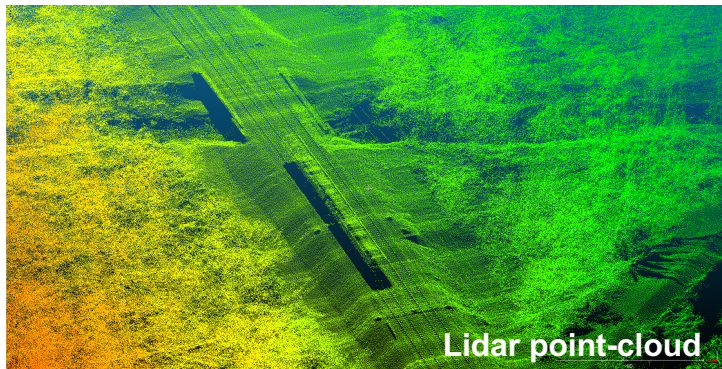
Acquisition - optical sensors on different platforms



Examples – main mapping products

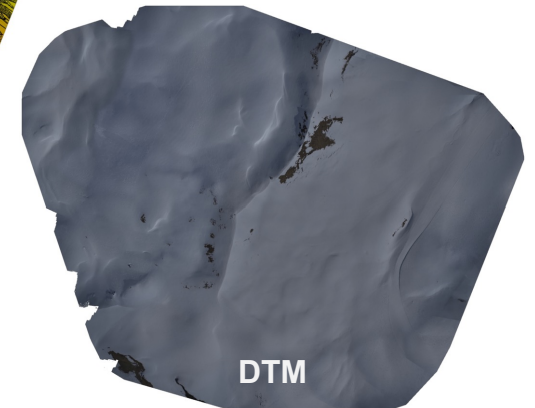
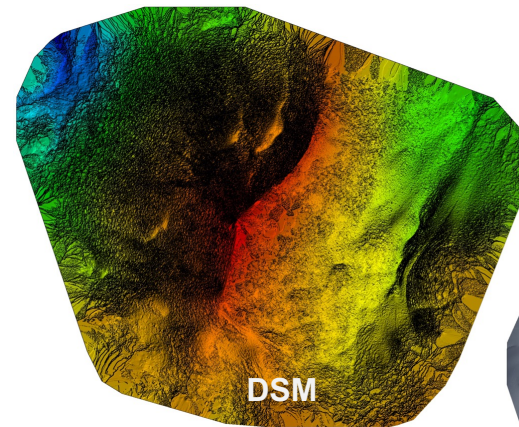
1. Point cloud

- from camera (hard surface)
- from lidar (hard surface + vegetation)



2. Digital Elevation Model – DEM

- surface model (DSM)
- terrain model (DTM, no vegetation or buildings)



EPFL Examples – main mapping products

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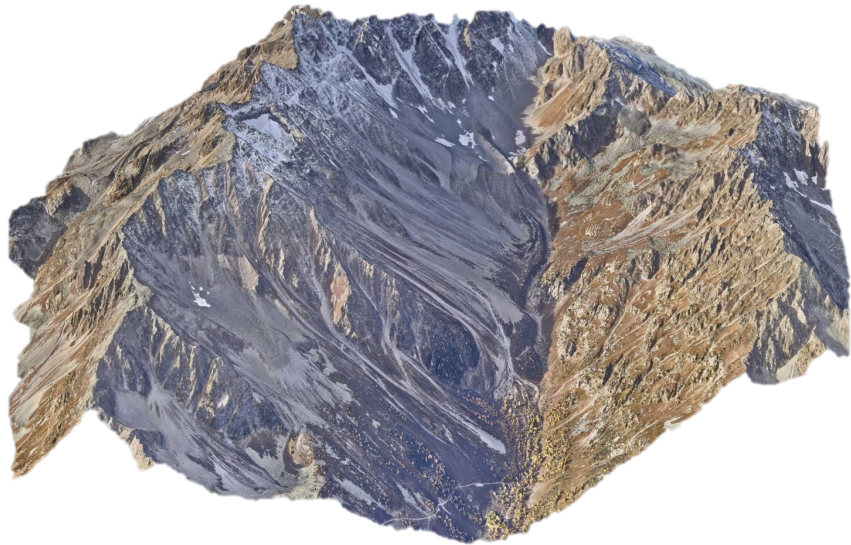
3. Ortho-photo
(**orthographically rectified image**) stitched image with an orthogonal projections on a planar surface

Online example: [swisstopo](https://www.swisstopo.admin.ch/en) each pixel has its associated coordinates in a mapping frame



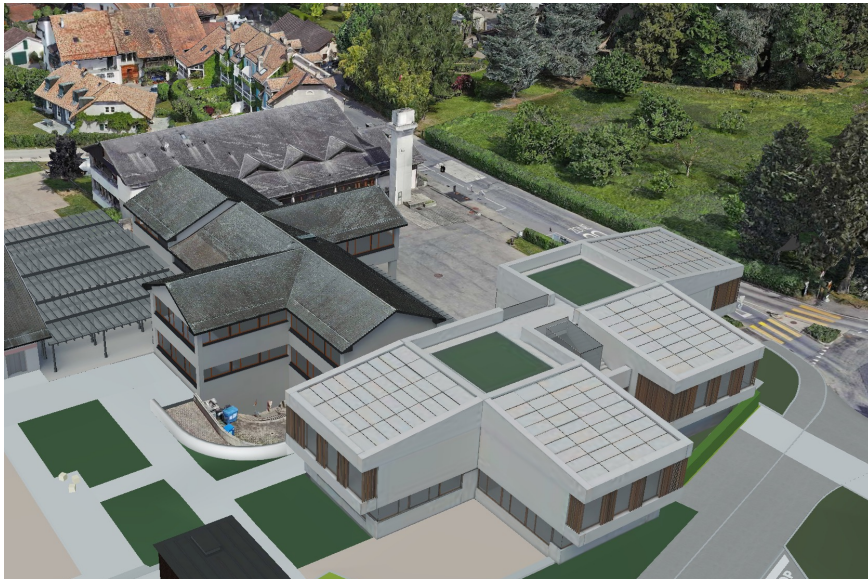
4. 3D models

[Online example:](#)

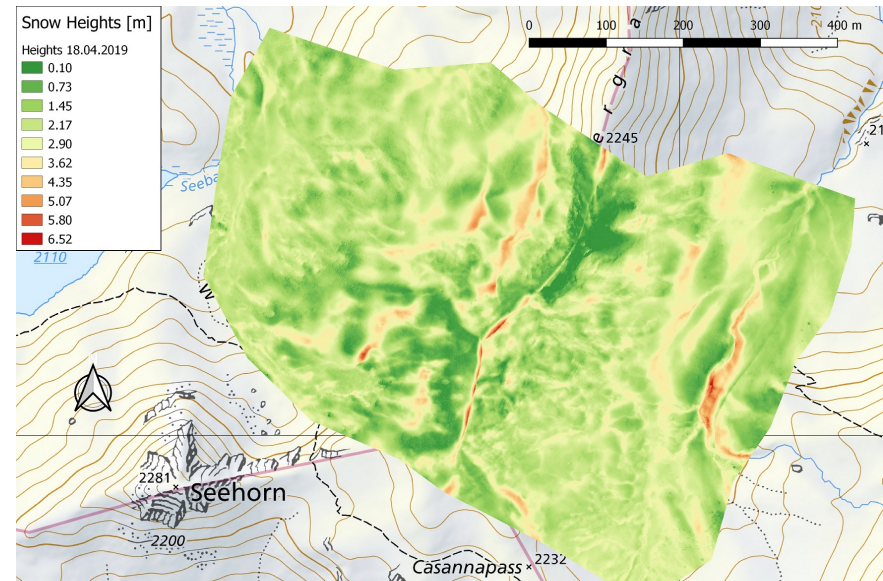


EPFL Examples – derived mapping products

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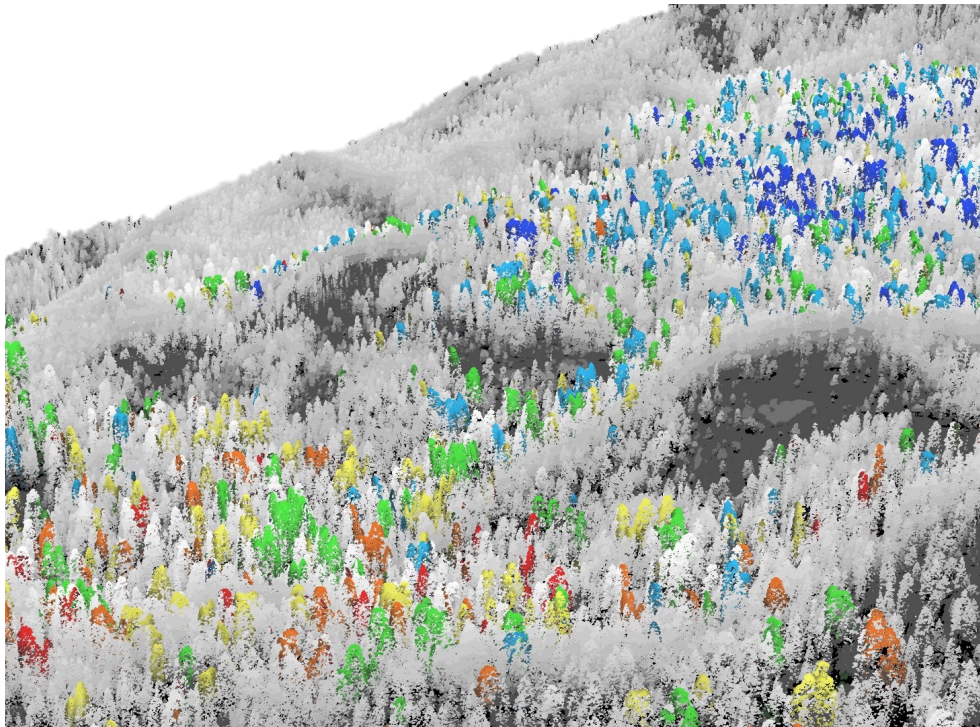


Textured CAD model



Snow-pack thickness map (DSM-DTM)

Examples – derived mapping products (2)

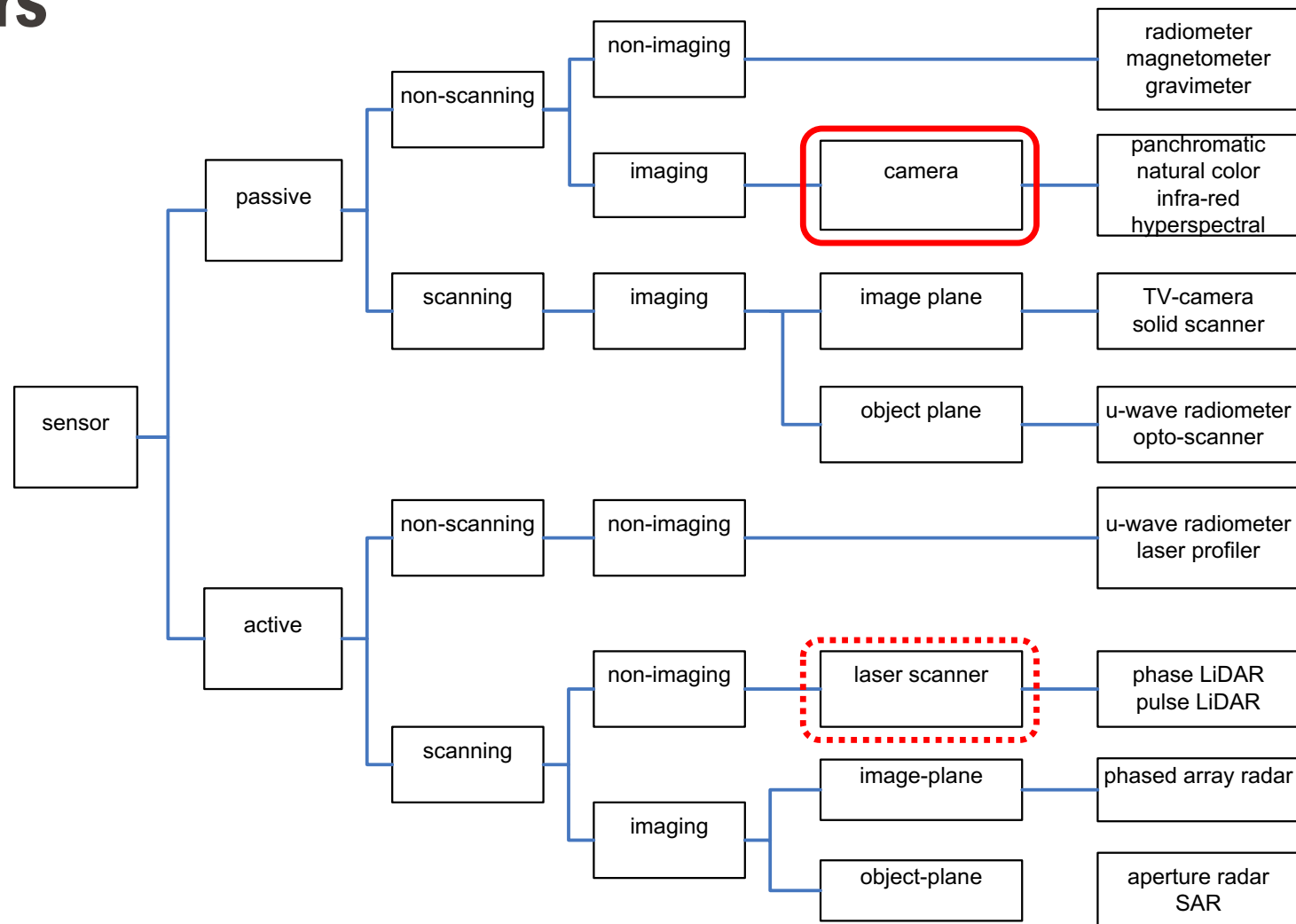


Tree species classification

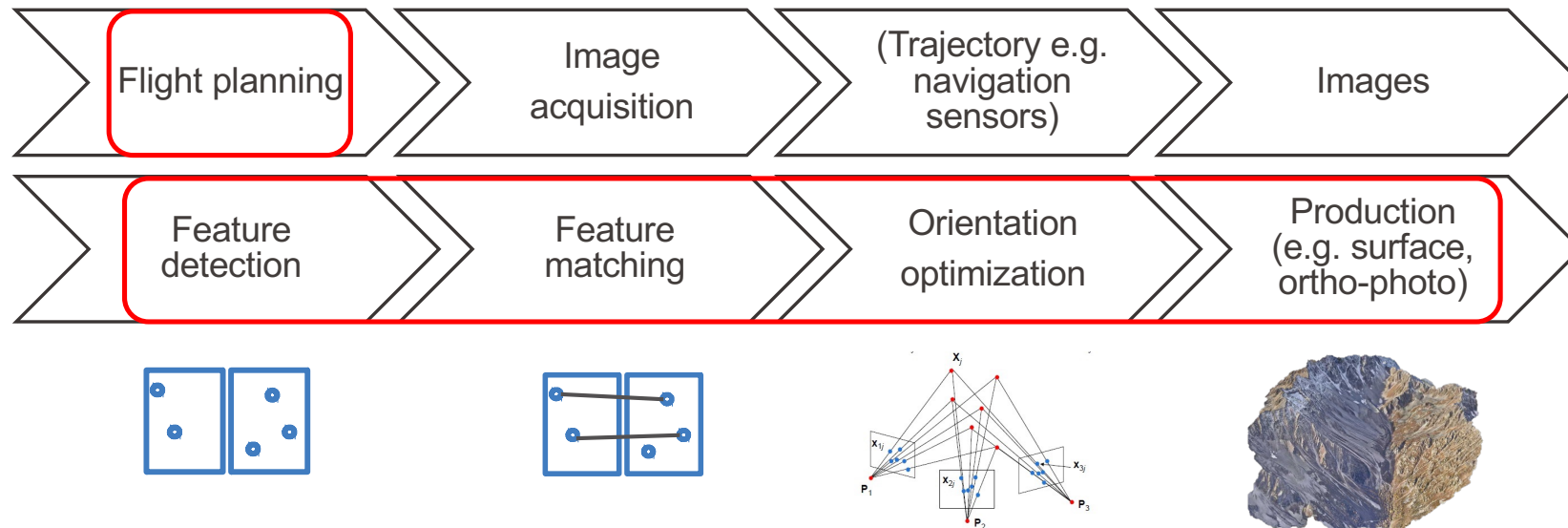
Usually via a combination of passive (e.g. camera) and active (e.g. lidar) sensors

Polycopié*

focus



- Optical sensors – what do we use them for?
 - Examples & focus
- What are the main processing steps before information extraction?
 - Passive sensors (camera)



Lecture 1 to 5
(Course part 2-3 on information extraction)

Lectures

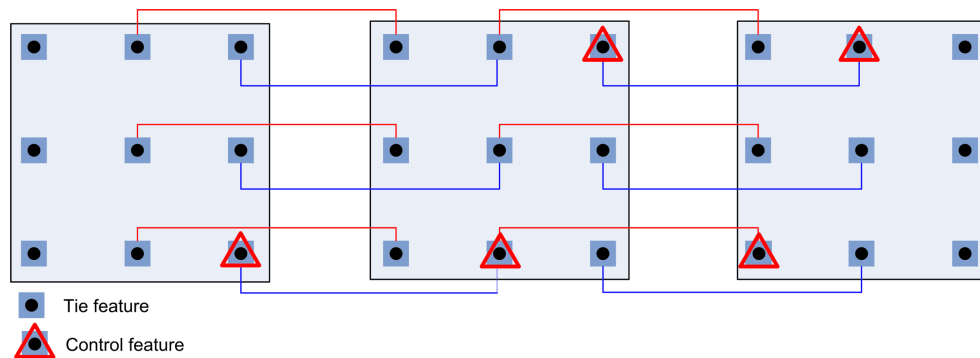
- Image primes (L1)
- Salient *features* (L2)
- Image *orientation* (L3)
- *Optimization* (calibration) (L4)
- Mapping products (L5)

Exercises

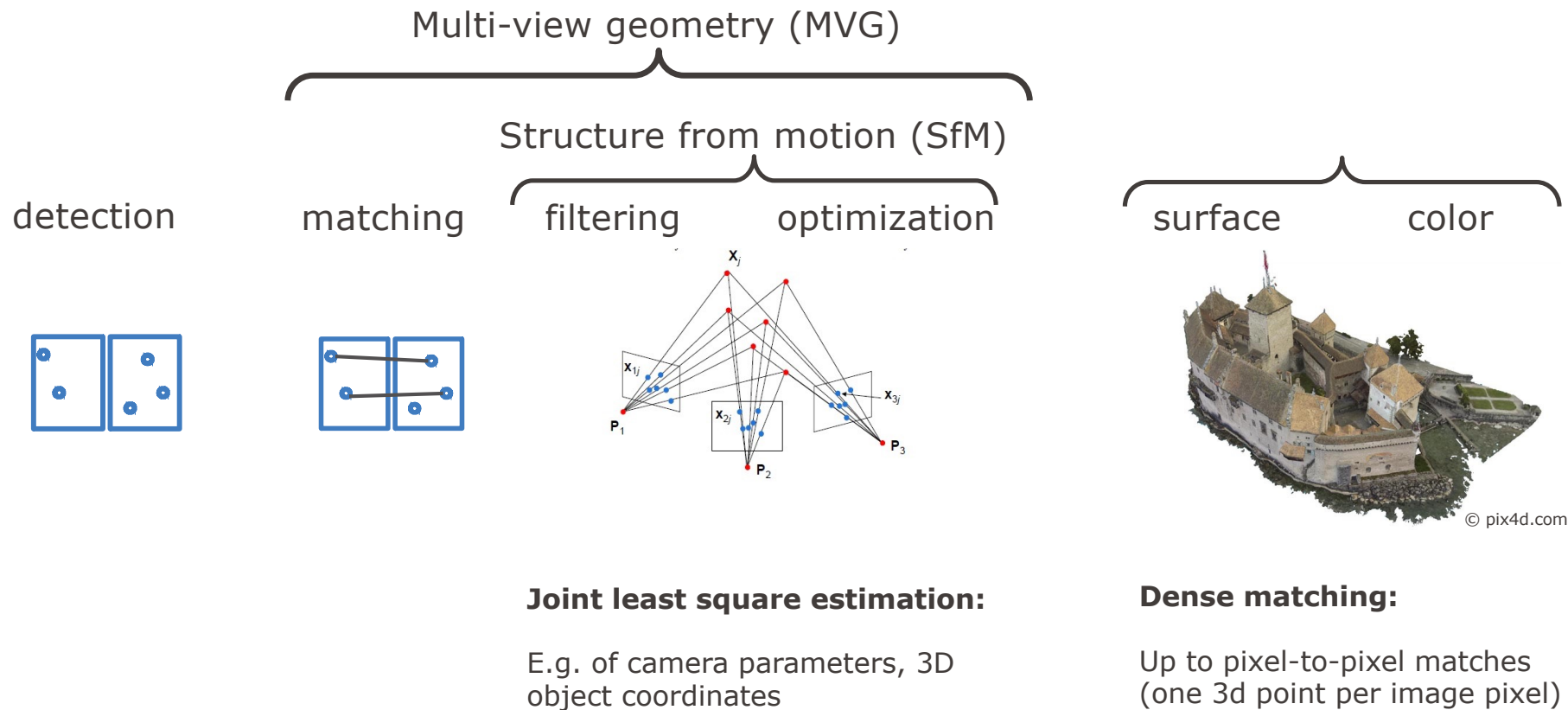
- Image 'corrections' (Ex1)
- Detection & matching (Ex2)
- Approx. absolute orientation (Ex3)
- Approx. relative orientation (Ex4)
- Calibration, DEM, ortho-photo (Ex5)

The **3** enabling technologies / disciplines

- General image **matching** (color-color, lidar-lidar, color-lidar)



- Navigation sensors (GNSS/ inertial) → **orientation/pose estimation** (e.g. ENV548 Sensor orientation)
+ surveying of control features (e.g. ENV140 Eléments de géomatique)
- Modeling and **estimation** (e.g. ENG267 Méthodes d'estimation)



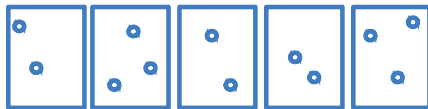
Vocabulary

computer vision (course) vs. photogrammetry

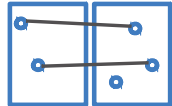
Inputs:



frames / images / views



features / attributes / (points)



matched-(x), tie-(x), homologous-(x)
with (x) : points, features

Camera calibration

- CV - **sensor in 3D space and its parameters of correction** (e.g. lens)
- Photogrammetry - sensors' parameters of **interior orientation** (IO)

Camera orientation

- CV - **pose** (position and attitude)
- Photogrammetry - relative or absolute **exterior orientation** (EO)