

UNIK 4690 – Maskinsyn Introduction

18.01.2018

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Idar Dyrdal (idar.dyrdal@its.uio.no)

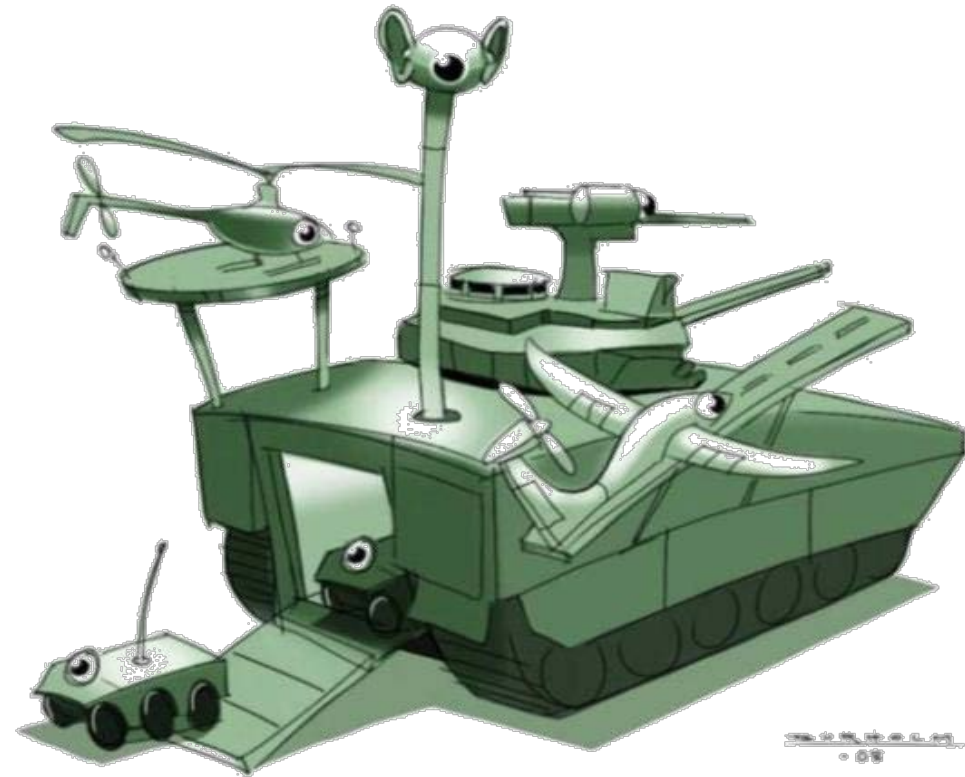
Thomas Opsahl (thomasoo@its.uio.no)

Ragnar Smestad (ragnar.smestad@ffi.no)

Computer vision

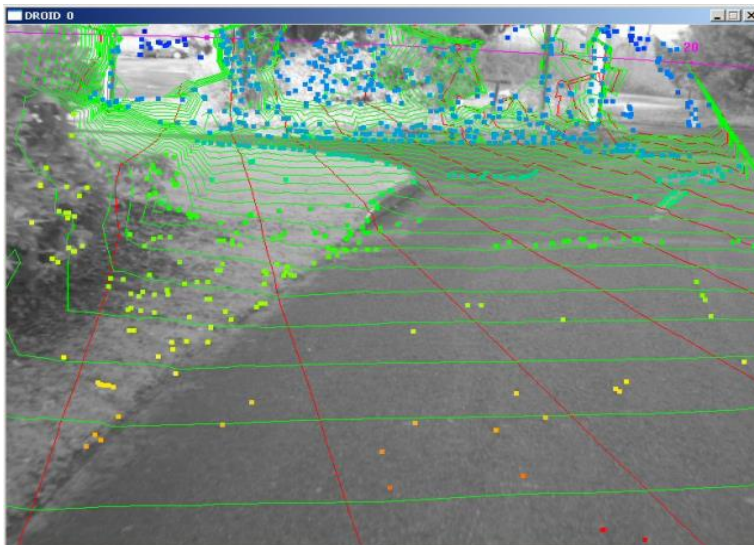
- The study of how a machine can be made to gain high-level understanding from images

➤ «Teaching computers how to see»!



Important for humans and machines

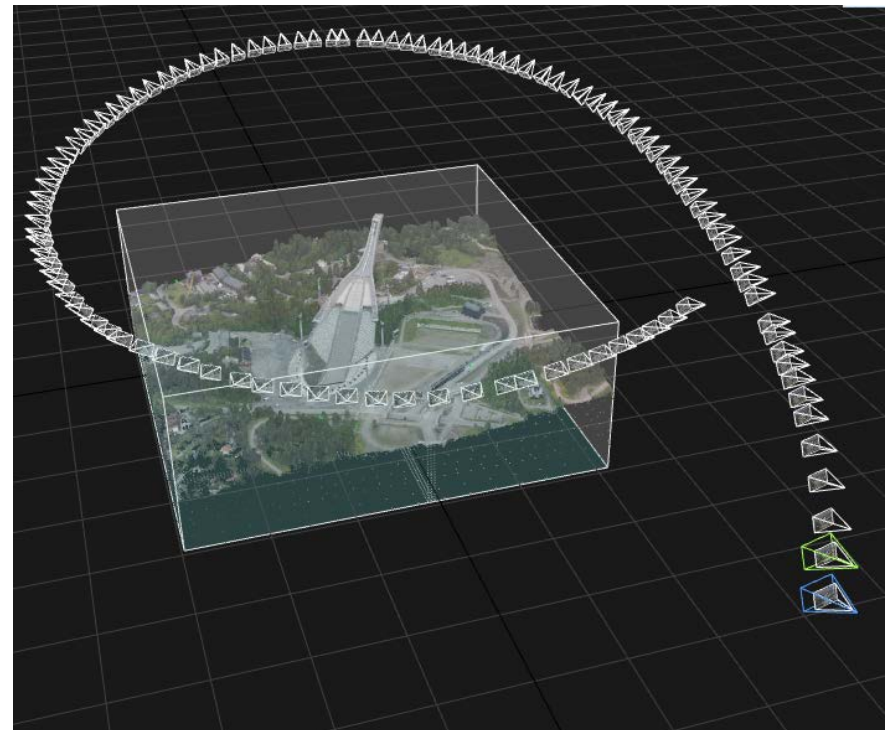
- For humans
 - Find, interpret, fuse



- For robots
 - Understand its own situation!

Quick round of introductions

- Name
- Field of study
- Previous relevant courses
- Motivation for taking this course



Today

- Overview of the course
 - Curriculum
 - Practical information
- Processing live images using OpenCV

Learning outcome

- After completing UNIK4690
 - you have a basic understanding of the field of computer vision
 - you know basic methods and tools within the field and you are able to put them into use
 - you understand how some of the important methods and tools work in detail
 - you are able to implement algorithms that solve simple computer vision problems
 - you are able to create computer vision applications using the software library OpenCV

Learning outcome

- After completing UNIK9690
 - you have a basic understanding of the field of computer vision
 - you know basic methods and tools within the field and you are able to put them into use
 - you understand how some of the important methods and tools work in detail
 - you are able to implement algorithms that solve simple computer vision problems
 - you are able to create computer vision applications using the software library OpenCV
 - you have a deeper understanding of the methods and you are able to pass this on to other students

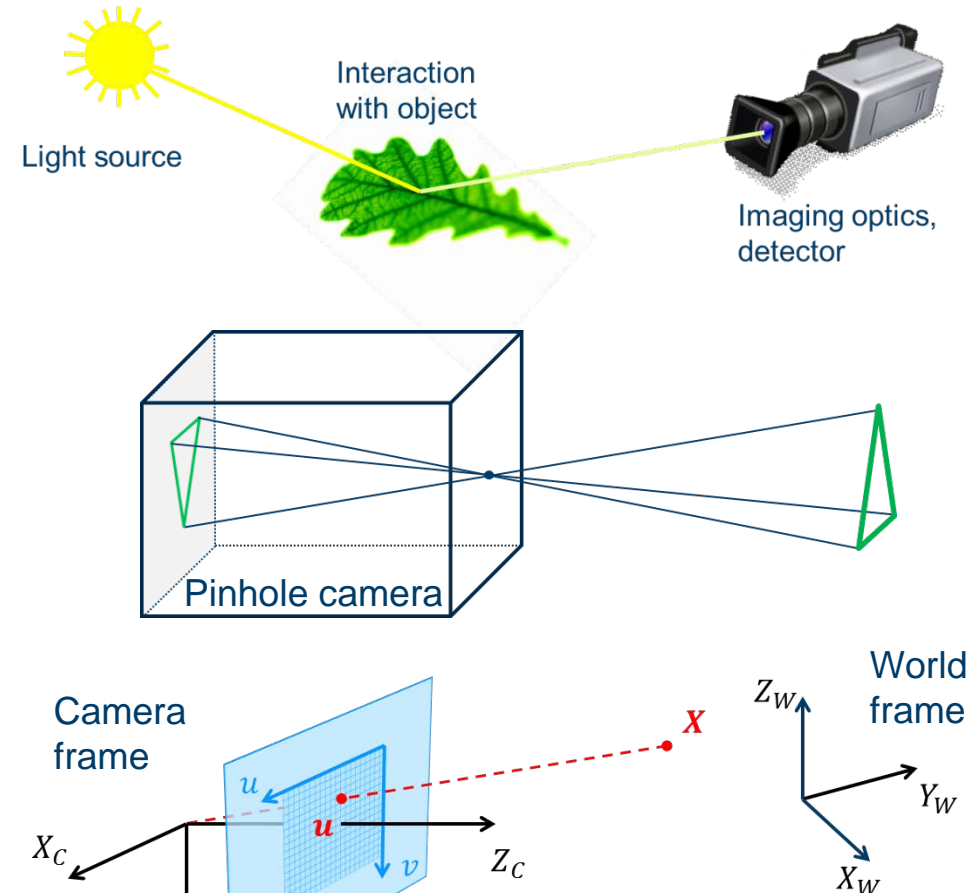
«Flipped classroom»

- Purpose
 - To make the most out of your 3 hours at Kjeller per week
- Online
 - Prerecorded video lectures each week
- At Kjeller
 - ~20 minutes summary and Q&A
 - ~2.5 hours programming lab
- Mandatory student project (60%)
 - Large project of your own choosing, preferably in groups of 2-3 students
- Individual oral exam (40%)

Schedule

Part I: Image formation, processing and features

25.01	1. Image formation <ul style="list-style-type: none"> • Light, cameras, optics and colour • Pose in 2D and 3D • Basic projective geometry • The perspective camera model
01.02	2. Image Processing <ul style="list-style-type: none"> • Image filtering • Image pyramids • Laplace blending
08.02	3. Feature detection <ul style="list-style-type: none"> • Line features • Local keypoint features • Robust estimation with RANSAC
15.02	4. Feature matching <ul style="list-style-type: none"> • From keypoints to feature correspondences • Feature descriptors • Feature matching • Estimating homographies from feature correspondences

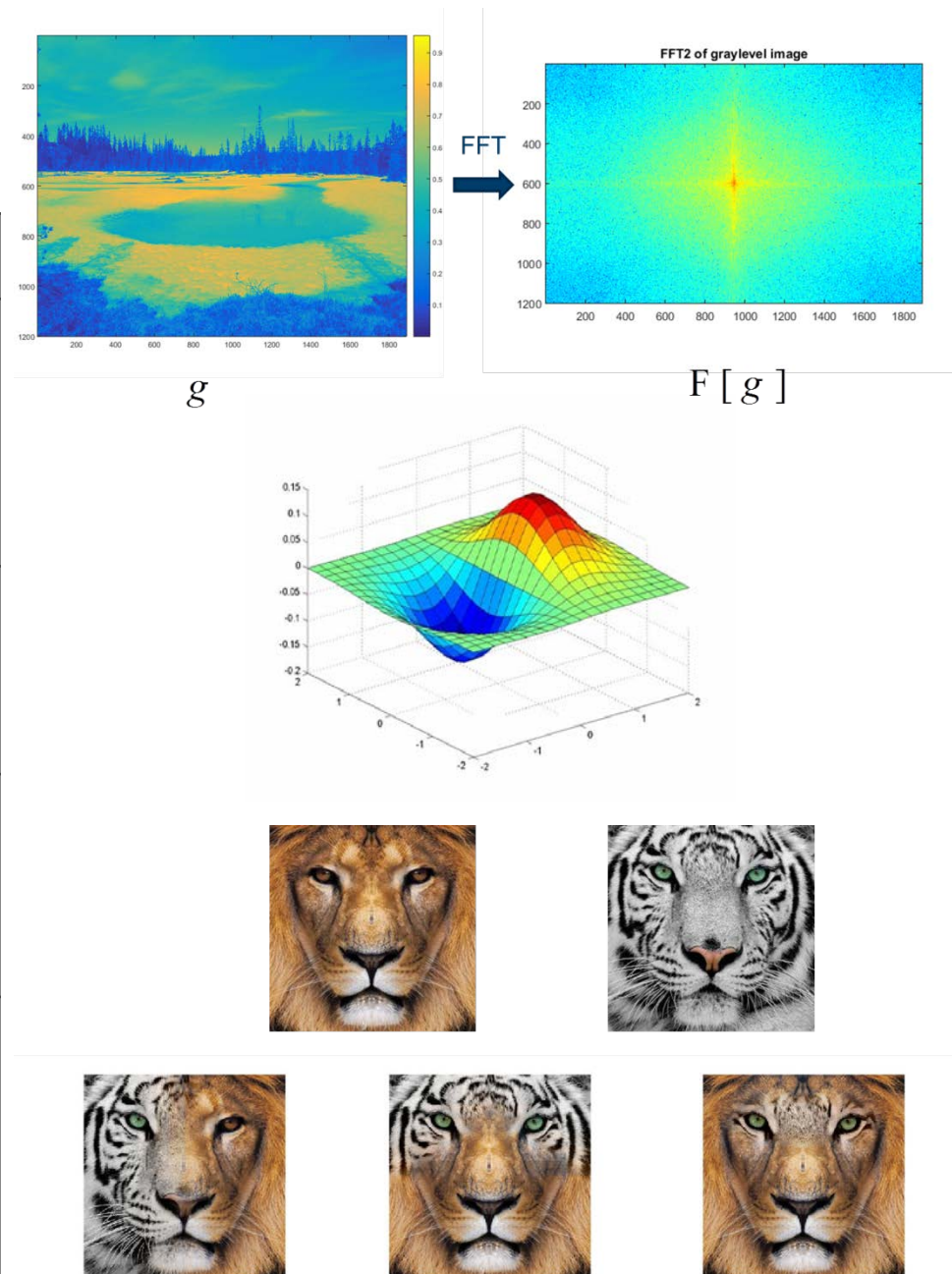


$$\tilde{u} = \begin{bmatrix} f_u & s & c_u \\ 0 & f_v & c_v \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} R & t \\ 0 & 1 \end{bmatrix}^w \tilde{X}$$

Schedule

Part I: Image formation, processing and features

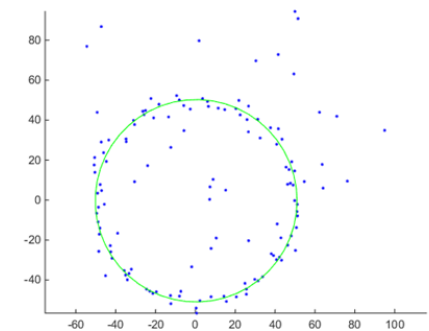
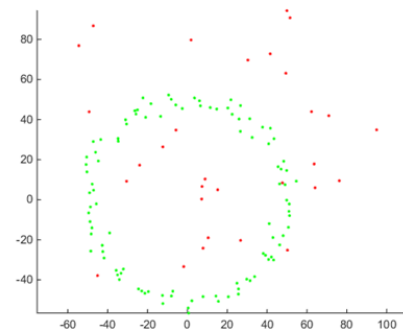
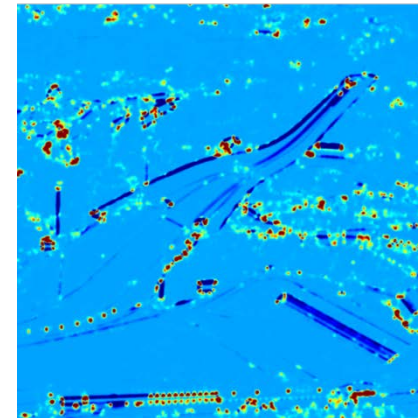
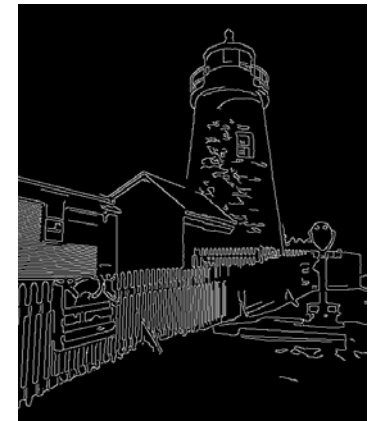
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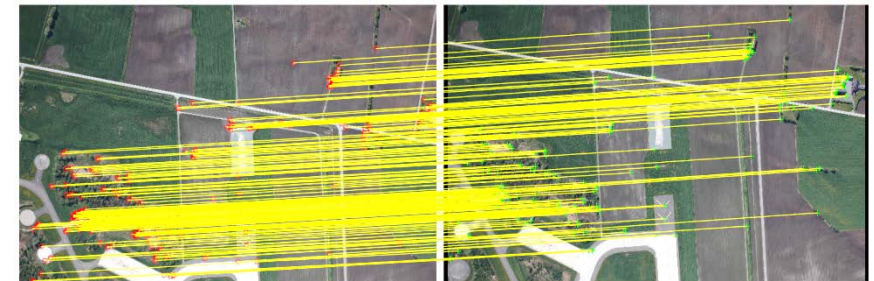
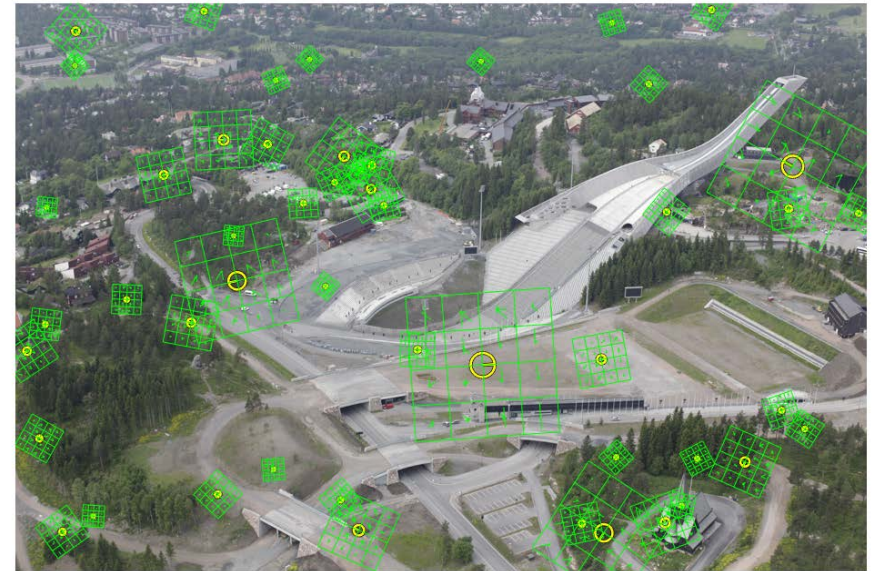
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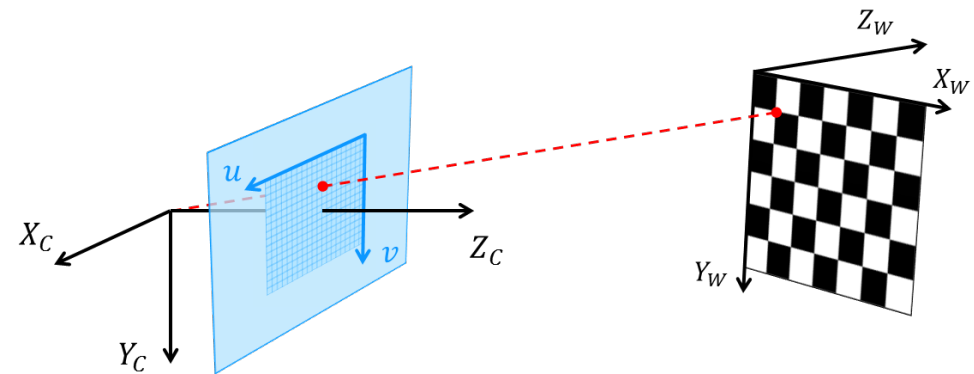
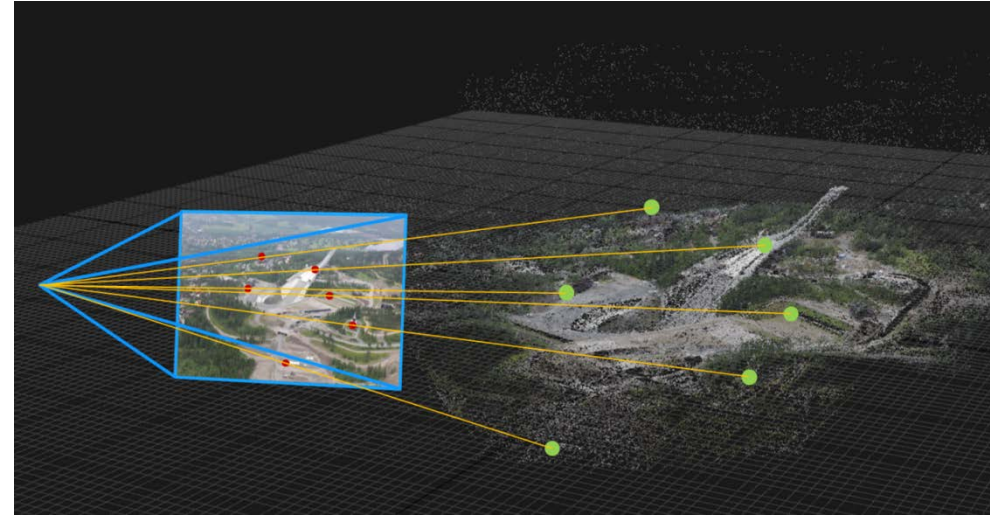
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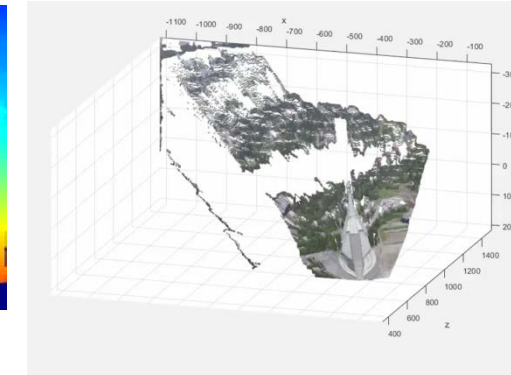
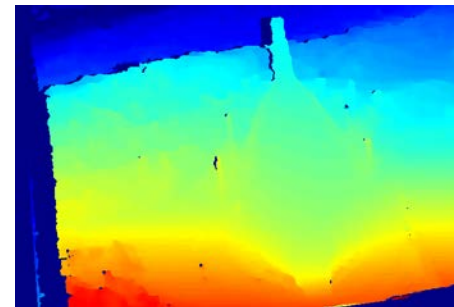
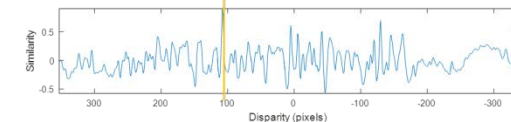
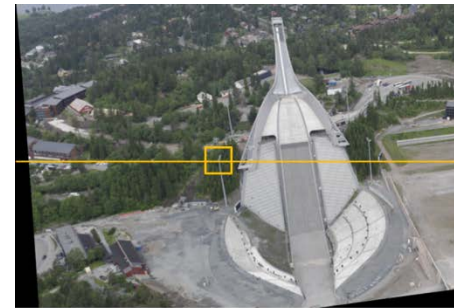
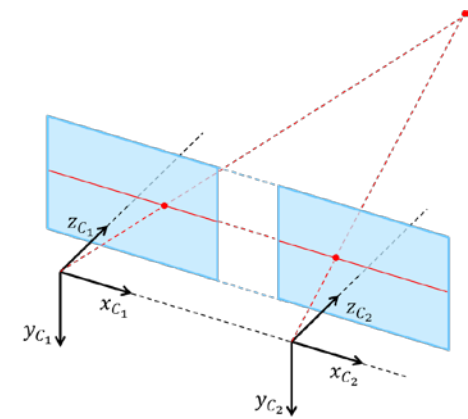
Part II: World geometry and 3D	
22.02	5. Single-view geometry <ul style="list-style-type: none"> • The camera matrix P • Pose from known 3D points • Camera calibration
01.03	6. Stereo imaging <ul style="list-style-type: none"> • Basic epipolar geometry • Stereo imaging • Stereo processing
08.03	7. Two-view geometry <ul style="list-style-type: none"> • Epipolar geometry • Triangulation • Pose from epipolar geometry
15.03	8. Multiple-view geometry <ul style="list-style-type: none"> • Multiple-view geometry • Structure from motion • Multiple-view stereo



Schedule

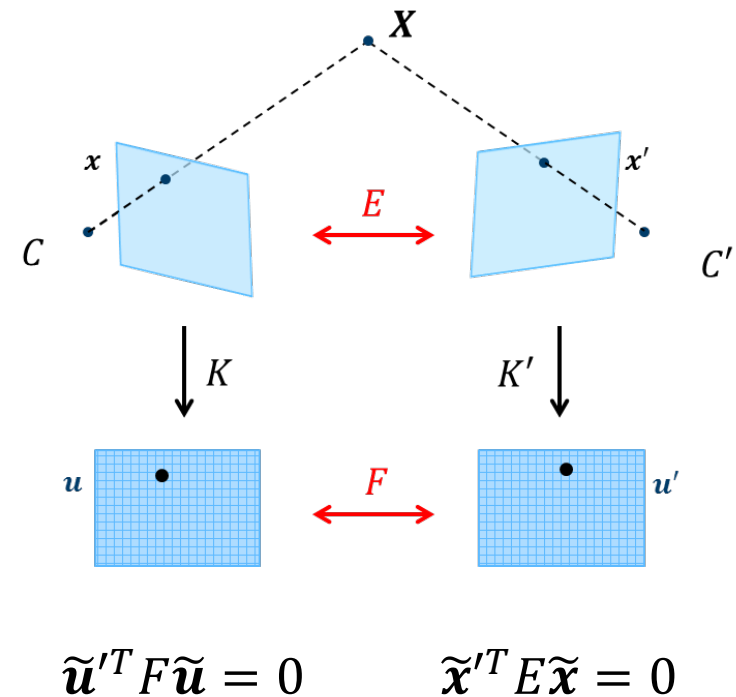
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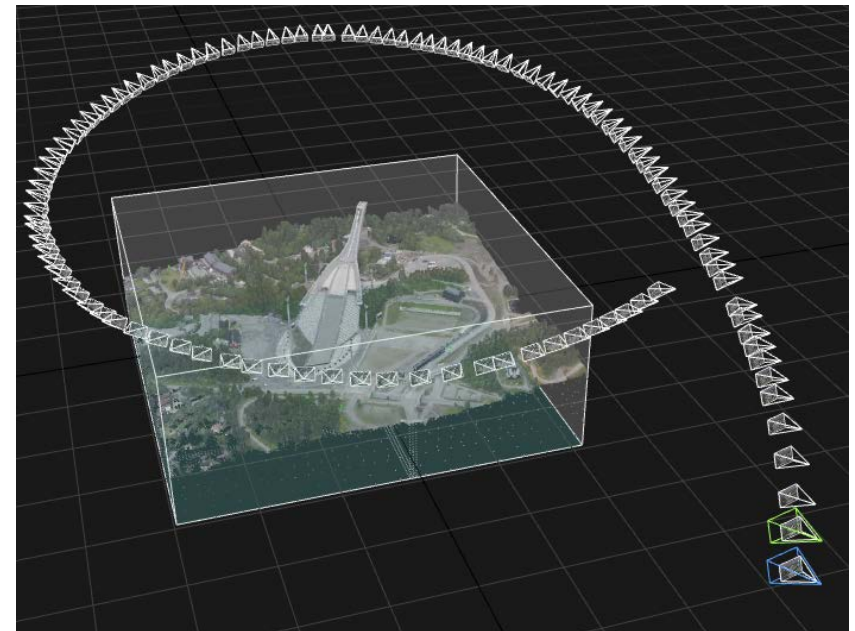
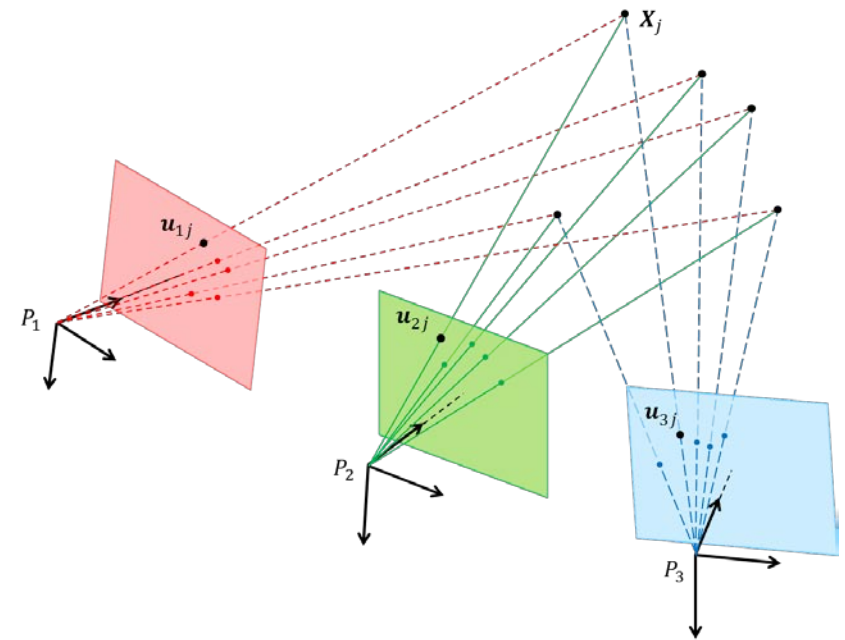
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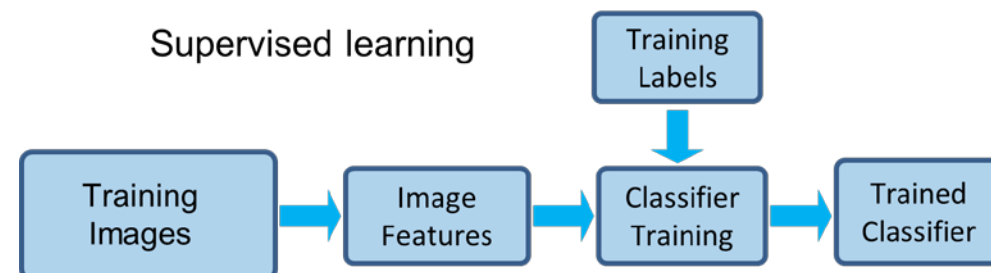


Schedule

Part III: Scene analysis	
22.03	9. Image analysis <ul style="list-style-type: none"> • Image segmentation • Image feature extraction • Introduction to machine learning
05.04	10. Object detection <ul style="list-style-type: none"> • Descriptor-based detection • Introduction to deep learning with CNNs
12.04	11. Image retrieval and place recognition <ul style="list-style-type: none"> • Image retrieval • Visual place recognition

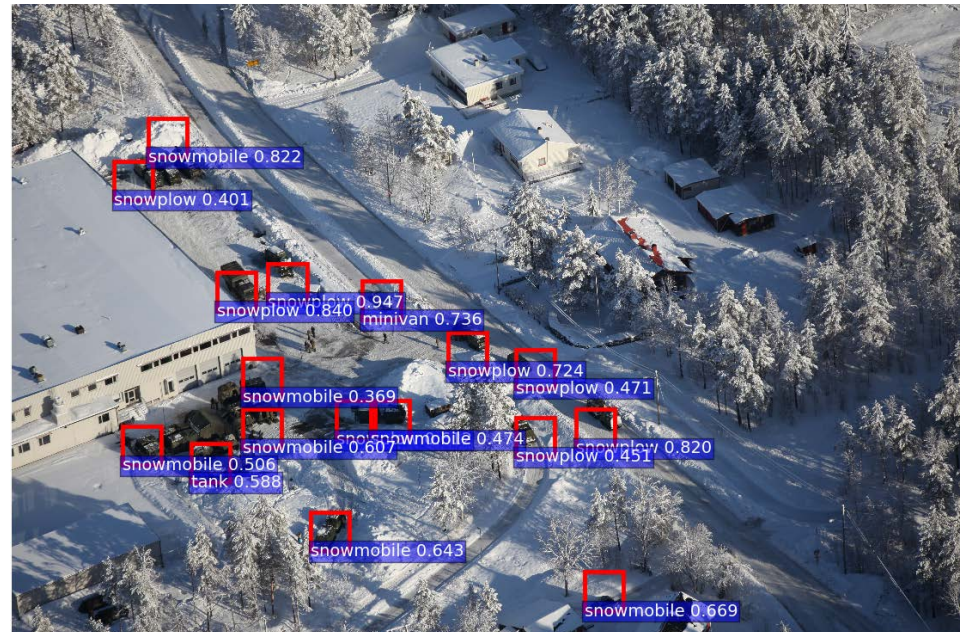
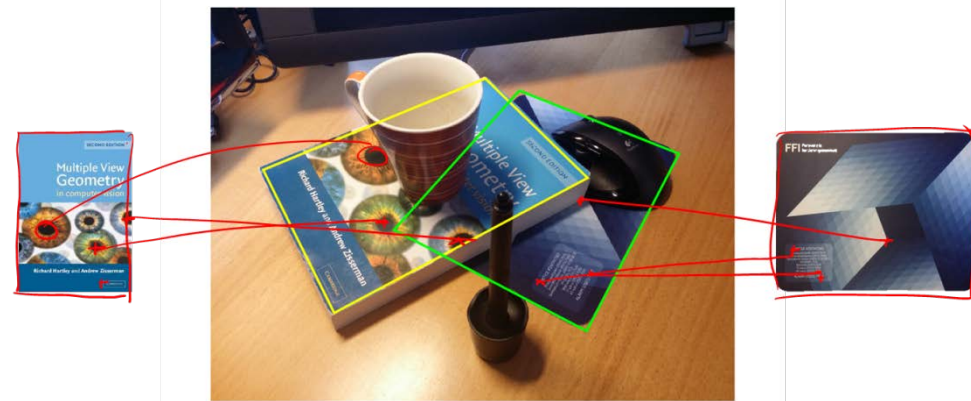


$$\vec{x} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ \dots \\ x_d \end{bmatrix}$$



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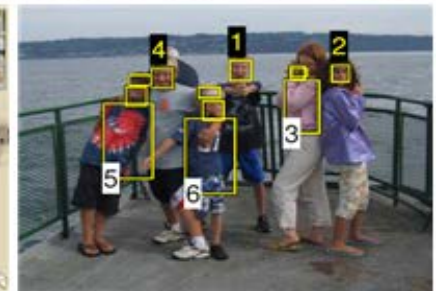
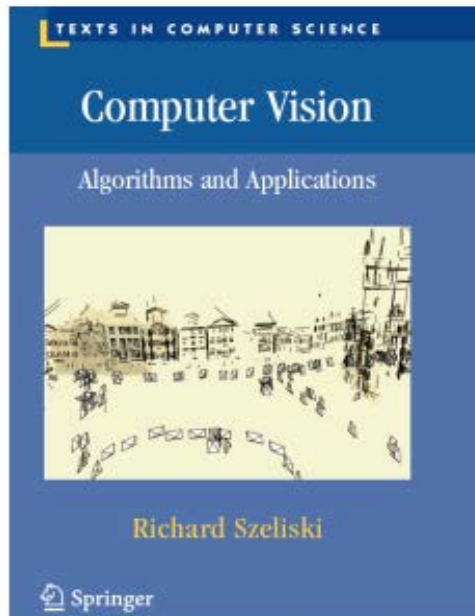
Schedule

Part IV: Student project	
12.04	Student project proposals
19.04	Student project feedback
26.04	Teachers available for support 9:15-12:00
03.05	Teachers available for support 9:15-12:00
10.05	Holiday
17.05	Holiday
24.05	Teachers available for support 9:15-12:00
27.05	Project report deadline
31.05	Project presentations

Textbook

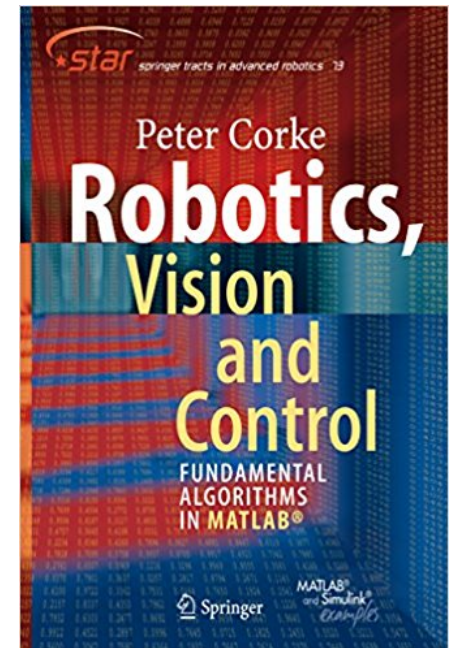
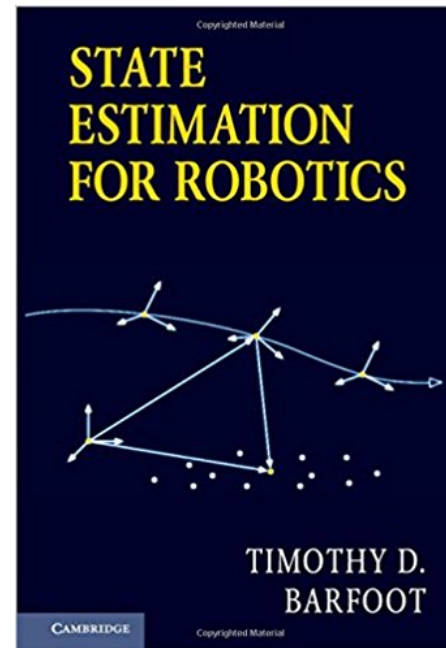
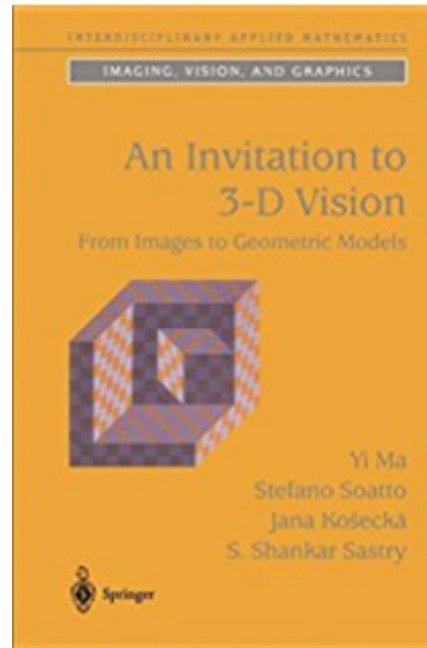
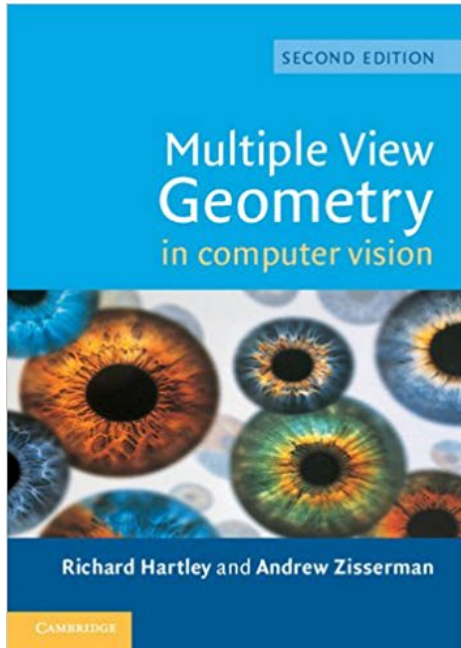
Computer Vision: Algorithms and Applications

© 2010 [Richard Szeliski](#), Microsoft Research



Free version online: <http://szeliski.org/Book/>

Supplementary resources

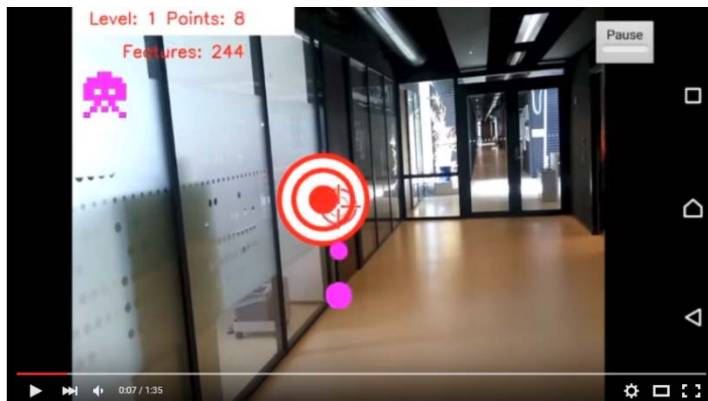


Lecture weeks

- Friday afternoon/evening the week before
 - Lectures are made available online
 - 3-4 videos (~20 minutes each)
- Read the chapters in the textbook
- Q&A, discussions on Piazza
- Thursdays 09:15
 - Brief summary with room for questions
- Thursdays ~09:35-12:00
 - Programming lab
 - Supervised by lecturers and lab assistant

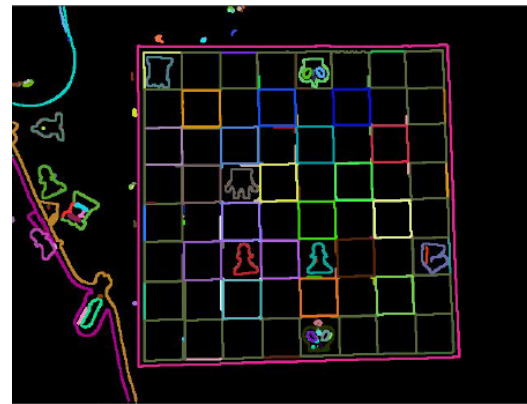
The student project

- Develop a functioning computer vision system that does something interesting
 - Large: More than a month
 - Mandatory: 60% of the grade
- Students propose their own projects
- Preferably groups of 2-3 students



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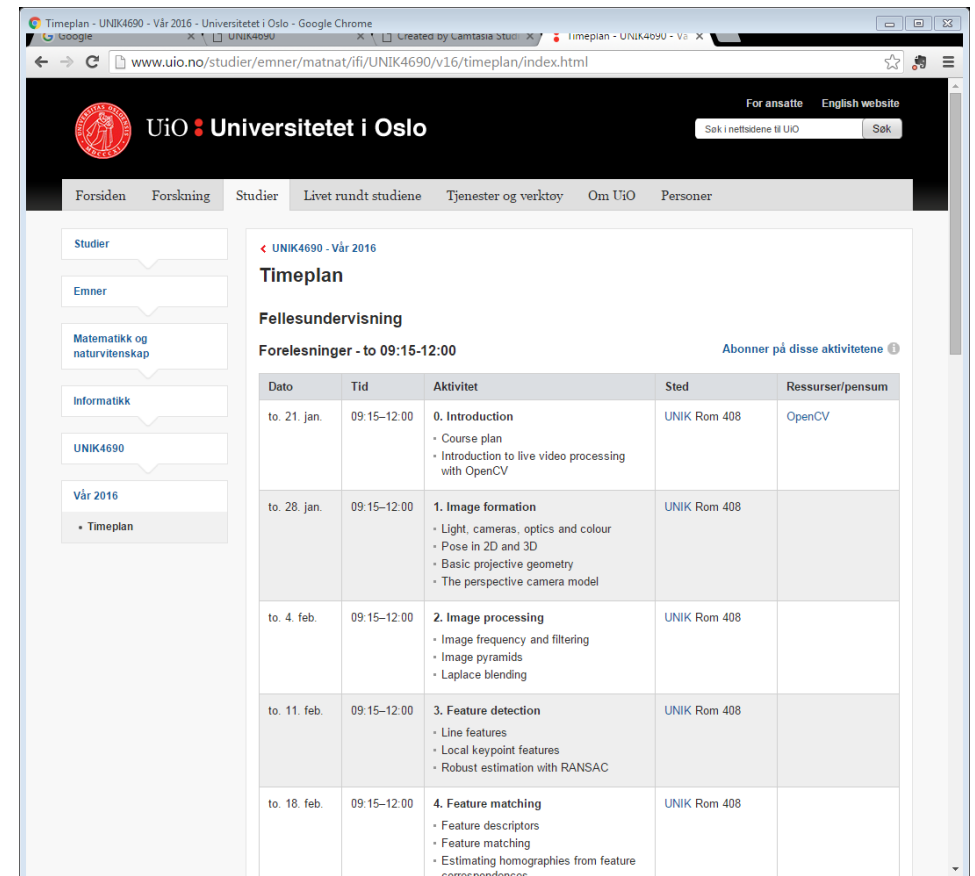


The student project

- Freedom of choice
 - Platform, programming language, tools,...
- Important dates
 - 12.04: Hand in written project proposal
 - 19.04: Oral feedback on the project proposals
 - 28.05: Hand in project report
 - 31.05: Project presentations
- During the project period we will be available for project support here at Kjeller on Thursdays 09:15-12:00
- The lab will in general be available to you (at least within office hours)

Webpage

- <http://www.uio.no/studier/emner/matnat/its/UNIK4690/v18/timeplan/index.html>
- Schedule
- Resources
 - Lectures as video
 - Lectures as pdf
 - Lab tutorials and exercises



Dato	Tid	Aktivitet	Sted	Ressurser/pensum
to. 21. jan.	09:15-12:00	0. Introduction <ul style="list-style-type: none">• Course plan• Introduction to live video processing with OpenCV	UNIK Rom 408	OpenCV
to. 28. jan.	09:15-12:00	1. Image formation <ul style="list-style-type: none">• Light, cameras, optics and colour• Pose in 2D and 3D• Basic projective geometry• The perspective camera model	UNIK Rom 408	
to. 4. feb.	09:15-12:00	2. Image processing <ul style="list-style-type: none">• Image frequency and filtering• Image pyramids• Laplace blending	UNIK Rom 408	
to. 11. feb.	09:15-12:00	3. Feature detection <ul style="list-style-type: none">• Line features• Local keypoint features• Robust estimation with RANSAC	UNIK Rom 408	
to. 18. feb.	09:15-12:00	4. Feature matching <ul style="list-style-type: none">• Feature descriptors• Feature matching• Estimating homographies from feature correspondences	UNIK Rom 408	

Piazza

- <https://piazza.com/uio.no/spring2018/unik4690/home>

- Messages
- Questions
 - Open or private
- Discussions

The screenshot shows the Piazza web interface for the UNIK4690 course. The top navigation bar includes links for notifications, lecture materials, Q & A, resources, statistics, and class management. A sidebar on the left lists various posts, including lecture notes and assignments, organized by week. The main content area displays a post titled "Bygge OpenCV på Ubuntu med CMake". A blue banner at the top of the post area states: "This class has been made inactive. No posts will be allowed until an instructor reactivates the class." The post content includes a note about building OpenCV on Ubuntu, a list of dependencies, and a terminal command to clone the repository. The bottom of the interface shows a table with columns for Average Response Time, Special Mentions, and Online Now.

UNIK4690 Q & A Resources Statistics Manage Class Trym Vegard Haavardsholm

Unread Updated Unresolved Following

New Post Search or add a post...

Forelesningene for uke 10 li... 3/25/17
Videor og slides finner dere på timeplanen. Idar

WEEK 3/12 - 3/18

Forelesningene for uke 9 lig... 3/16/17
Videor og slides finner dere på timeplanen. Idar

Forelesninger for uke 8 ligg... 3/12/17
Videor og slides finner dere på timeplanen. - Thomas

WEEK 3/5 - 3/11

Forelesninger for uke 7 ligg... 3/5/17
Videor og slides finner dere på timeplanen. - Thomas

WEEK 2/26 - 3/4

Forelesninger for uke 6 ligg... 2/27/17
Videor og slides finner dere på timeplanen. - Thomas

WEEK 2/12 - 2/18

Instr Bygge OpenCV på Ubuntu ... 2/16/17
Dette er en guide for Ubuntu til hvordan du kan bygge OpenCV selv fra kildekoden. Det kan hende guiden må oppdateres et

Instr Videresender invitasjon fra T... 2/14/17
Programming a client. Interested candidates for a task related to programming Sam Knows client <https://www.samknows.com>

Instr Forelesninger for uke 4 ligg... 2/12/17
Videor og slides finner dere på timeplanen. - Thomas

WEEK 2/5 - 2/11

Instr Forelesning 3 ligger ute 2/6/17
Du finner videoer og slides på timeplanen.

WEEK 1/29 - 2/4

Instr Løsningsforslag på Laplace... 2/2/17
Løsningsforslaget kan lastes ned fra lab-siden

Instr Løsningsforslag for andre d... 1/30/17
Last det ned fra Lab-1-siden. -Trym

WEEK 1/22 - 1/28

Instr Forelesningene for uke 2 (lm... 1/27/17
Linker til videoer og pdf'er for denne ukens forelesninger finner dere i timeplanen: <http://www.uio.no/studier/emner>

Note History

This class has been made inactive. No posts will be allowed until an instructor reactivates the class.

note 14 views

Bygge OpenCV på Ubuntu med CMake

Dette er en guide for Ubuntu til hvordan du kan bygge OpenCV selv fra kildekoden.

Det kan hende guiden må oppdateres etter hvert! Gi tilbakemelding!

Når du skal bygge store prosjekter med CMake er det mest praktisk å bruke gui-versjonen, siden vi skal endre endel variabler. Denne kan du laste ned fra <https://cmake.org/download>, eller du kan bruke `sudo apt install cmake-gui`.

Først så skal vi installere endel dependencies. Her smeller jeg bare alt inn i en kommando. \ betyr at kommandoen fortsetter på neste linje.

Dette kan ta litt tid!

```
sudo apt-get -y install \
build-essential \
cmake git pkg-config libgtk2.0-dev libavcodec-dev libavformat-dev libswscale-dev \
libeigen3-dev \
libglu1-mesa-dev \
libglew-dev \
libgtkglext1 \
libgtkglext1-dev \
libjasper-dev \
libjpeg-dev \
libopenexr-dev \
libpng-dev \
libtbb2 \
libtbb-dev \
libtiff-dev \
libvtk6-dev \
libxt-dev \
python-numpy
```

Gå til en mappe der du vil ha kildekoden for OpenCV, og last ned filene fra github. Du trenger også opencv_contrib.

```
git clone https://github.com/opencv/opencv.git --depth 1
git clone https://github.com/opencv/opencv_contrib.git --depth 1
```

Average Response Time: N/A Special Mentions: There are no special mentions at this time. Online Now: 1 This Week: 1

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Feedback

- We encourage feedback during the course
 - We are open for making adjustments
- We encourage you to participate in the course evaluation
- Any questions?