

Computer Vision I

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Machine Learning for Computer Vision
TU Dresden



Winter Term 2022/2023

Welcome

- ▶ Course consisting of
 - ▶ Lectures in ASB/0028/H on Mon, 11:10–13:00
 - ▶ Exercise groups starting Oct 17th

Online	Mon, 14:50–16:20
In APB/E069	Tue, 13:00–14:50
In APB/E069	Tue, 14:50–16:40
 - ▶ Self-study and moderated discussion in a forum
 - ▶ Final examination (covering lectures and exercises)
- ▶ <https://mlcv.inf.tu-dresden.de/courses/22-winter/cv1/index.html>
- ▶ **Registration:**
 - ▶ All participating students need to register through **OPAL**
 - ▶ Those enrolled in the study program Computational Modeling and Simulation (CMS) need to register additionally via **SELMA**.
- ▶ **Textbooks:**
 - ▶ Szeliski, R.. *Computer Vision: Algorithms and Applications*, 2nd ed., 2020, available online at <http://szeliski.org/Book/>
 - ▶ Hartley, R. I. and Zisserman, A.. *Multiple View Geometry in Computer Vision*. Second edition. 2004. Cambridge University Press
- ▶ **No recordings/reproductions of the lectures or exercises!**

Computer Vision

Computer Vision is a branch of computer science devoted to the *study* and *development* of mathematical models, algorithms, software and systems for analyzing and interpreting images.

- ▶ Poses challenging problems
- ▶ Combines insights and methods from multiple disciplines
 - ▶ Mathematics (esp. optimization, probability theory, statistics)
 - ▶ Computer Science (esp. algorithms, complexity, software engineering)
 - ▶ Engineering (electrical, mechanical, optical)
- ▶ Provides an opportunity for applying analytical and engineering skills
- ▶ Is rewarding by visual results
- ▶ Has impact on applications (medical, robotic, consumer)
- ▶ Grows dynamically
- ▶ Offers excellent career opportunities (esp. in tech companies and startups)

Computer Vision

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- ▶ Leading scholarly journals:
 - ▶ Transactions on Pattern Analysis and Machine Intelligence (TPAMI)
 - ▶ International Journal on Computer Vision (IJCV)
 - ▶ Journal on Mathematical Imaging and Vision (JMIV)
- ▶ Leading academic conferences:
 - ▶ Computer Vision and Pattern Recognition (CVPR)
 - ▶ International Conference on Computer Vision (ICCV)
 - ▶ European Conference on Computer Vision (ECCV)
- ▶ Scientific communities
 - ▶ Computer Vision
 - ▶ Mathematical Image Analysis
 - ▶ Medical Image Analysis
 - ▶ Computational Imaging (tomography, MRI, radar, ultrasound, etc.)
 - ▶ Machine Learning

Contents

1. Formation of digital images
 - ▶ Real projective geometry
 - ▶ Projective camera
 - ▶ Color spaces
2. Operators on digital images
 - ▶ Point operators
 - ▶ Linear operators
 - ▶ Non-linear operators
 - ▶ Classic computer vision
3. Fourier analysis of digital images
 - ▶ Discrete Fourier transform
 - ▶ Discrete Cosine transform
4. Geometric analysis of digital images
 - ▶ Panorama stitching
 - ▶ Epipolar geometry
 - ▶ Stereo vision

Contents

5. Classification of digital images
 - ▶ Probabilistic model
 - ▶ Machine learning problem
 - ▶ Learning algorithms
 - ▶ Inference problem
 - ▶ Inference algorithms
6. Decomposition of digital images
 - ▶ Region growing heuristics
 - ▶ (Lifted) multicut problem
 - ▶ Local search algorithms
7. Segmentation of digital images
 - ▶ Joint graph decomposition and node labeling problem
 - ▶ Local search algorithms
8. Object recognition in digital images
 - ▶ Single object recognition
 - ▶ Multiple object recognition
9. Object tracking in digital images
 - ▶ Single object tracking
 - ▶ Multiple object tracking