



Friedrich-Alexander-Universität  
Department Artificial Intelligence  
in Biomedical Engineering | AIBE

# Fachrichtung Medizinische Bild- und Datenverarbeitung

## Medical Image and Data Analysis

Dr. Christine Müller / Prof. Dr. Bernhard Kainz



# Medical imaging



Source: <https://www.healthcare.siemens.com>

**EXACT**

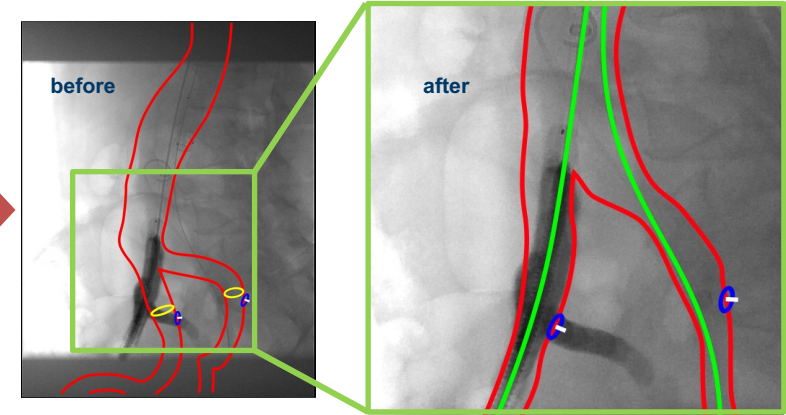
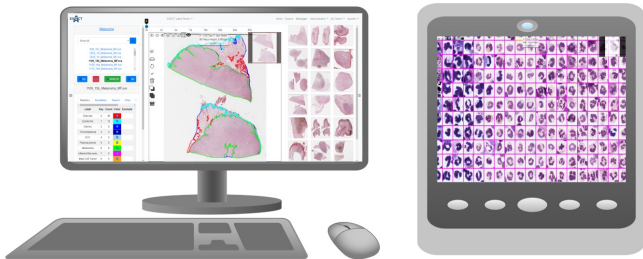
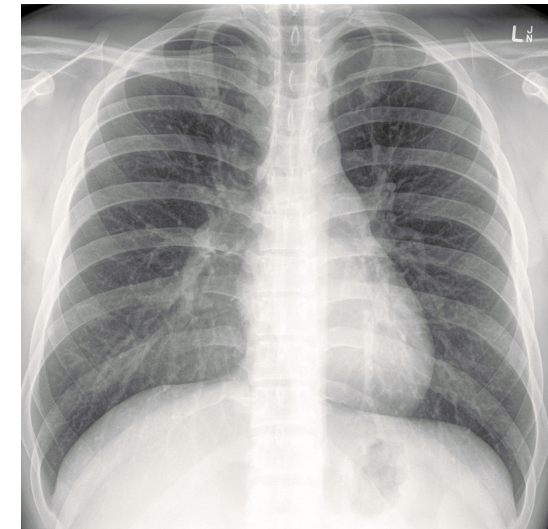
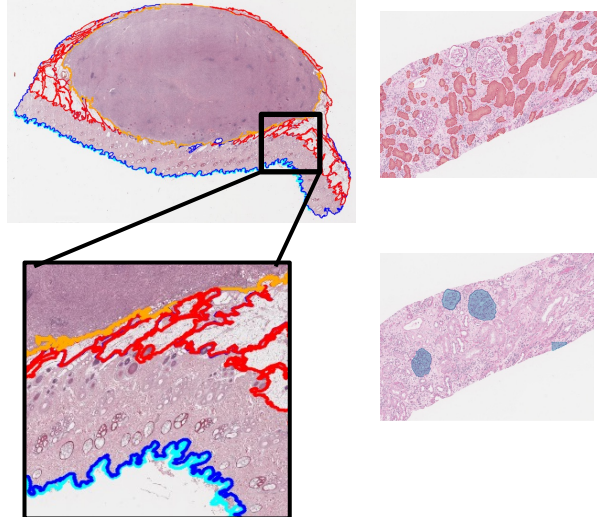


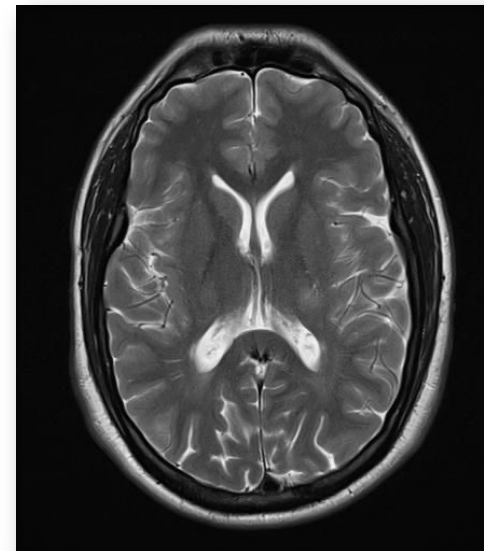
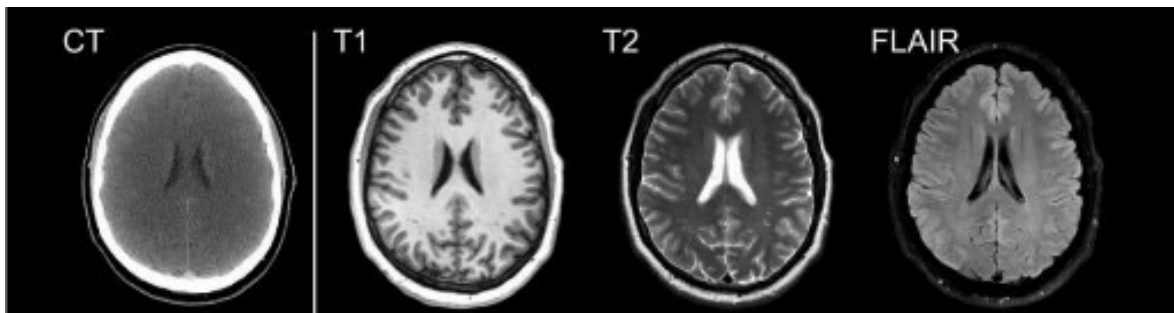
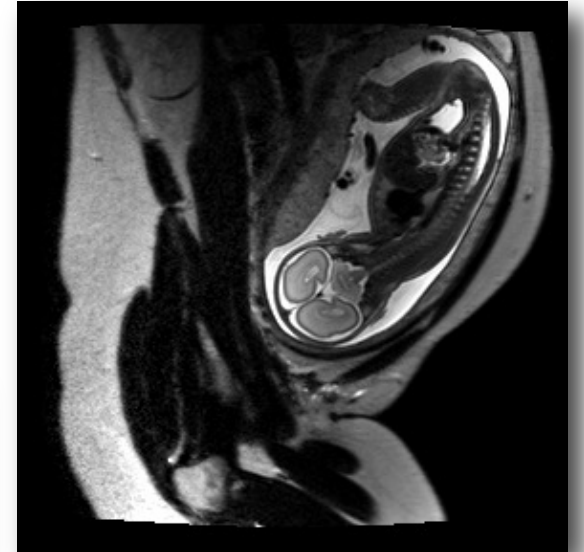
Image courtesy: Prof. Falkenberg, Sahlgrenska, Sweden

Background
  Tumor
  Epidermis
  Dermis
  Subcutis
  Inflammation/Necrosis

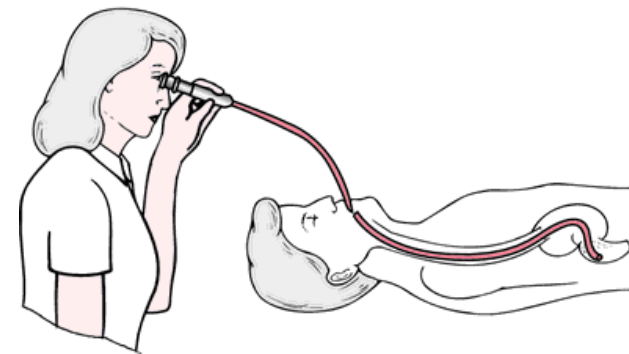
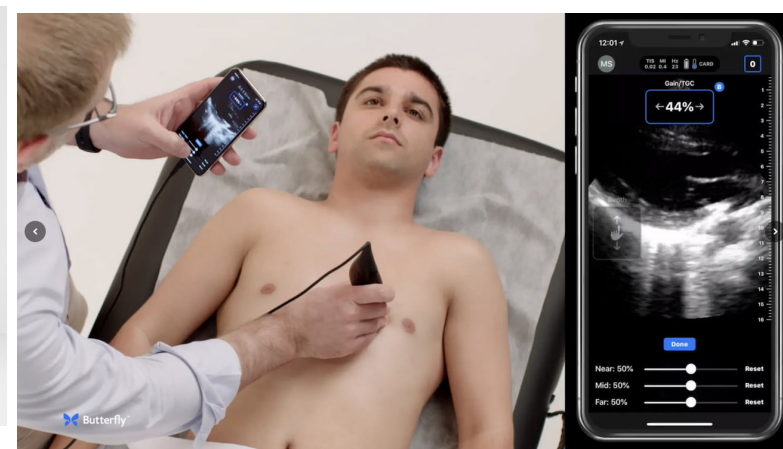
Image courtesy: Prof. Klopffleisch, FU Berlin



# Medical imaging



# Medical imaging



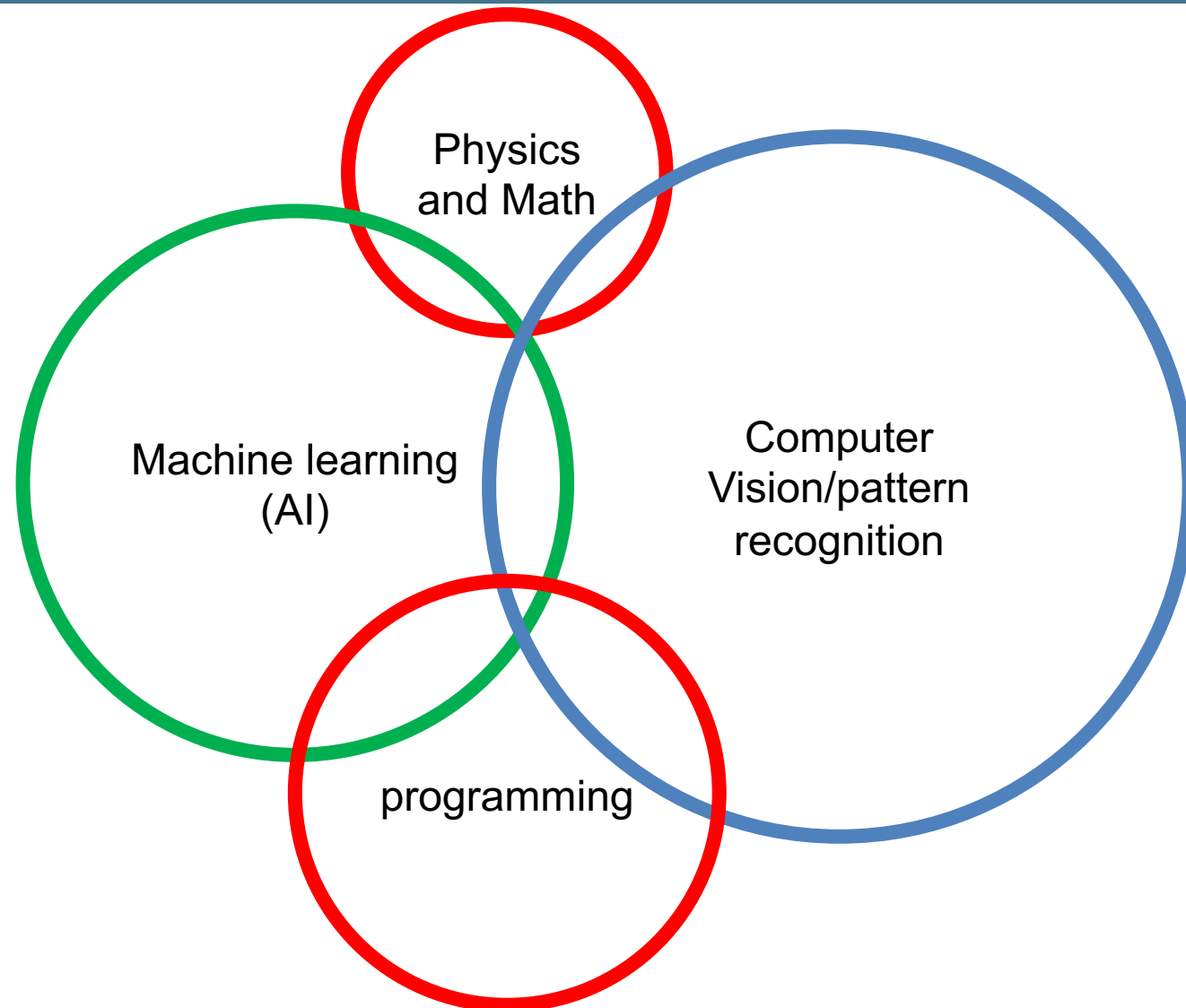
# Choices

Dept. AIBE

<https://aibe.tf.fau.de/>

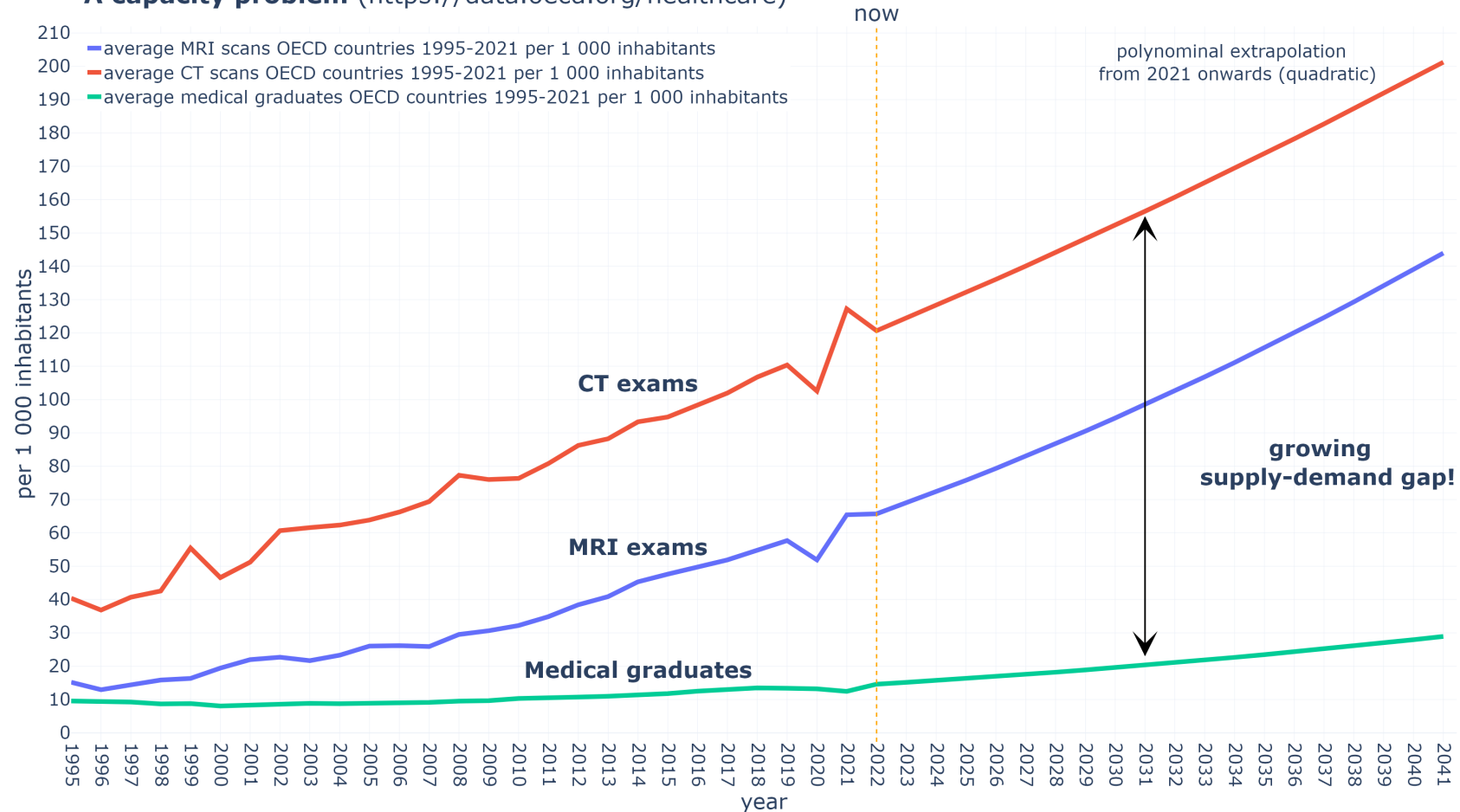
Dept. Informatik

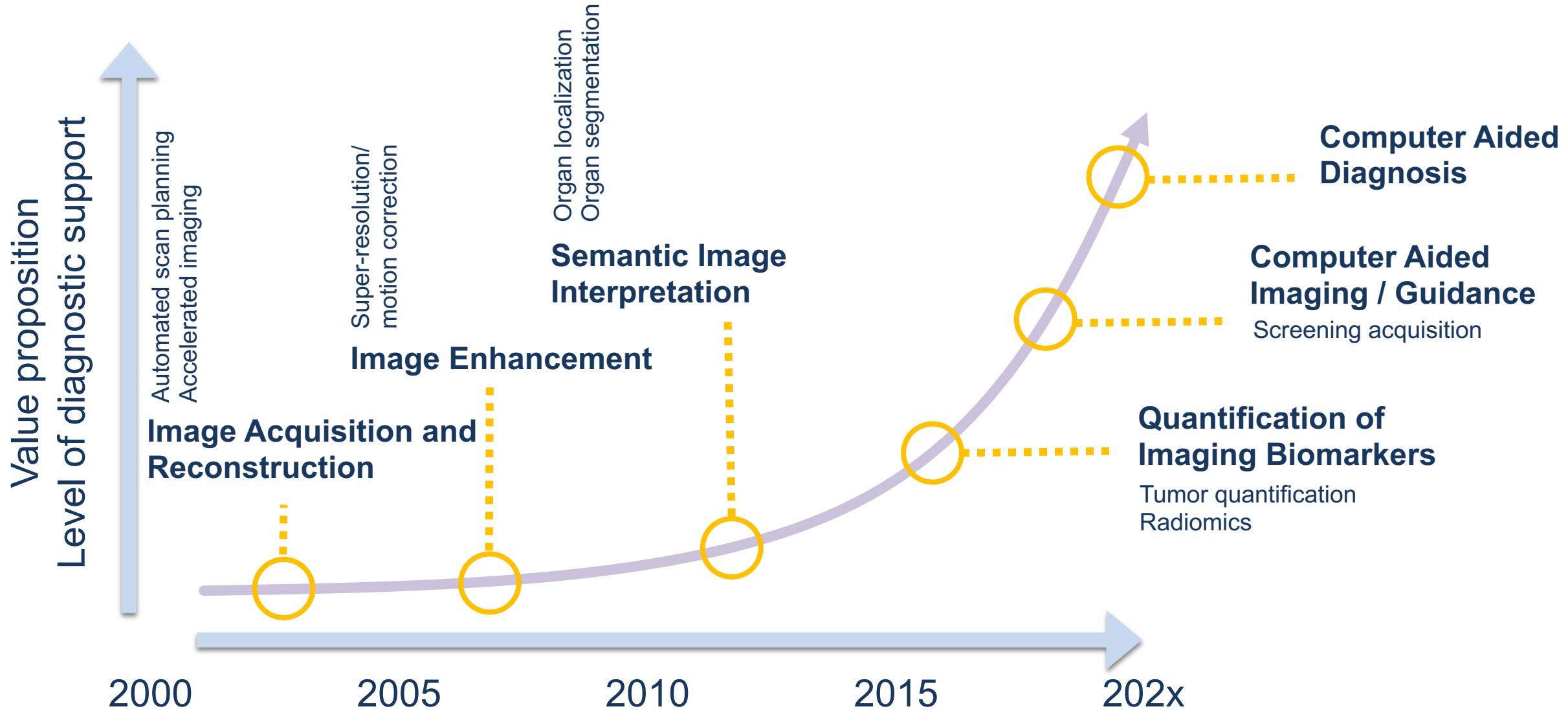
<https://cs.fau.de/>



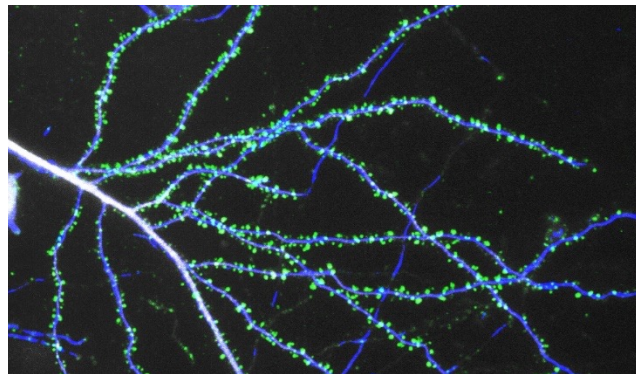
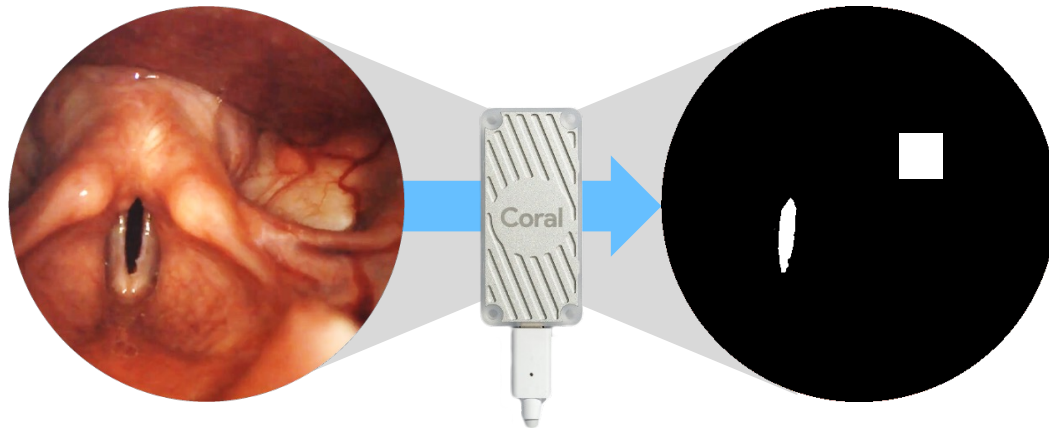
# Future relevance?

**A capacity problem** (<https://data.oecd.org/healthcare>)





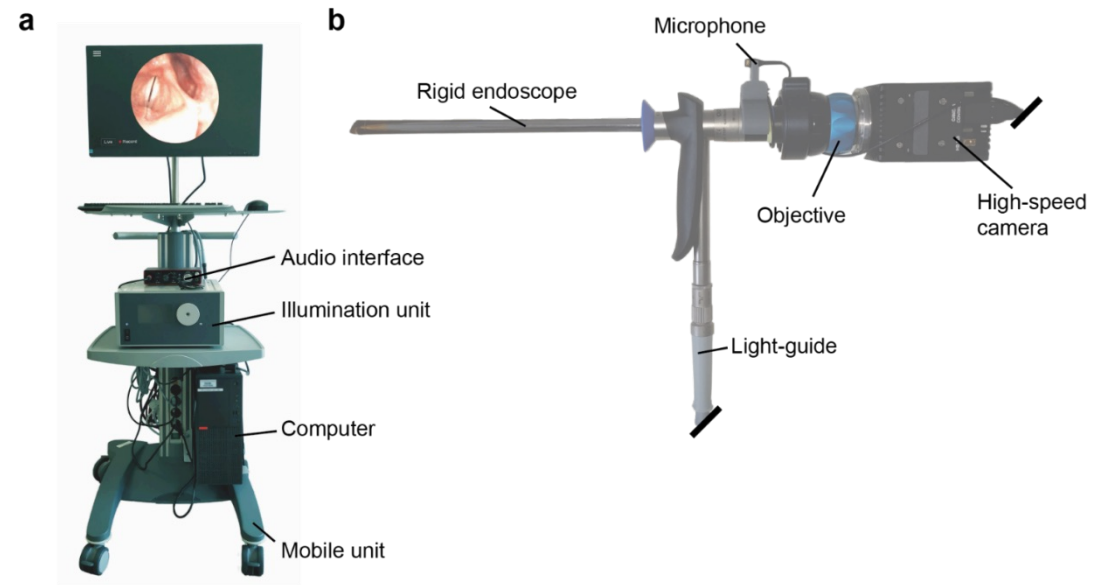
# Data analysis – ANKI lab



Revolutionizing  
 neuroscience  
 research through  
 AI-driven  
 neuroanatomical big  
 data analysis

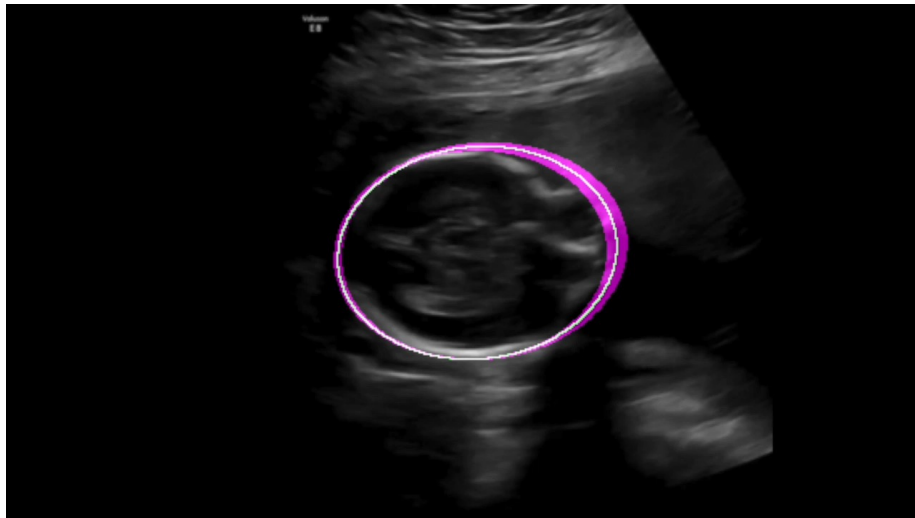
# OpenHSV

AI-powered, Open Source system for high-speed videoendoscopy to quantify and monitor voice physiology



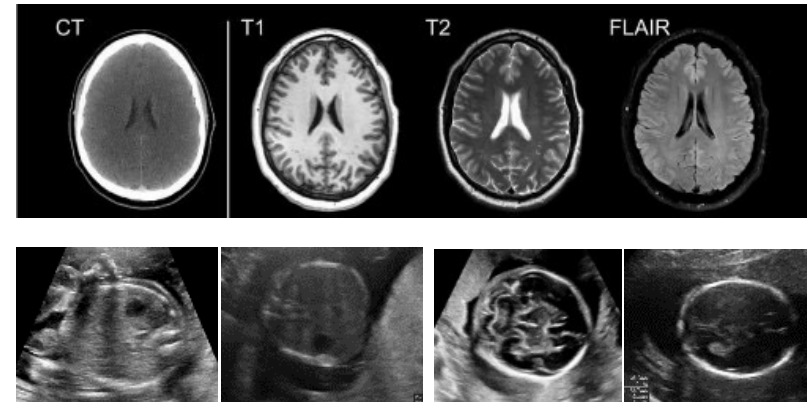
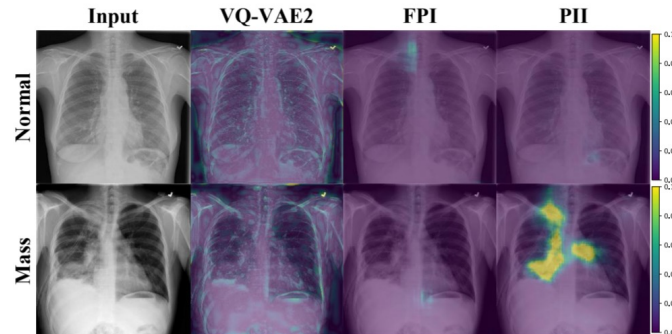


# Image analysis – IDEA lab

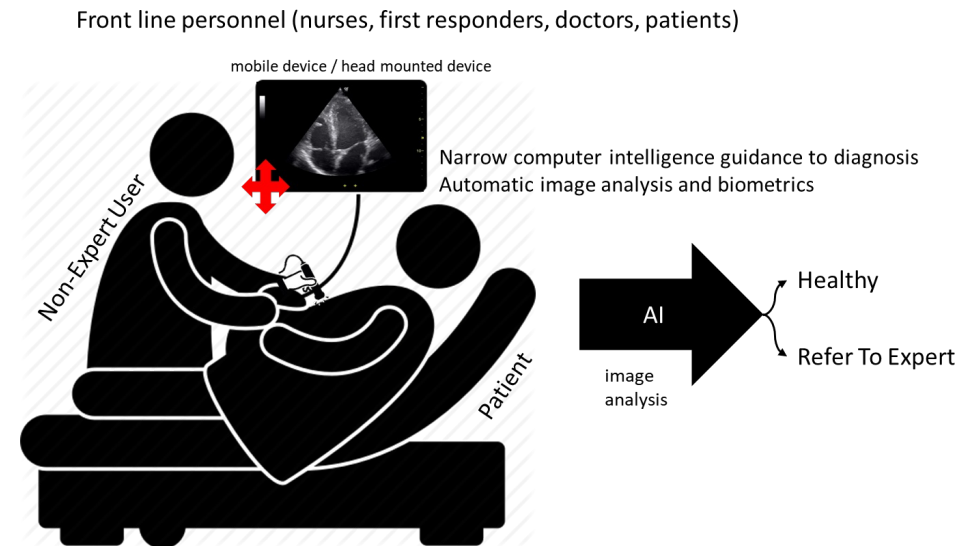


Ultra-sound imaging: predicting the head circumference of a fetus

Normative Machine Learning /anomaly detection



Multi-modal imaging





# Pattern recognition lab

Hardware

Data acquisition

Image reconstruction

Analysis and diagnosis

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Pattern Recognition Lab

Pattern Recognition Lab, Computer Science, Friedrich-Alexander-Universität Erlangen-Nürnberg

## Welcome to the Pattern Recognition Lab!

Researchers and students at Pattern Recognition Lab (LME) work on the development and implementation of algorithms to classify and analyze patterns like images or speech. The research is mostly interdisciplinary and is focussed on medical- and health engineering. The LME has close national and international collaborations with other universities, research institutes and industrial partners.

## Contact

Mail: [cs5-info@lists.fau.de](mailto:cs5-info@lists.fau.de)

Phone: +49-9131-85-27775

Fax: +49-9131-85-27270

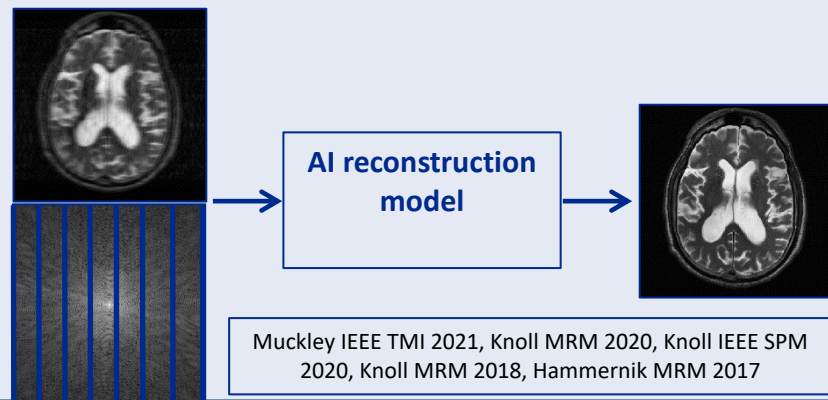
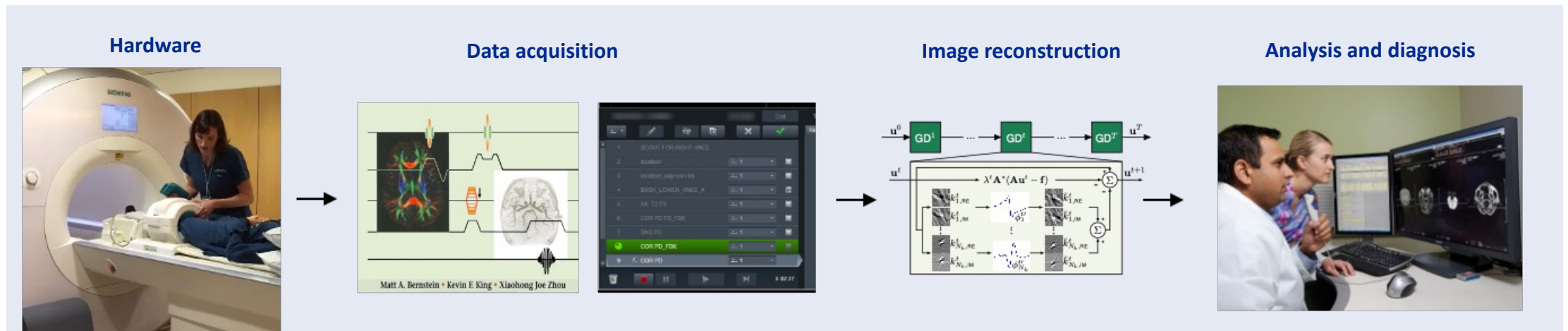
## Secretary:

Due the current limitations, the office hours may vary. Please make an appointment by e-mail.

## Research Areas

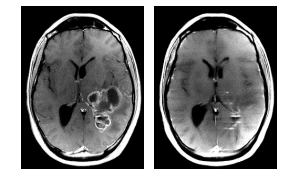
# Data analysis – Computational imaging lab

*Machine Learning in Medical Engineering ; MRI in the era of AI (florian.knoll@fau.de)*

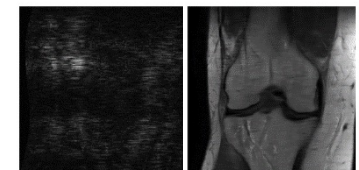


## Ongoing challenges

Missing image features

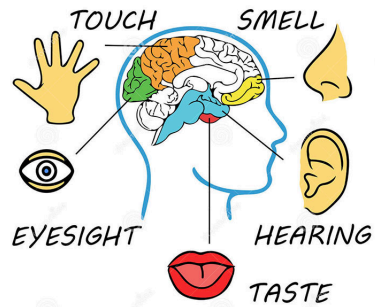


Robustness/stability



# Data analysis – Sensory Neuroengineering lab

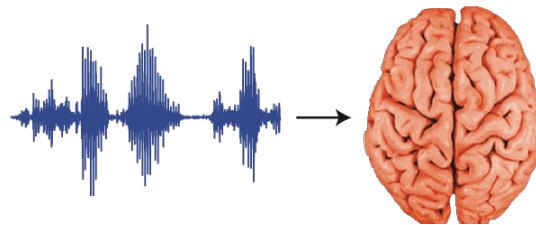
## Sensorische Neurotechnologie:



## Verstehen multisensorischer Wahrnehmung

### Grundlagen:

- z.B. Neuronale Mechanismen von Sprachverarbeitung
- Multisensorische Verarbeitung



### Diagnose von Störungen

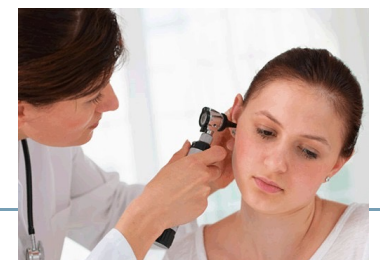
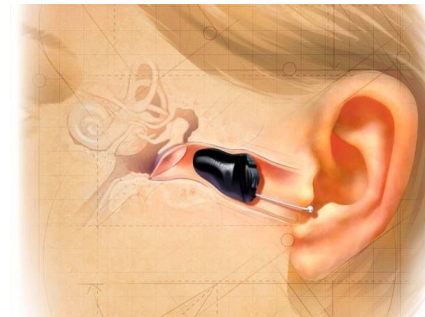
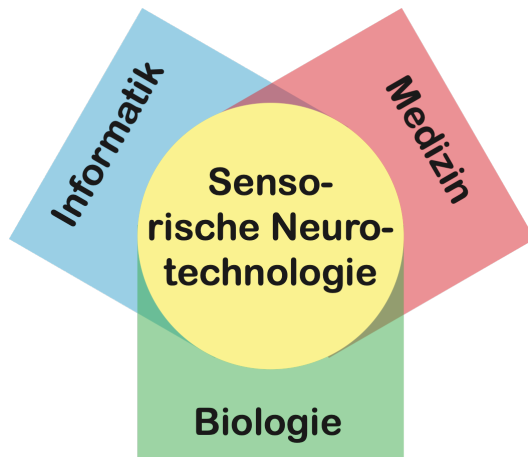
### Technologien zur Behandlung

### Technologie / Industrie:

- kognitive Hörgeräte
- audiovisuelle Hörgeräte
- Oticon, Sivantos (Hörgeräte); Google (KI)

### Klinische Links:

- Hörschäden, Cochlea-Implantate
- Aphasie nach Schlaganfall
- Traumatische Hirnverletzungen





# Artificial Intelligence in Medical Imaging – AIMI lab



## AIMI Lab

Artificial Intelligence in Medical Imaging

### Master and Bachelor Theses & Projects

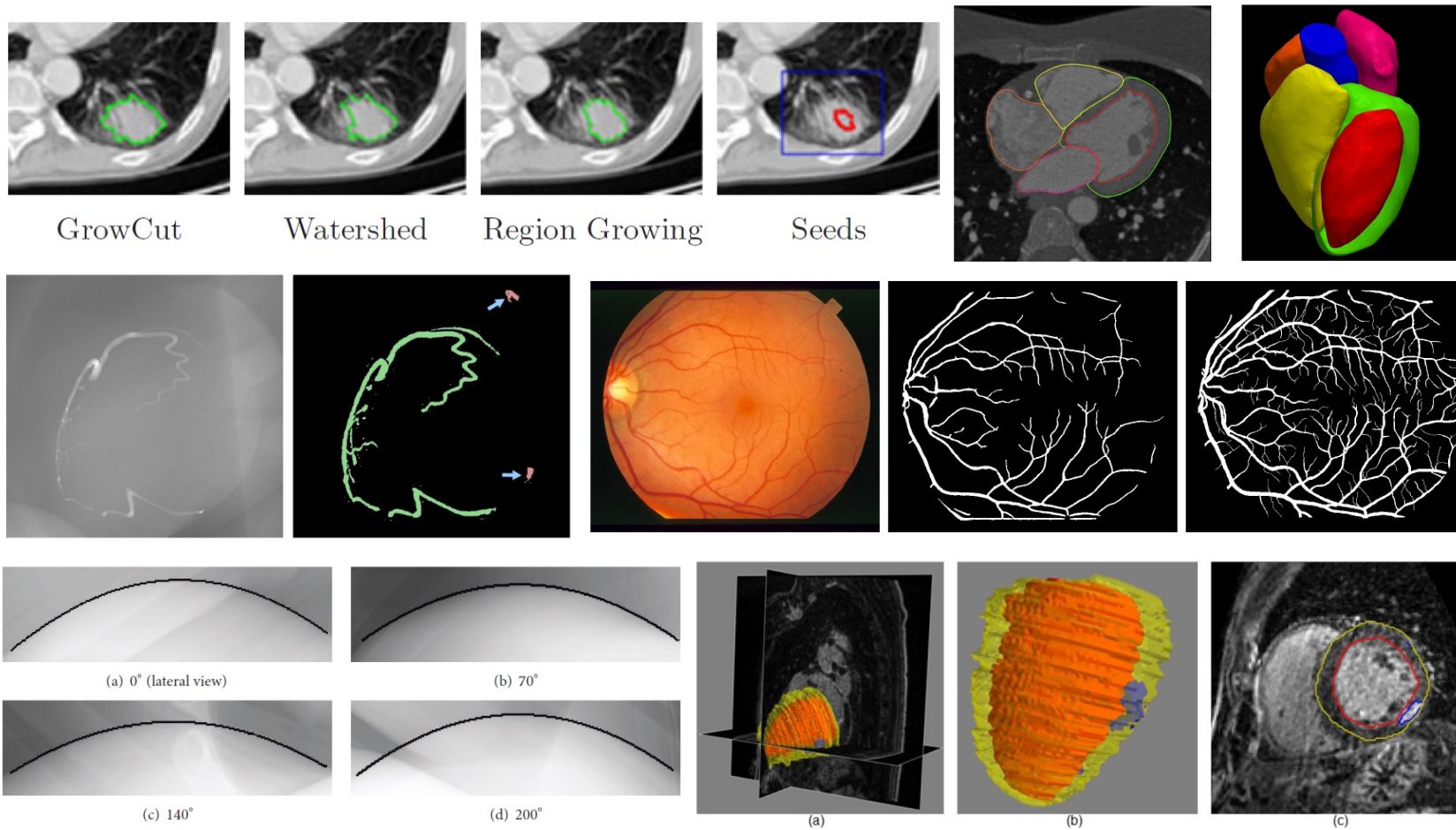
We typically have a number of open topics available for students from different study programs (Department of Computer Science and Department of Artificial Intelligence in Biomedical Engineering). Please contact **Prof. Dr.-Ing. Katharina Breininger** for an inquiry by sending your CV and a current transcript of records. Please also include your research interests, your programming experience as well as your motivation for a thesis with our lab.

# AIROB

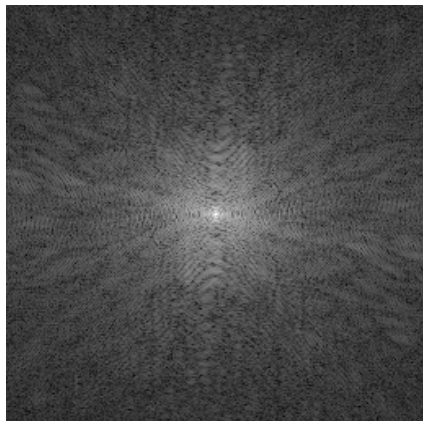
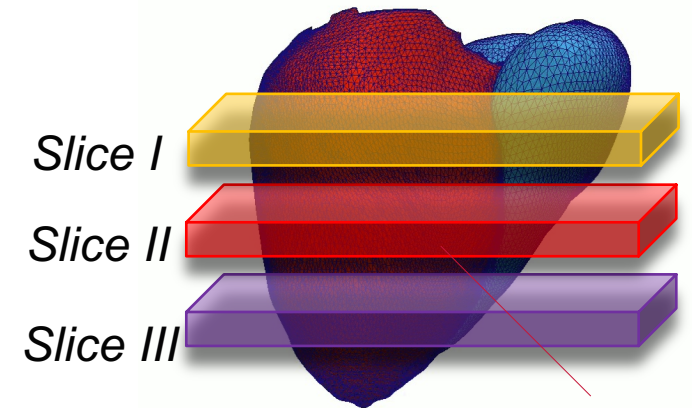
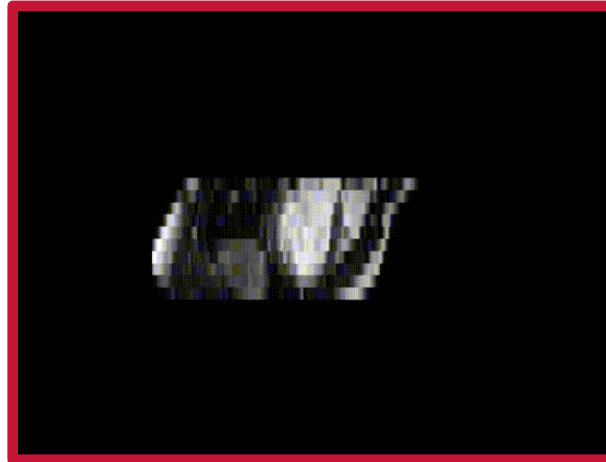
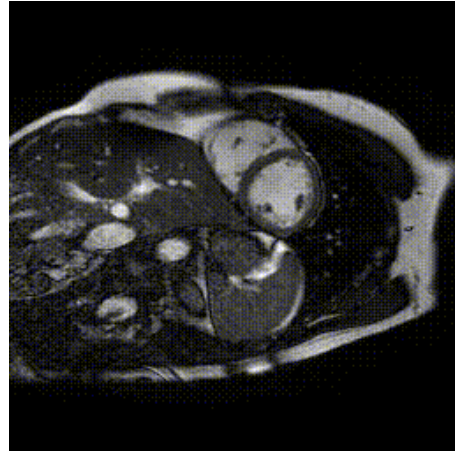
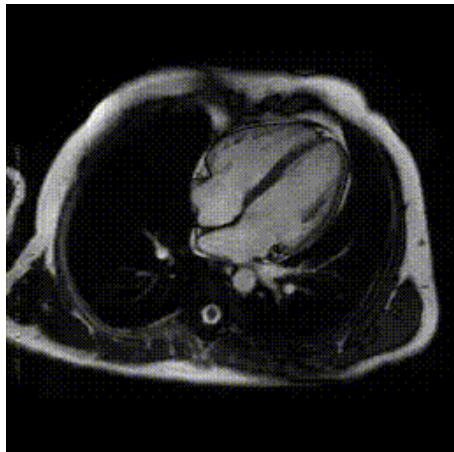
[https://www.youtube.com/watch?v=o5d0cpq\\_1WI&list=PLgLLPe5VGhclu6\\_uV4wBfsoH3C3nBT1HC&index=10](https://www.youtube.com/watch?v=o5d0cpq_1WI&list=PLgLLPe5VGhclu6_uV4wBfsoH3C3nBT1HC&index=10)



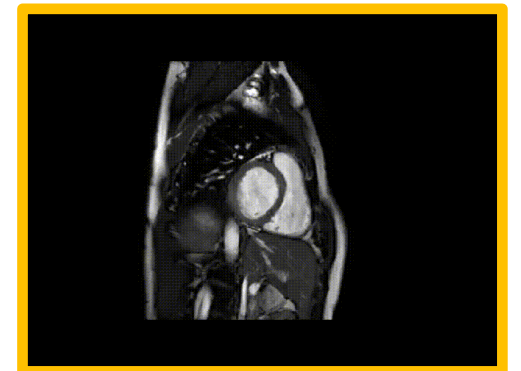
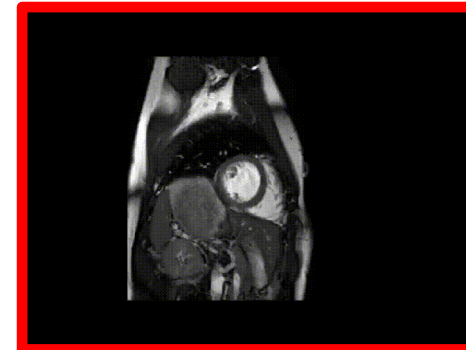
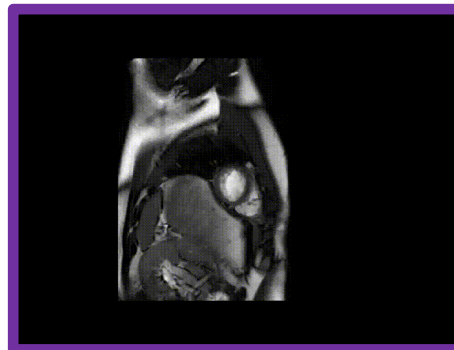
# Radiomics



# Data analysis - MRI

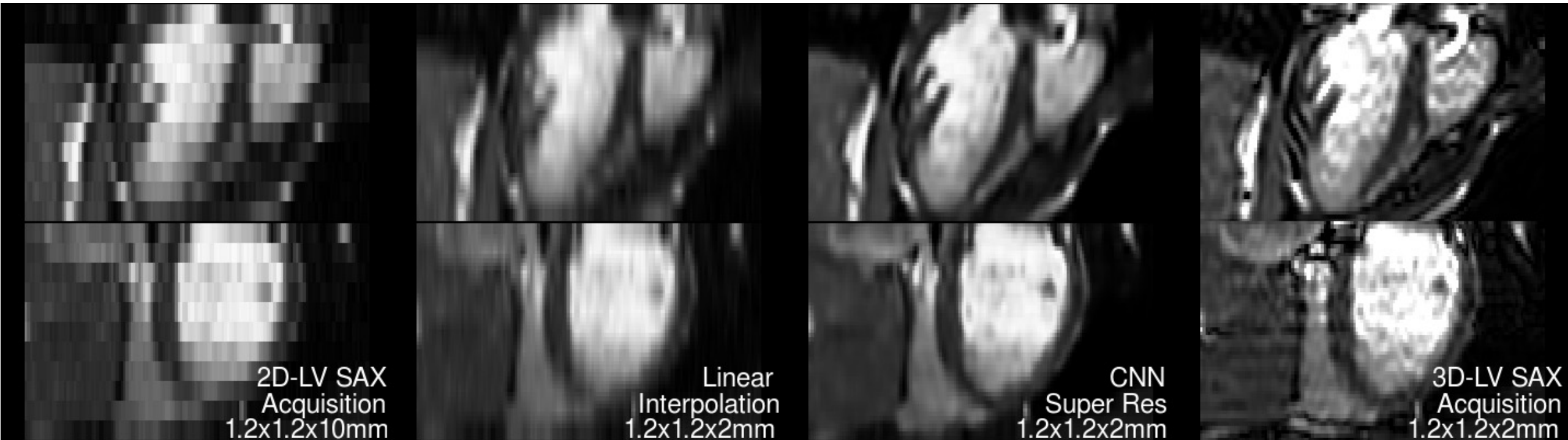


k-space

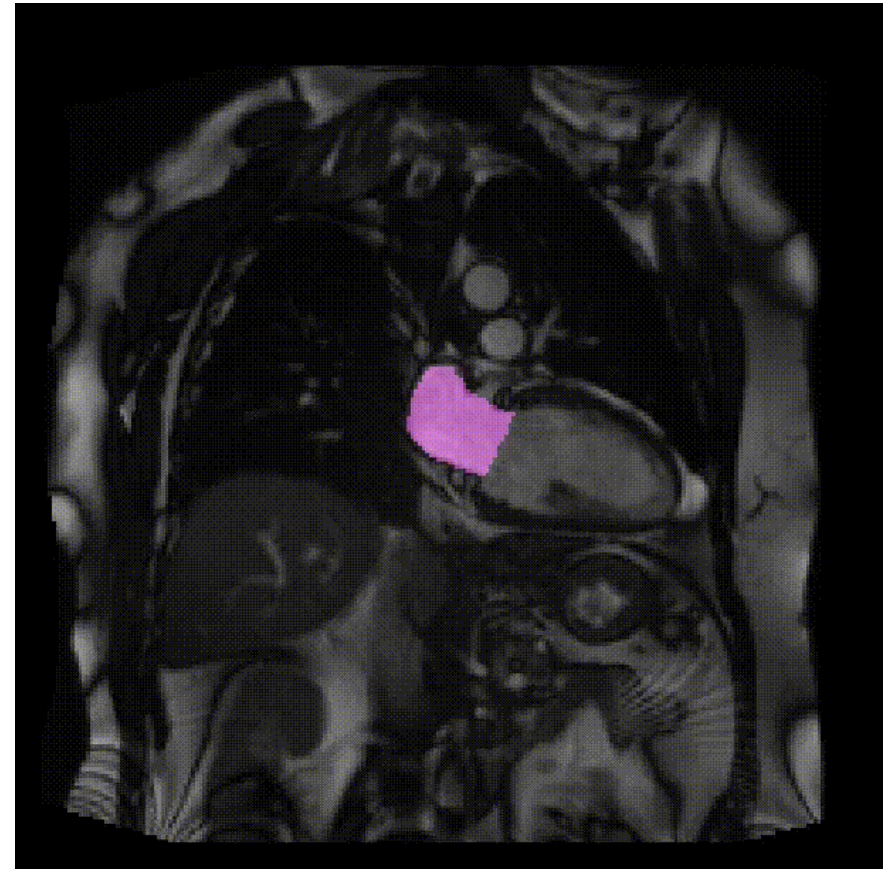
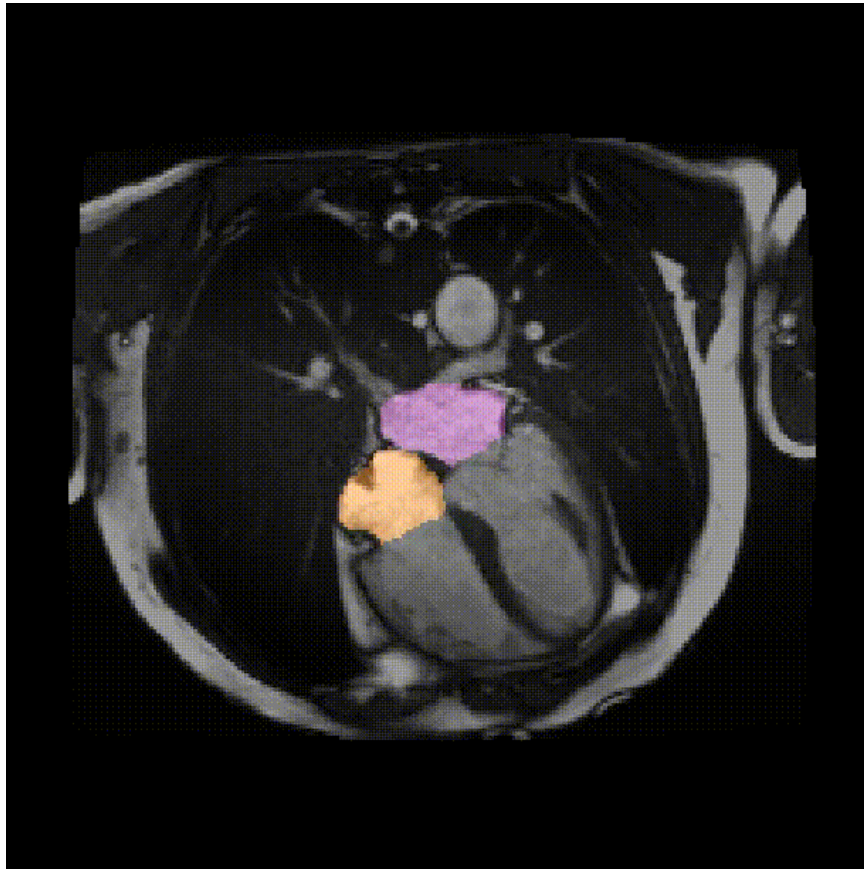
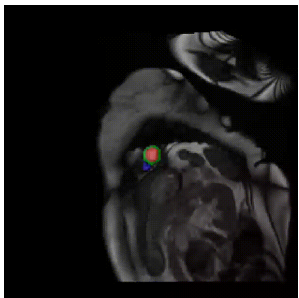
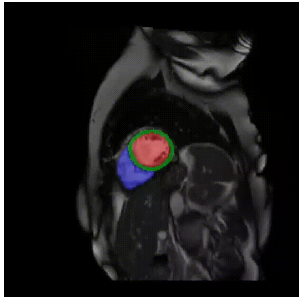
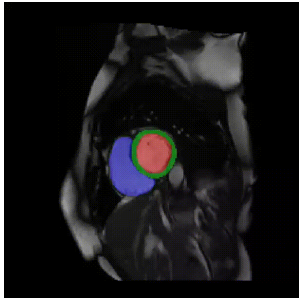




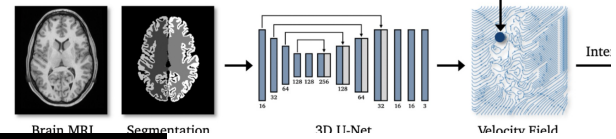
# Data analysis - MRI



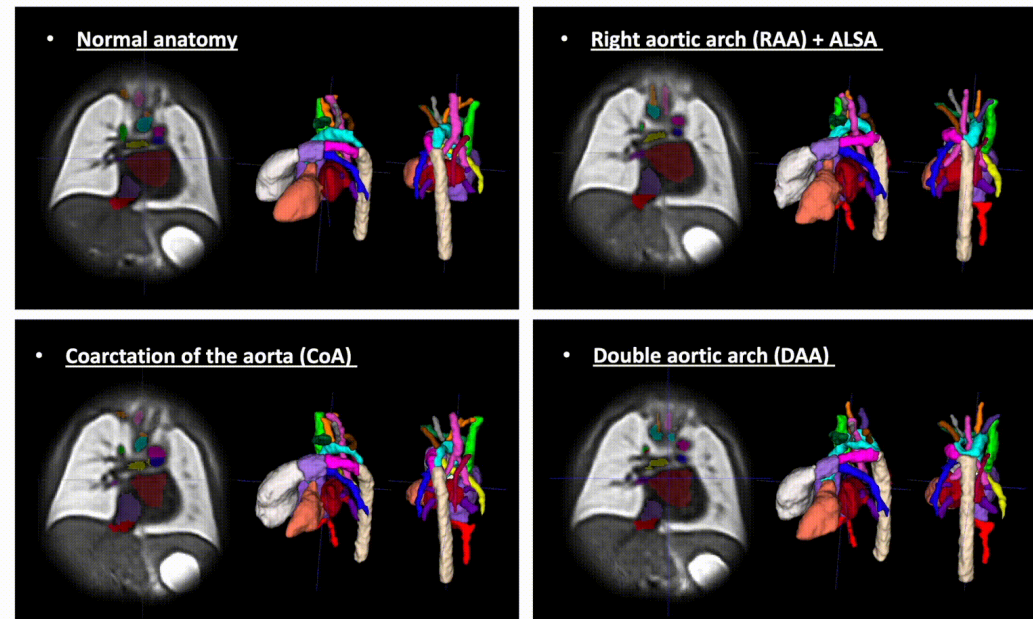
# Data analysis - MRI



# Data analysis - MRI

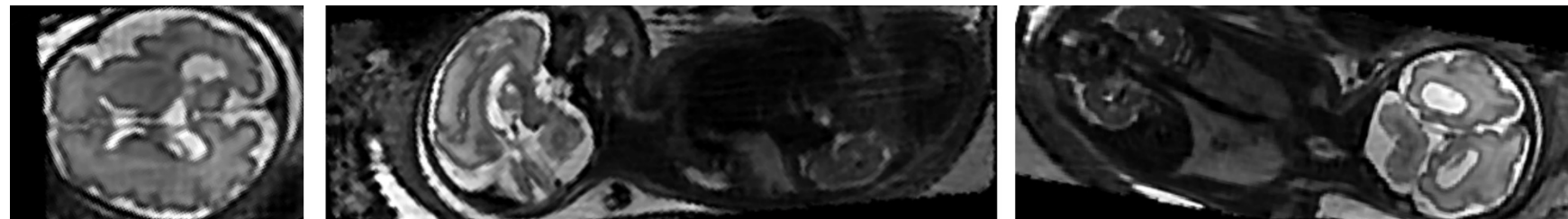


## 3D MRI atlases of the fetal heart



1	Inferior vena cava	IVC
2	Superior vena cava	SVC
3	Left pulmonary artery	LPA
4	Right pulmonary artery	RPA
5	Aorta	AO
6	Arterial duct	AD
7	Descending aorta	DAO
8	Main pulmonary artery	MPA
9	Left subclavian artery	LSA
10	Brachiocephalic artery	BCA
11	Left common carotid artery	LCCA
12	Pulmonary veins	Pvs
13	Azygos vein	Azy
14	Innominate vein	InnV
18	Left ventricle	LV
19	Left atrium	LA
20	Right ventricle	RV
21	Right atrium	RA
22	Trachea	T
23	Aberrant left subclavian artery	ALSA

Cardiac atlas by Alena Uus, Milou van Poppel and David Lloyd: [https://gin.g-node.org/SVRTK/fetal\\_mri\\_atlases](https://gin.g-node.org/SVRTK/fetal_mri_atlases)



# Outlook

- Image and data processing is an exciting branch of Medical Engineering
- In this branch you will learn
  - how images are created / calculated
  - how to evaluate large amounts of data
  - how Big Data technologies like "Deep Learning" work
- Special courses can be chosen:
  - X-ray / CT
  - Magnetic resonance tomography
  - PET / SPECT
  - Ultrasound imaging
  - advanced computer vision methods for image analysis and representation learning