

Preliminaries

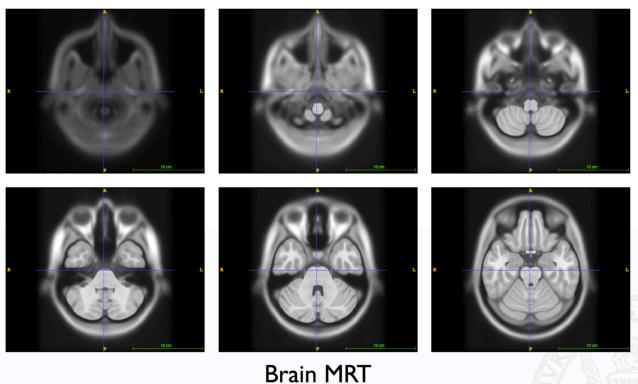
Topics covered in this lecture:

- Radiography (X-Ray & CT)
- Magnetic Resonance Tomography (MRT)
- Ultrasound
- Time-of-Flight (ToF)
- Structured Light
- LIDAR

So, this lecture is about imaging modalities **beyond typical "consumer electronics"**.

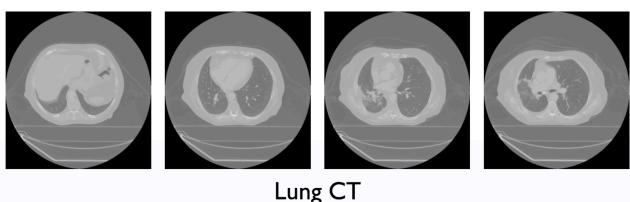
Imaging Modalities

Magnetic Resonance Tomography



Note: Physical environment (temperature, scanner parameters, etc.) has a huge impact on the captured image. Which means that an image of the same person might look different captures a second time.

Computer Tomography



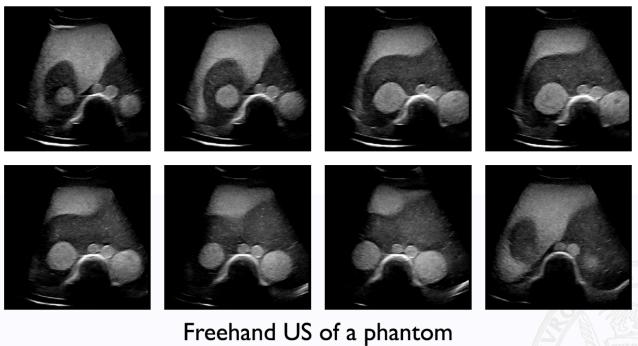
Note: Captured by "rotating X-Ray".

Problem with CT:

Ionizing ("ionisierend") radiation is typically used for more "bone-like" structures. Means it's hard to

differentiate between many different tissue types. MRT is always us to better differentiate between different tissue types.

Ultrasound



Structured Light



MS Kinect

We get two different types of information:

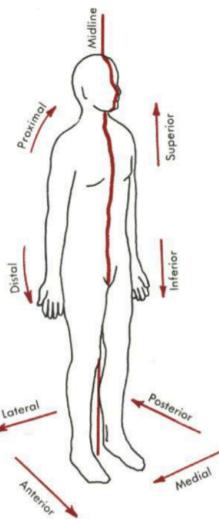
- Point Cloud
- Depth Map

Intensity values

Intensity values are related to physical tissue characteristics.

So the actual value of an image has more meaning than in standard imaging.

Anatomical Orientations



- Superior vs. Inferior
- Right vs. Left
- Anterior vs. Posterior

Note that "Left/Right" is seen from the view of the patient.

Orientations are typically encoded in a three letter code. We need to be really careful since different images can have totally different letter codes!

The code always describes to positive direction of each axis!

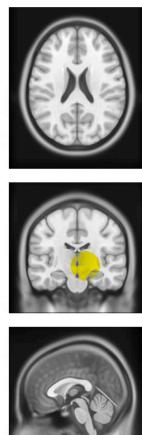
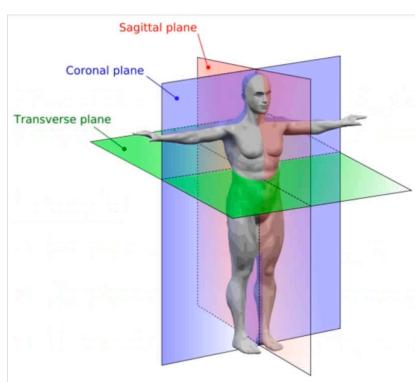
Example: RAS

R: x-axis from left to right

A: y-axis from posterior to anterior

S: z-axis from interior to superior

Imaging Planes



Transverse/Axial

Coronal

Sagittal

Coordinate Space

We have multiple coordinate systems:

- **World:** How the patient was "laying" within the scanner.
- **Anatomical:** Coordinate system with respect to the planes
- **Image:** Coordinate system of the image

Note: In some cases we have to go back from the image coordinate system to the world coordinate system.

For instance, we have a robot which operates a patient. Brain surgery

Image Origin

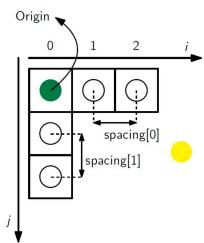
Position of the first voxel in the anatomic coordinate space.

origin = [100mm, 50mm, -10mm]

Voxel spacing

Distance between voxel.

spacing = [1mm, 1mm, 0.9mm]



Note: If want to see a lot of details (very small structures), I need a fine spacing, otherwise I'm not able to capture all the details.

What's a imaging phantom?

An imaging phantom for determining CT performance Imaging phantom, or simply phantom, is a specially designed object that is scanned or imaged in the field of medical imaging to evaluate, analyze, and tune the performance of various imaging devices. For example, we can use a phantom to calibrate your device.