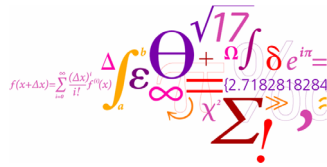


Image quality: *Contrast and point spread function*

Jens E. Wilhjelm

Biomedical Engineering
DTU Health Technology
Technical University of Denmark



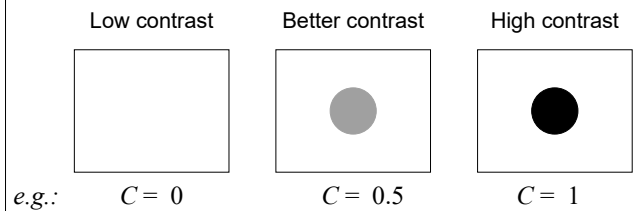
Contents

- Image contrast
- Point spread function and spatial resolution size
- Interpixel spacing (Sampling distance)

Contents

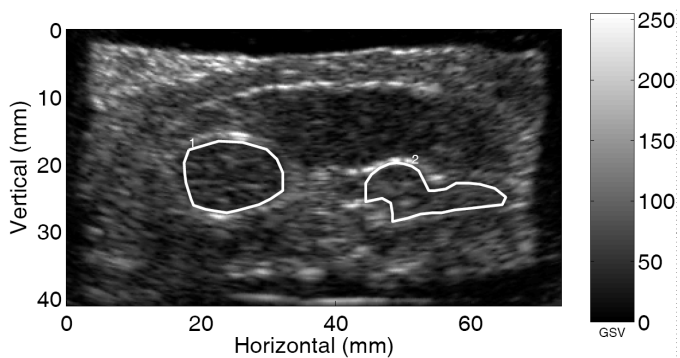
- Image contrast
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What I am talking about, when I talk about contrast*?

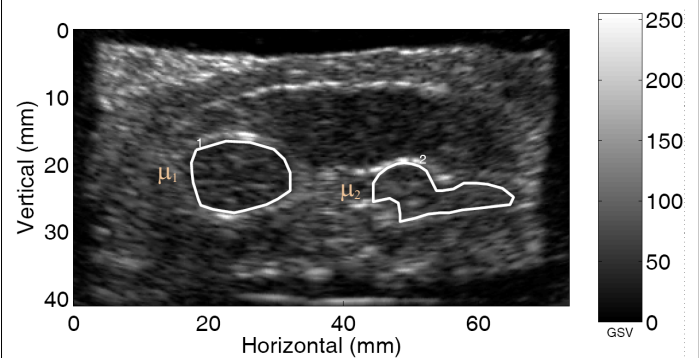


*Inspiration: Haruki Murakami

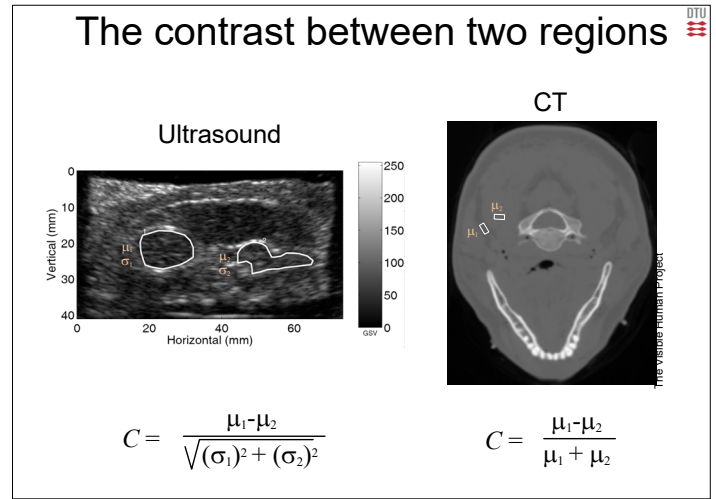
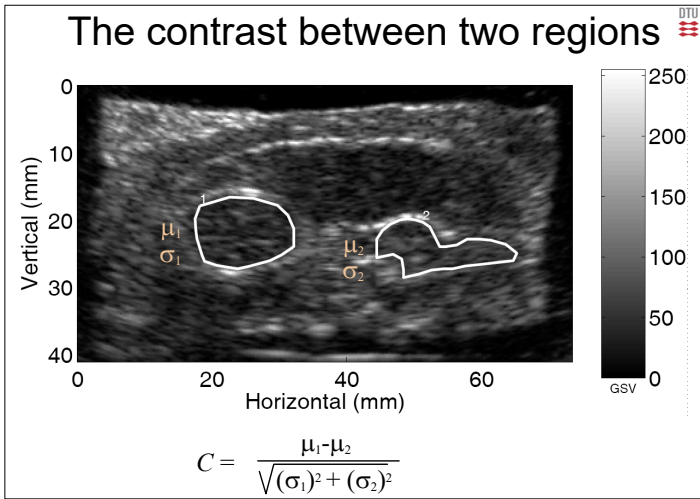
The contrast between two regions



The contrast between two regions

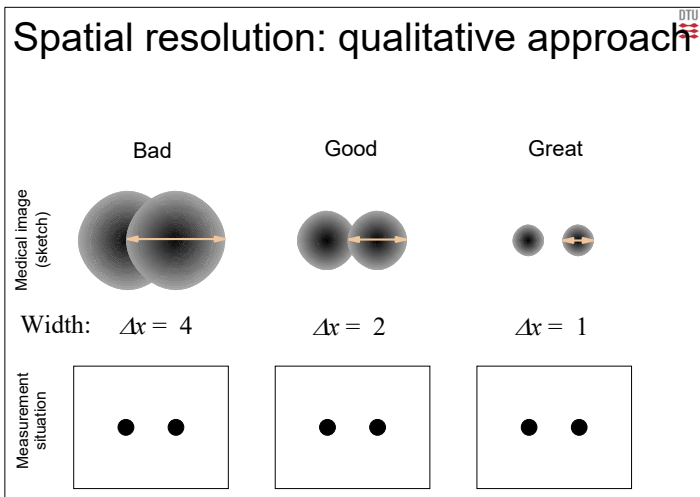
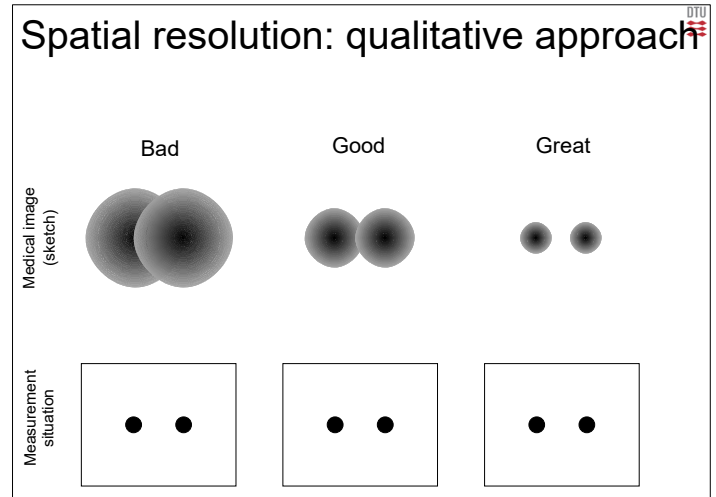


$$C = \frac{\mu_1 - \mu_2}{\mu_1 + \mu_2}$$



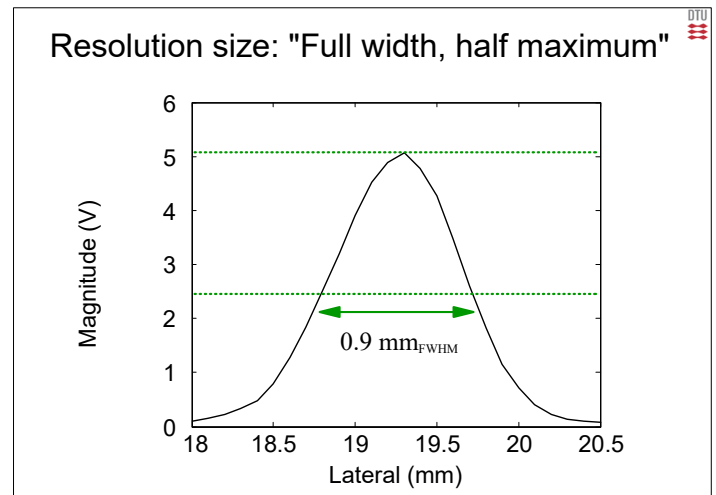
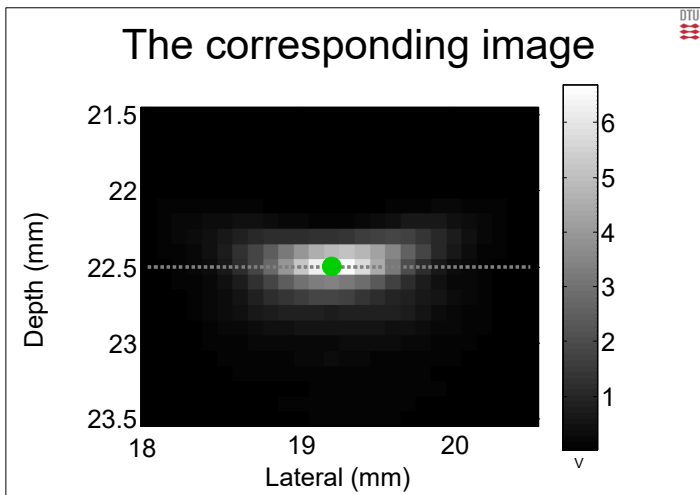
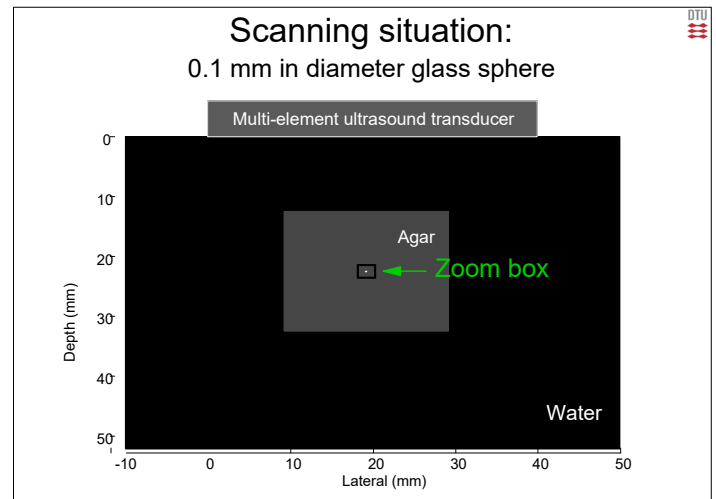
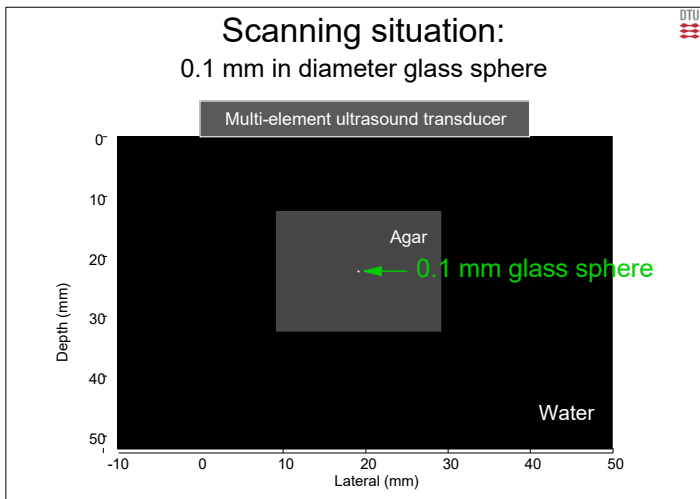
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Spatial resolution: qualitative approach

Quantitative?



DTU

How to measure psf?

Size of dot on screen = "size of psf + size of target"

Trade-off:

- ☺ Small size of target ⇒ good approximation
- ☹ Small size of target ⇒ bad estimate, due to low SNR

A good trade-off (at least axially in ultrasound) is:

size of target ~ (size of psf) / 10

DTU

How to measure psf?

Ultrasound:

Requirements: high change in *specific acoustic impedance*

- ☺ Glass sphere "floating" in agar
- ☹ Three nylon wires located perpendicularly in agar

Planar X-ray:

Requirements: high change in (electron) density in 3D

- ☺ Lead block with apertures of varying size and length
- ? Tungsten sphere floating in agar

CT:

Requirements: high change in density in image plane

- ☺ Tungsten wire perpendicularly to image plane
- ☹ 0.4 mm nylon wire in agar

How to measure psf?



MRI:

Requirements: No signal/Signal

- ☺ Thin line of water inside acrylic block

PET (SPECT):

Requirements: Spot of radioactivity in 3D

- ☺ Drop of strong radioactive tracer

Terms



Precise wording:

- ☺ Spatial resolution size (in mm)
- ☺ Good or bad (spatial) resolution

Unprecise wording:

- ⊗ Resolution
- ⊗ High/low resolution

Contents



Image contrast

Point spread function and spatial resolution size

- ▶ Interpixel spacing (Sampling distance)

Distance between pixels or voxels

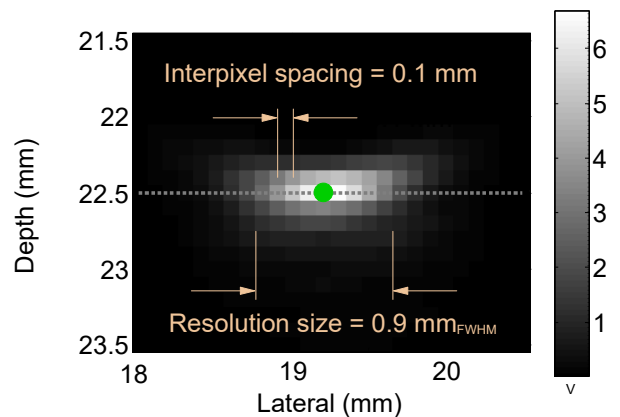
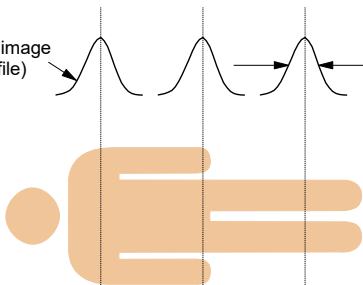


Image slice thickness



"Thickness" of image (sensitivity profile)

Image slice thickness



Interslice distance

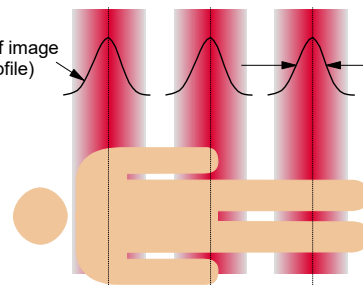
Location of 2D image plane

Image slice thickness



"Thickness" of image (sensitivity profile)

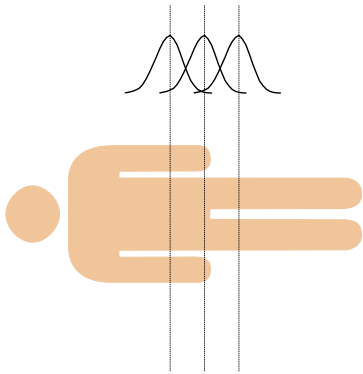
Image slice thickness



Interslice distance

Location of 2D image plane

Image slice thickness



left out, since they are hard to visualize properly

How to design

