

Más allá de la anatomía

¿Encontraremos lo que importa?

Ioannis Sechopoulos, Ph.D., DABR, FAAPM
 Advanced X-ray Tomographic Imaging (AXTI) Lab
 Department of Radiology, Nuclear Medicine, and Anatomy
 Radboud University Medical Center
 and
 Dutch Expert Center for Screening (LRCB)

ioannis.sechopoulos@radboudumc.nl
 axti.radboudimaging.nl
 ioannisNL



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AXTI Lab
(Advanced X-ray
Tomographic Imaging)

Mathias Prokop
Ewoud Smit
Jesse Habbets
Luuk Oostveen

Jelle Barentsz

James Nagy
Ingrid Reiser




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Hoy...

Demasiado?
Necesitamos más! (pero diferente)
La próxima evolución
Un ejemplo de primer paso...
Hacia adelante...

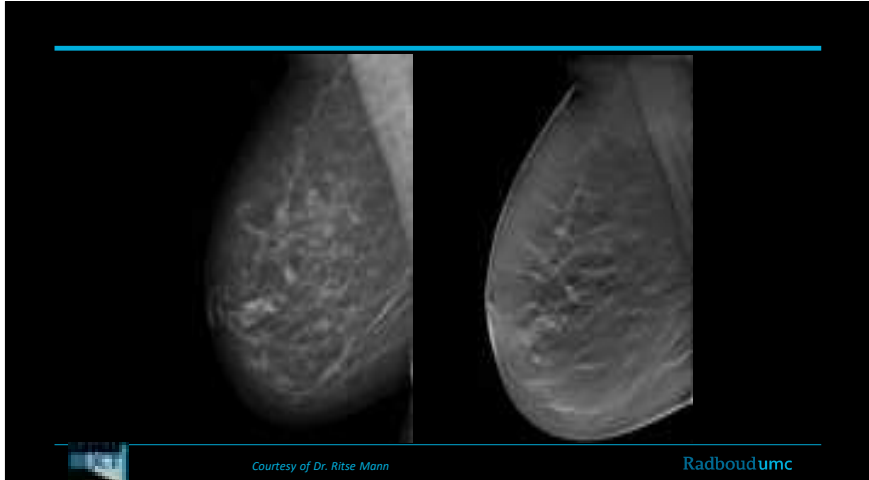
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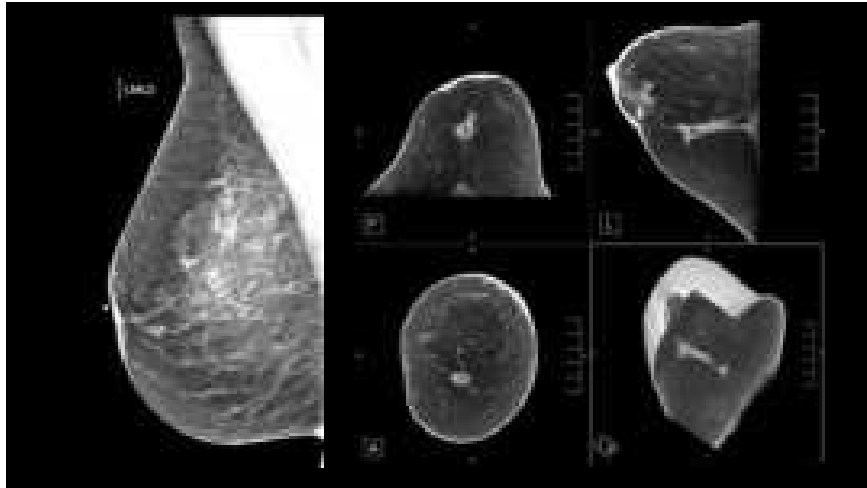
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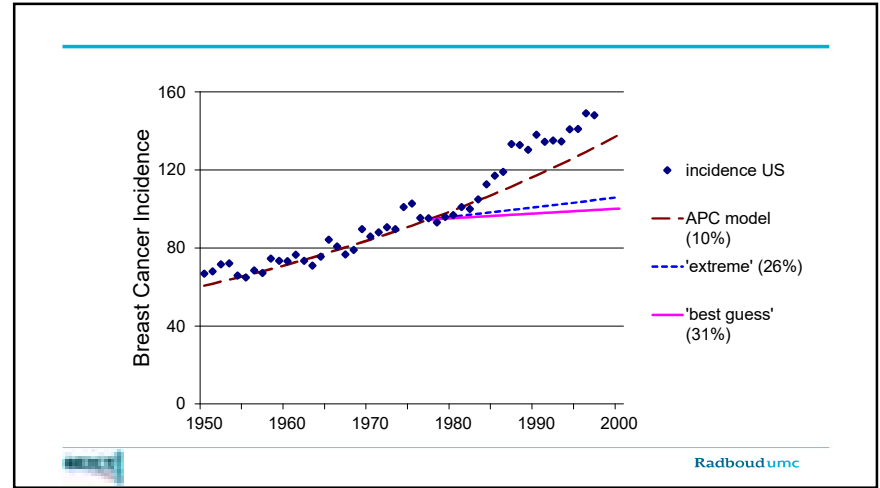
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Courtesy of Dr. Ritse Mann

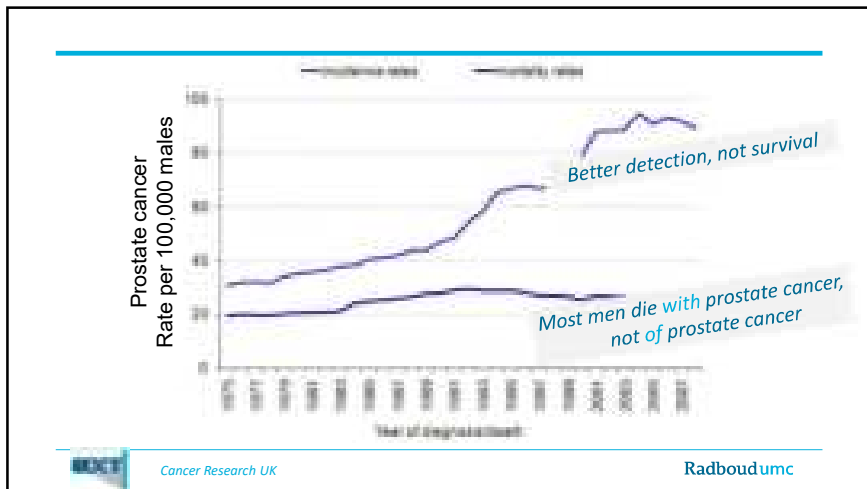
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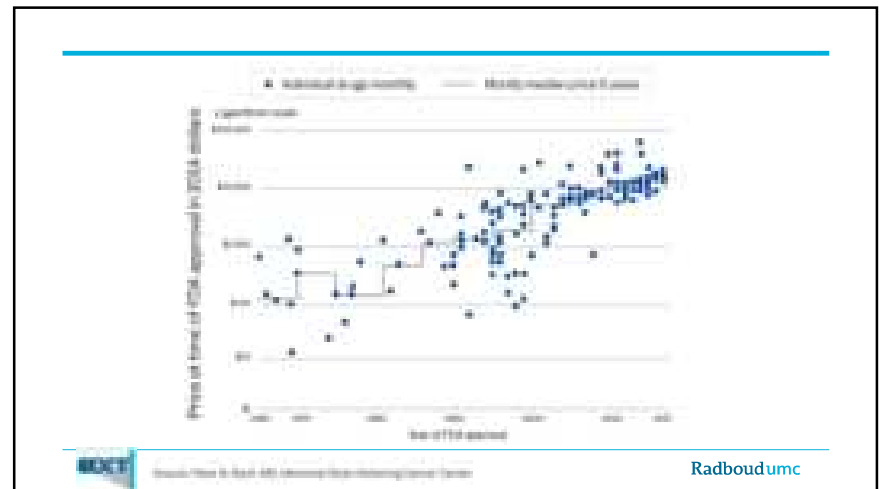
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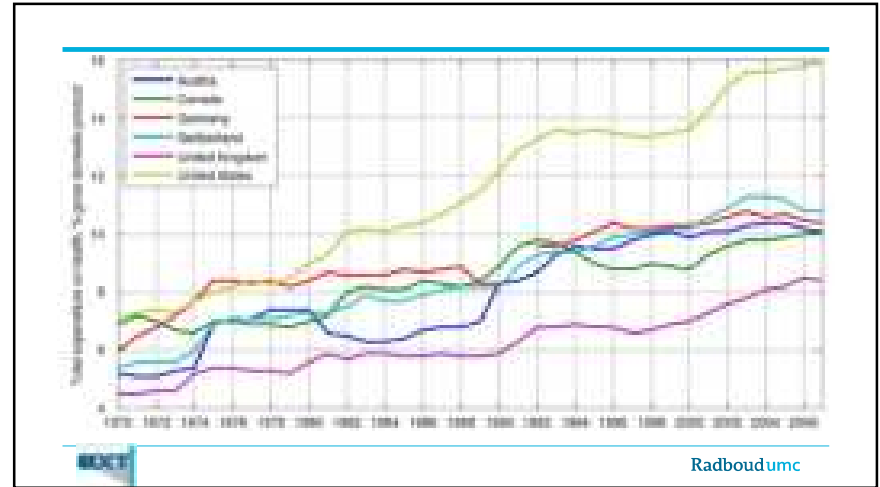
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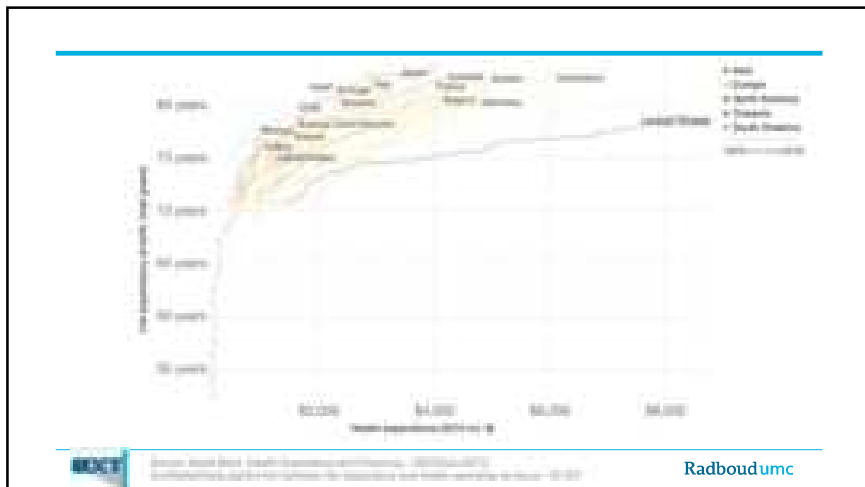
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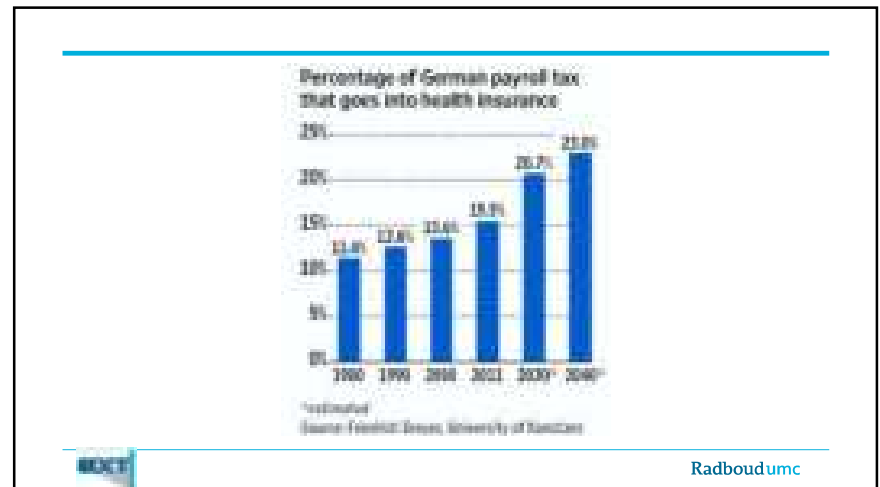
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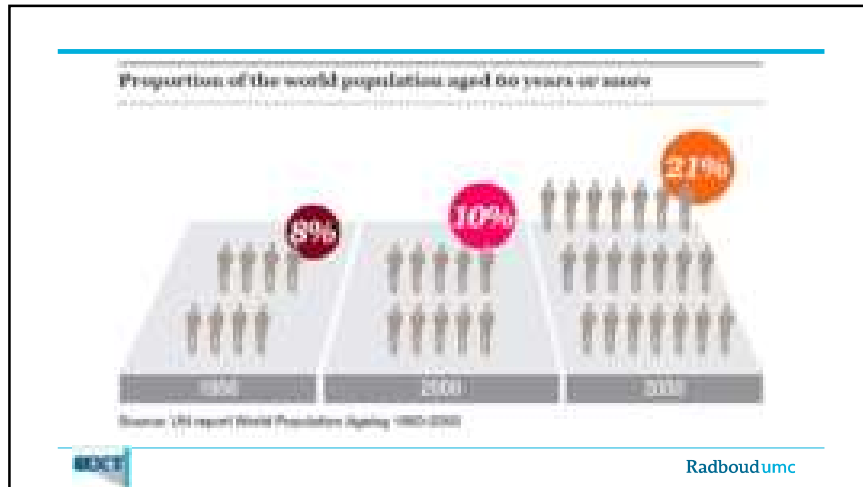
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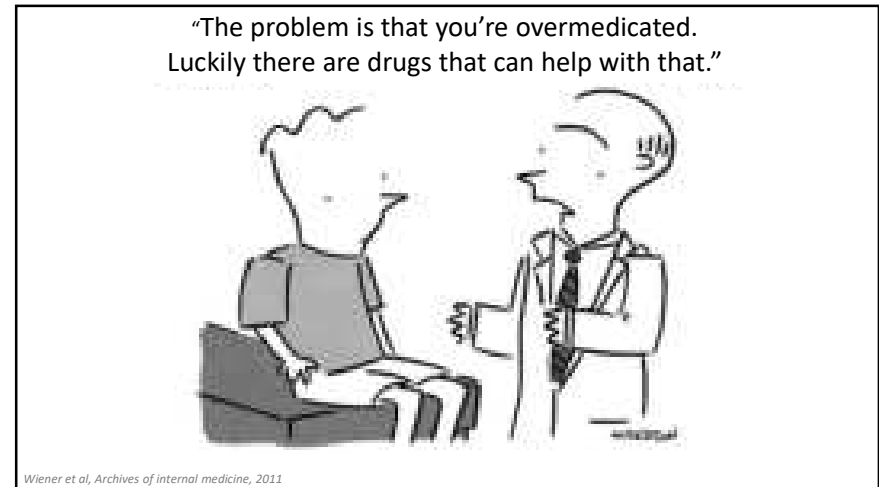
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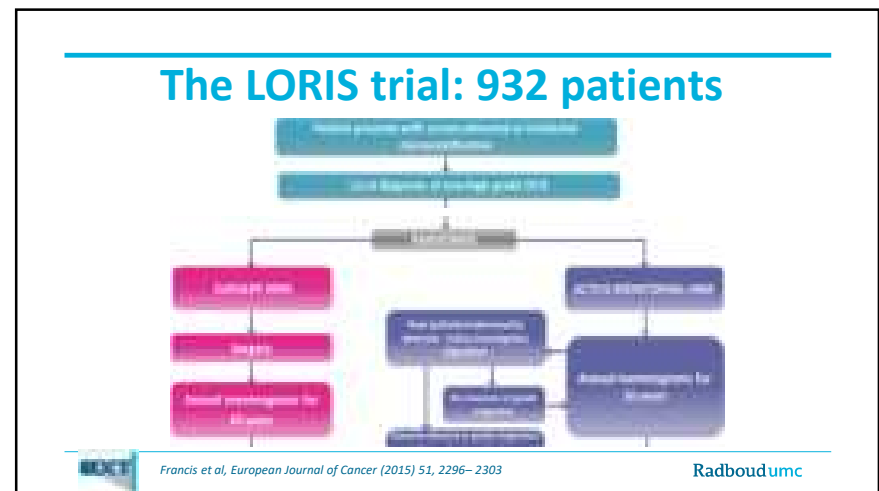
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Is this _____ working?

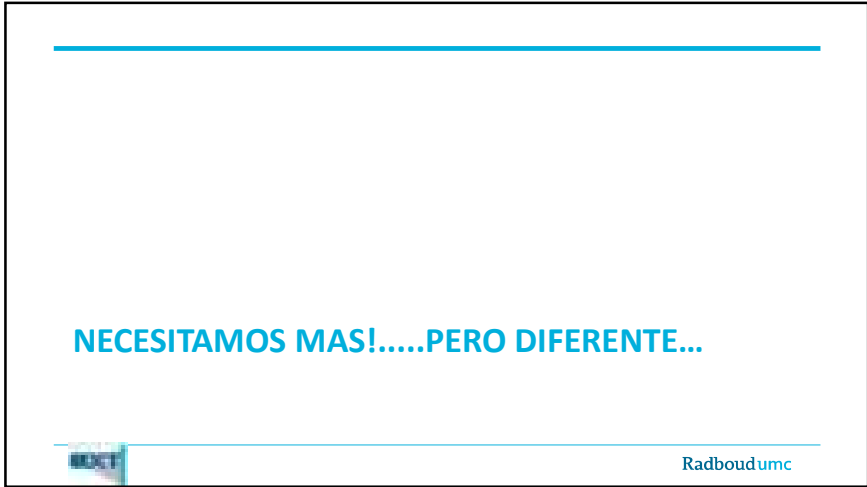
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Should we treat this
_____?

23

Is this tumor dying?

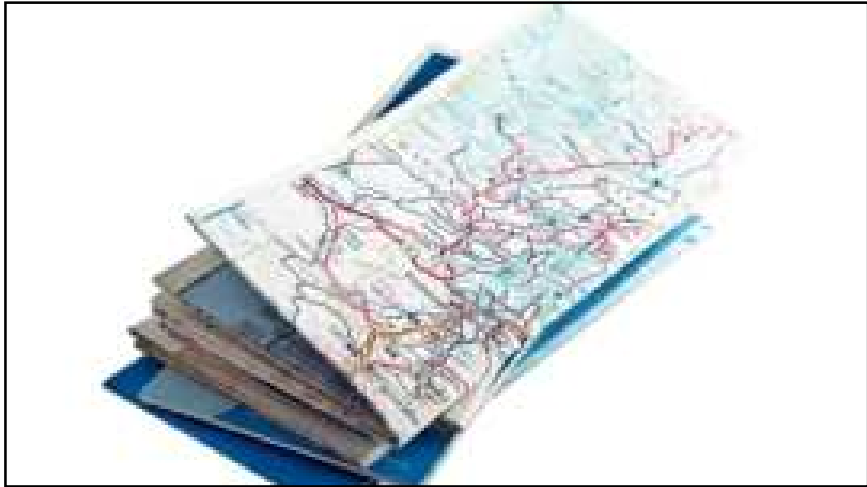
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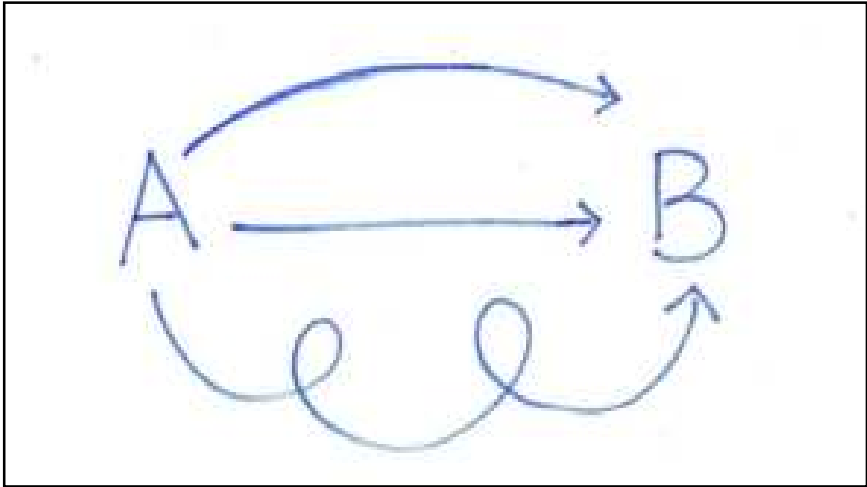
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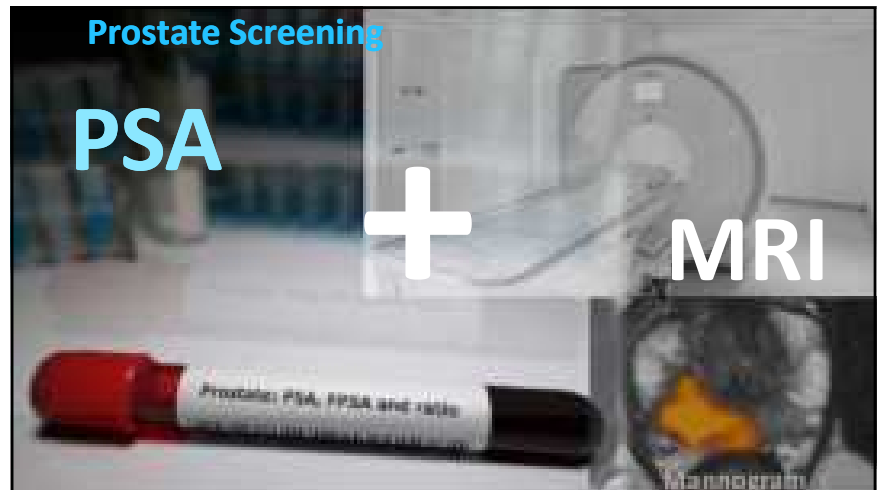
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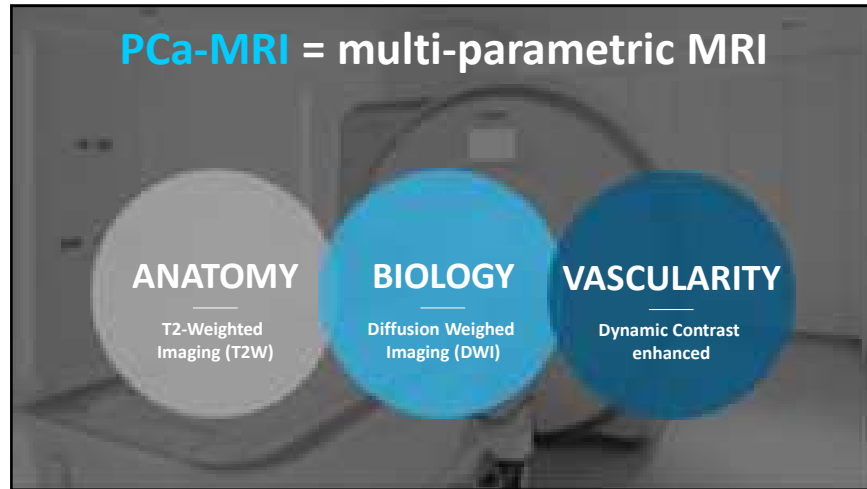
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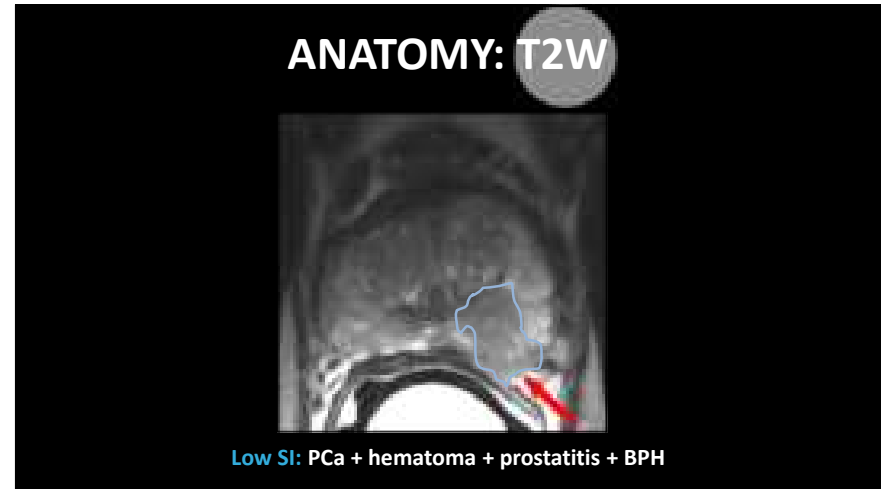
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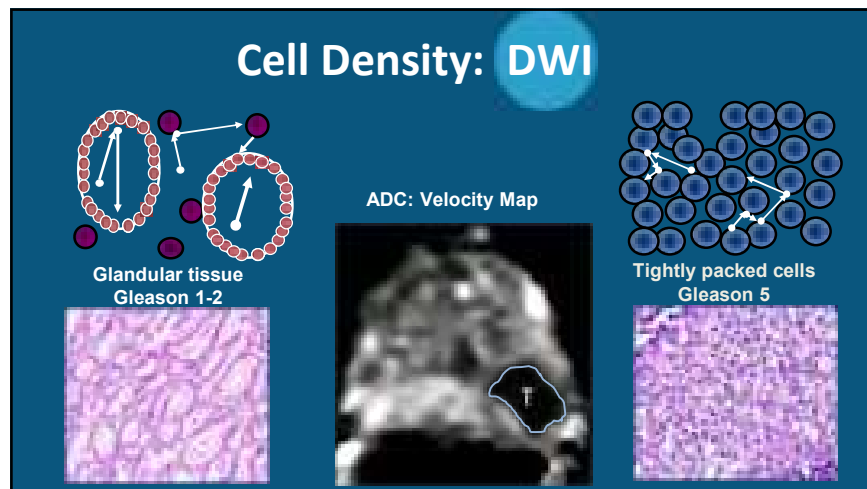
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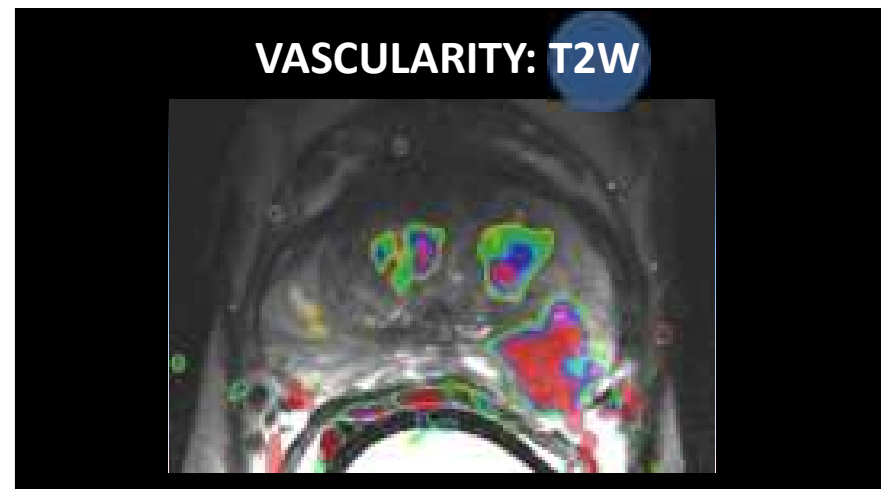
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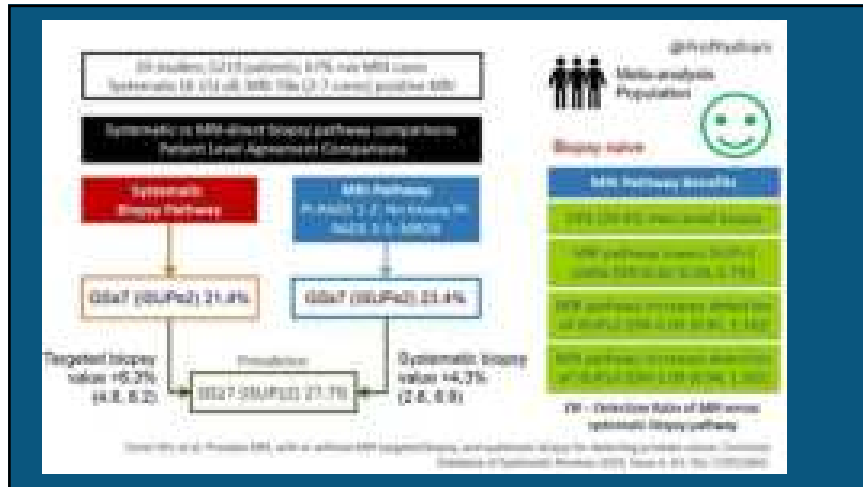
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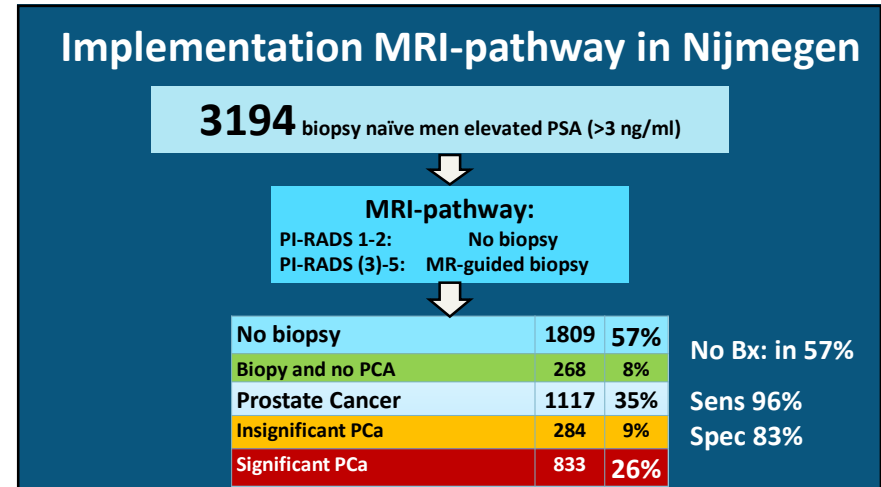
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Fast bpMRI

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Mannogram

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IN CT, UP TO NOW....

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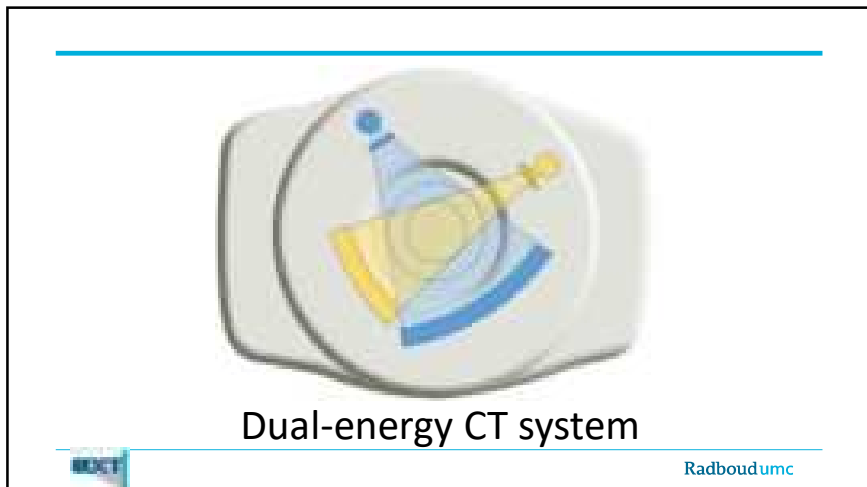
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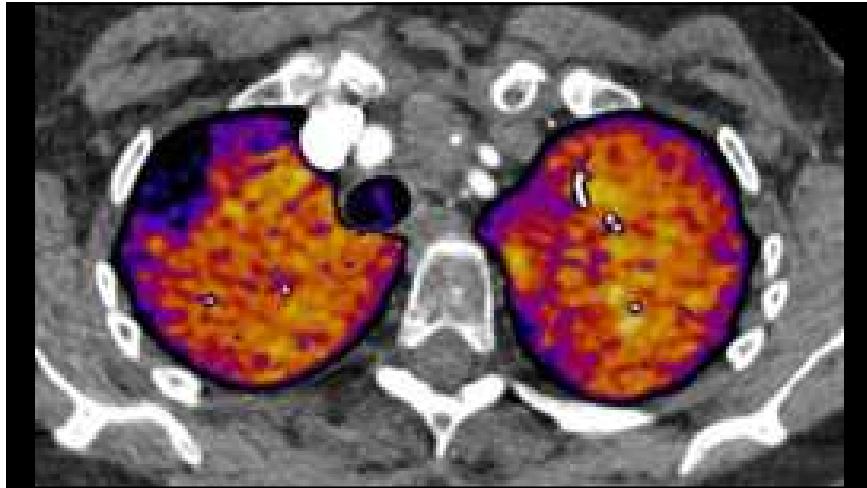
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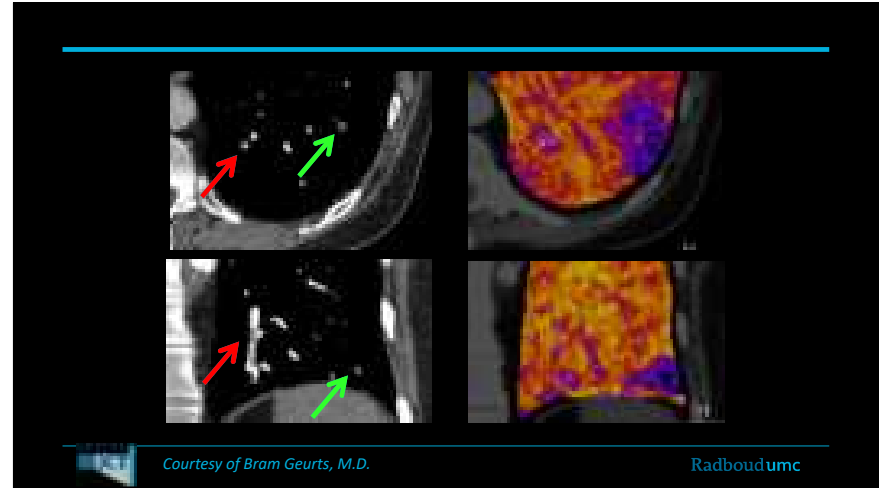
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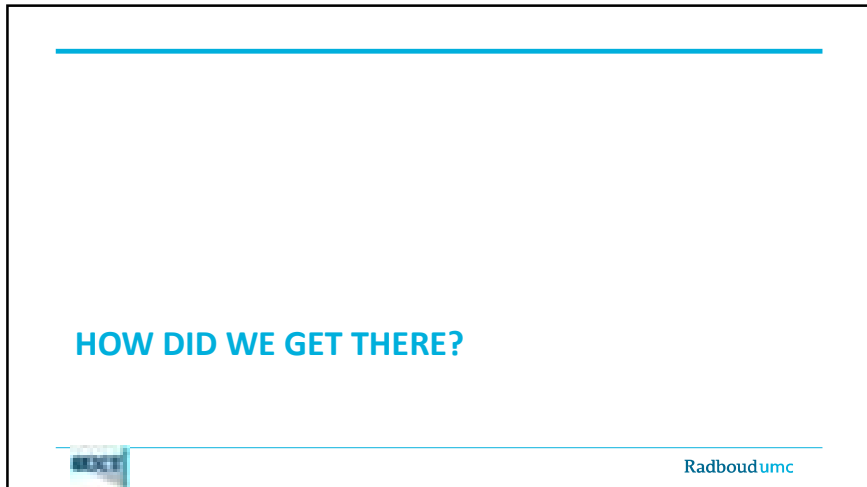
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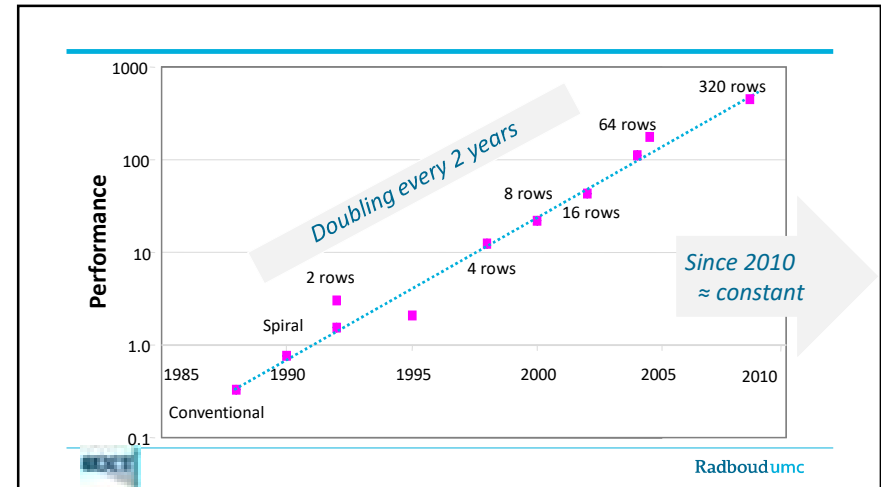
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Temporal Resolution

Hardware

- | | | |
|---------------------|--------------------|--------|
| • Single-shot scans | 16 cm detectors | 130 ms |
| • Flash scans | 40-60 cm/s | 300 ms |
| • Fast rotation | 200 ms | 100 ms |
| • Dual source | doubled resolution | 80 ms |



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Developed Hardware

High-end detectors

- 4 cm to 16 cm wide (64 to 320 rows)
- Detector elements 0.5-0.625 mm resolution
- Low electronic noise

Gantry

- 0.24 to 0.28 s per rotation
- Table speed up to 737 mm/s

Tubes

- High Performance (70-150 kV)
- Dual Source



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Hardware to be Developed

High-resolution detectors

- 0.25 mm detector elements
- Low electronic noise *Canon*

Photon-counting detectors

- Lowest dose
- Dual energy and scatter suppression for free *3-7 years*

X-ray lasers

- Monoenergetic , phase-coherent radiation *???*
- Multitude of small lasers *???*

Scanners with inverse Geometry

- Dose painting *???*
- One-shot body scans *???*



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WHAT IS THE NEXT BIG STEP?



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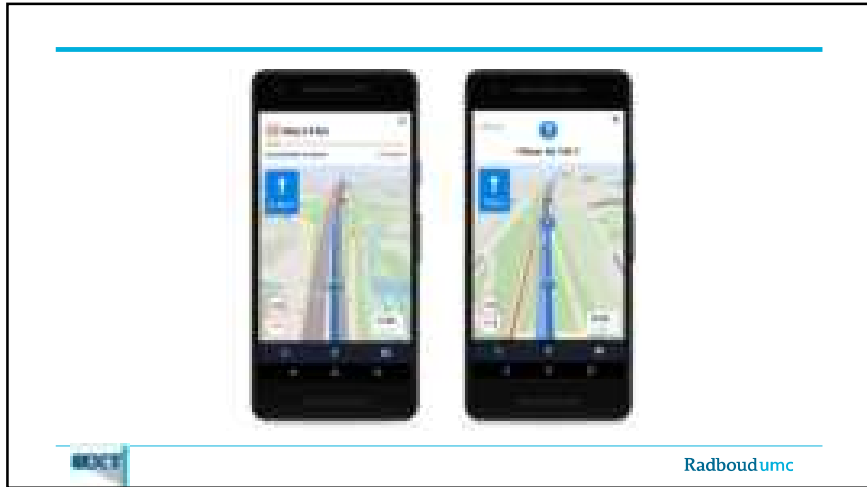


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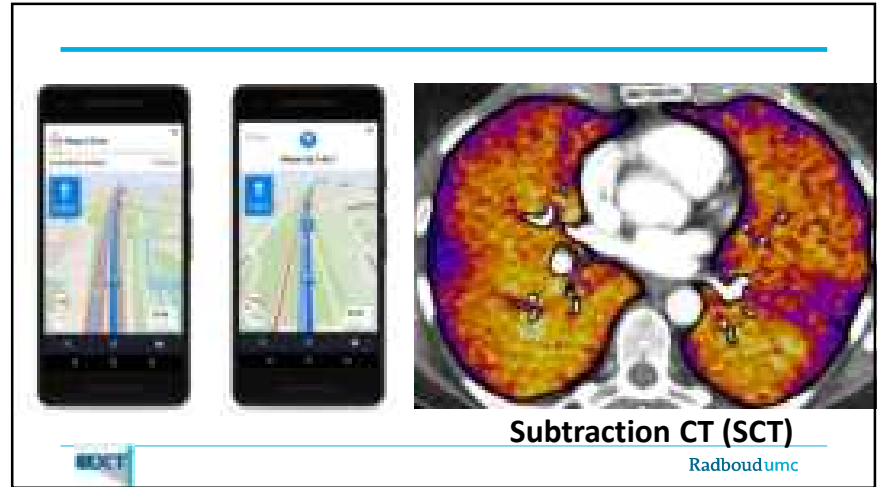
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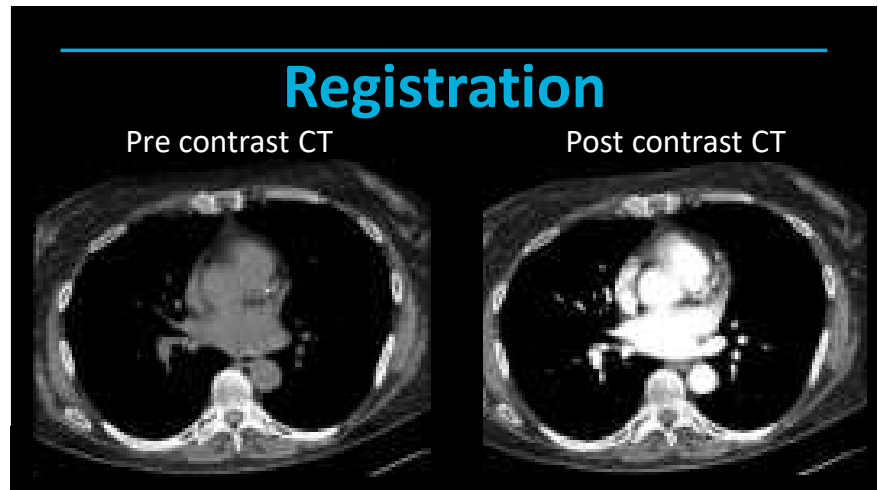
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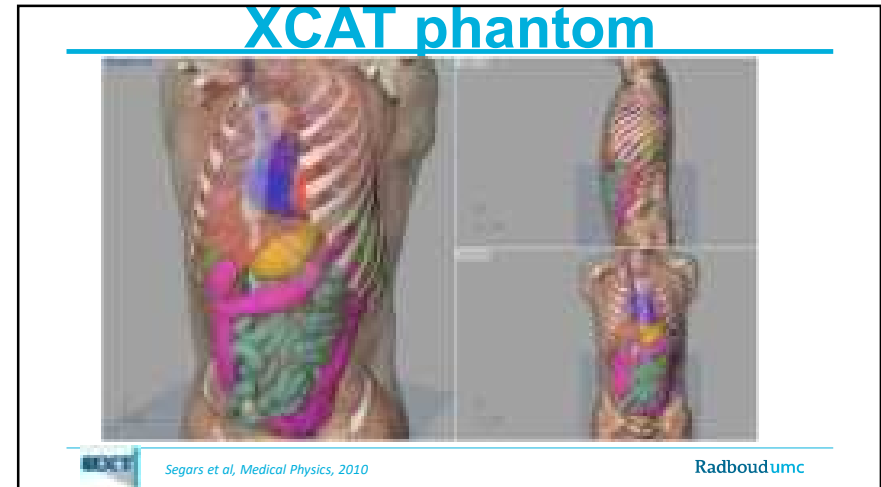
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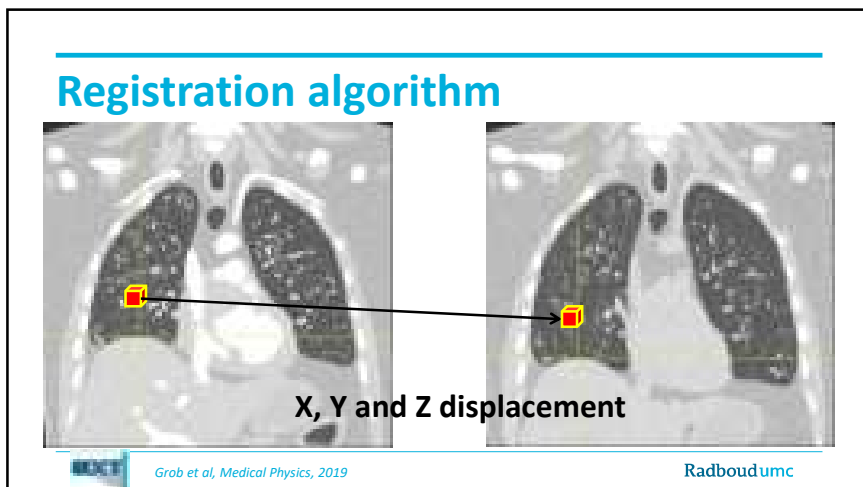
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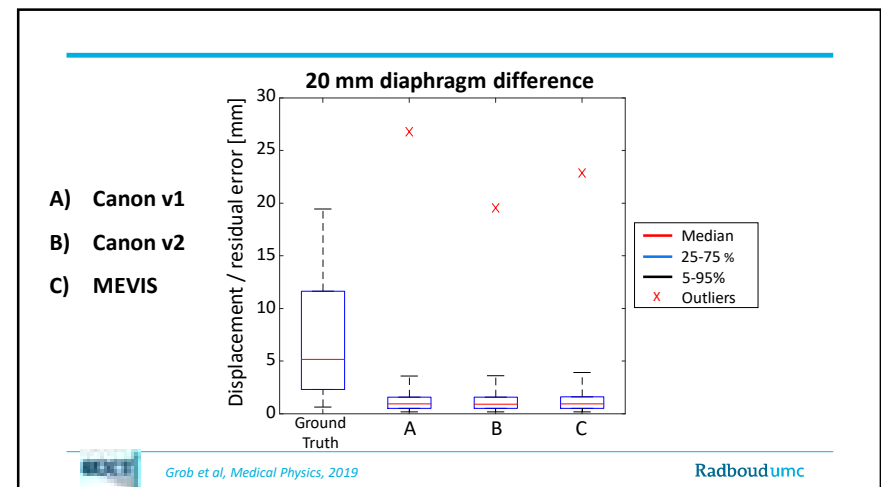
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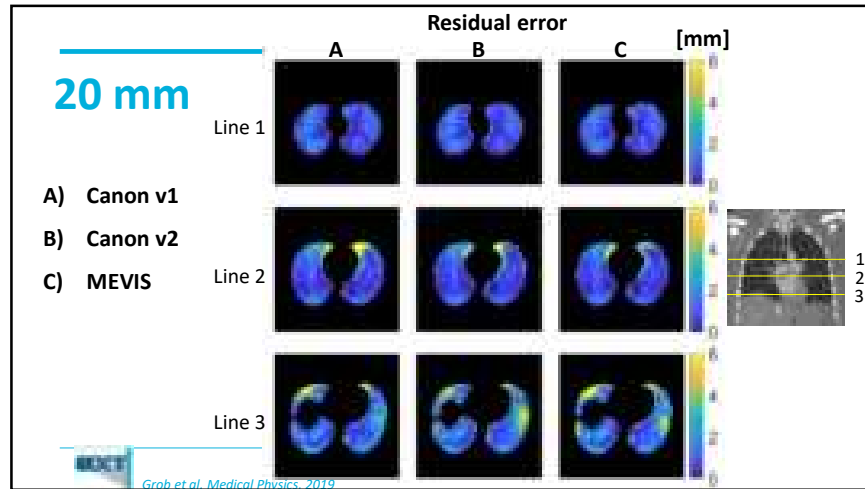
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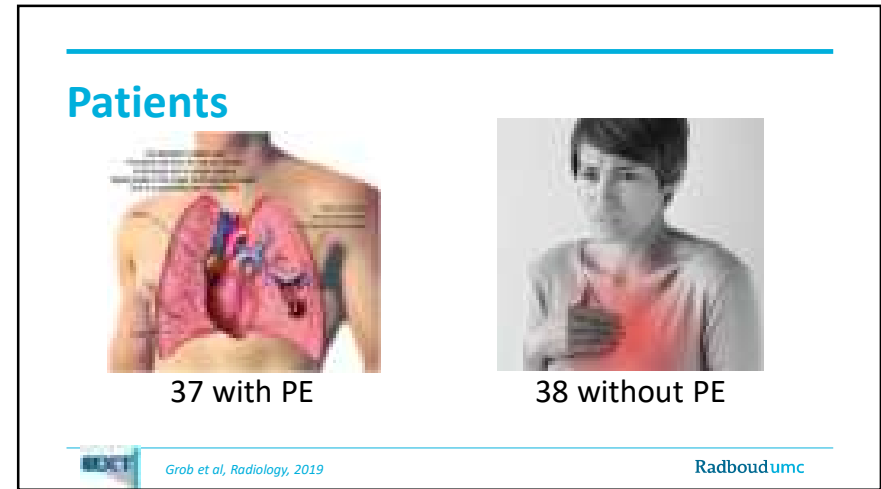
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Sensitivity

CTA	CTA + SCT	CTA + DECT
79 %	83 %	85 %
95 % CI: 67 – 89 %	70 – 91 %	72 – 91 %

Grob et al, Radiology, 2019

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Specificity

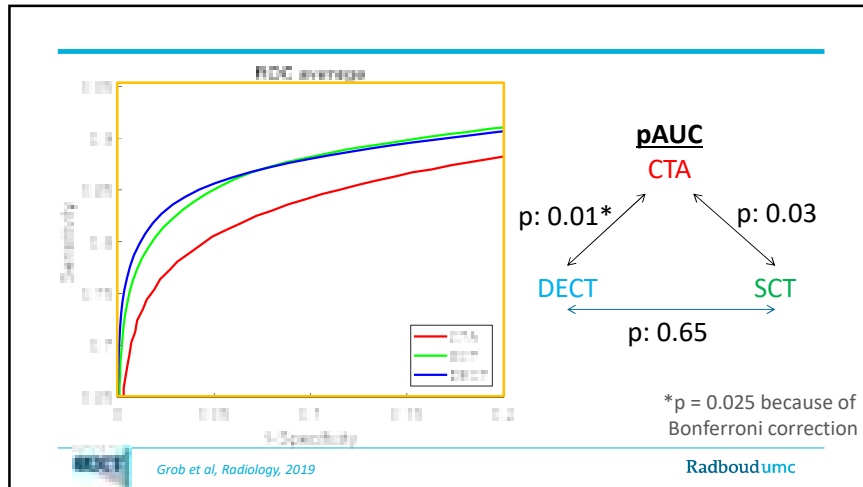
CTA	CTA + SCT*	CTA + DECT
94 %	100 %	95 %
95 % CI: 89 – 97 %	100 – 100 %	89 – 98 %

* Significant (p < 0.025, because of Bonferroni correction)

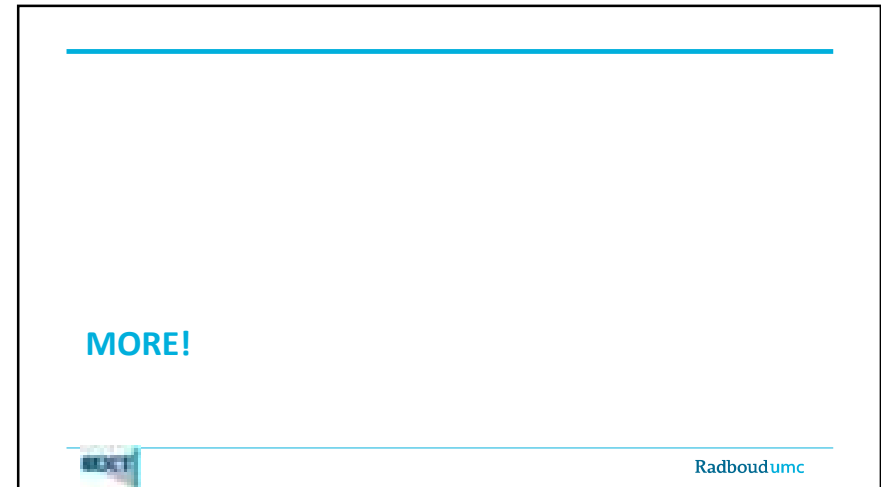
Grob et al, Radiology, 2019

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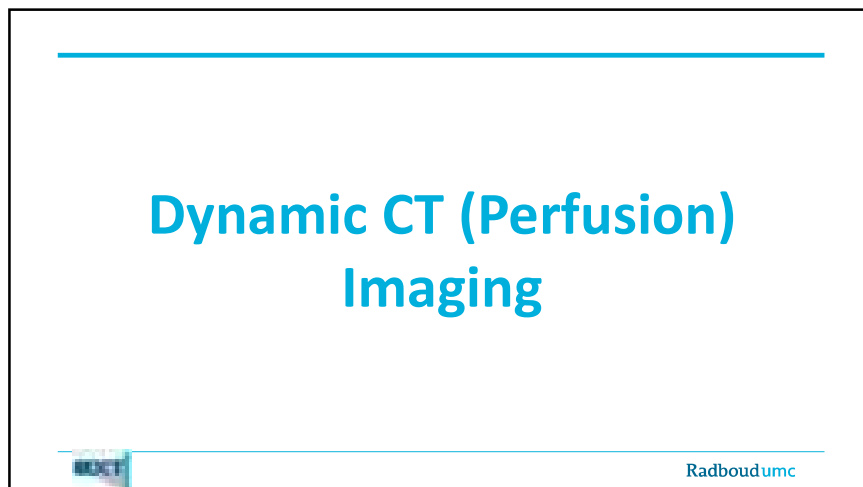
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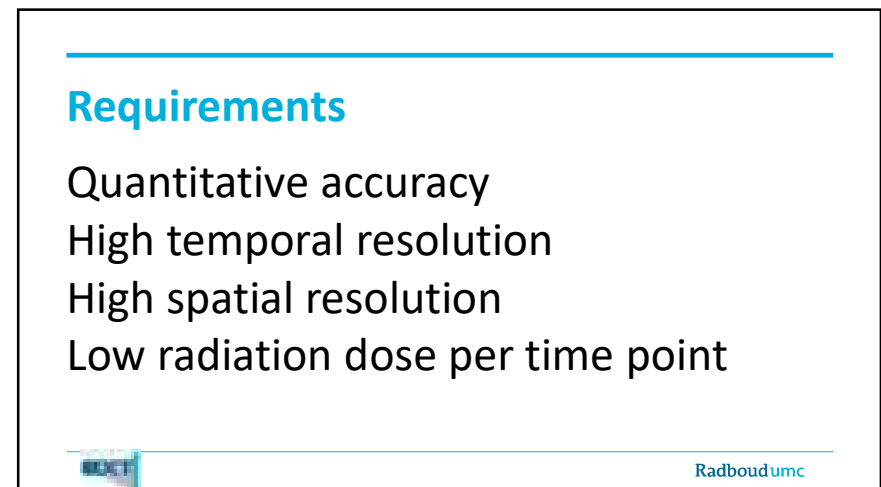
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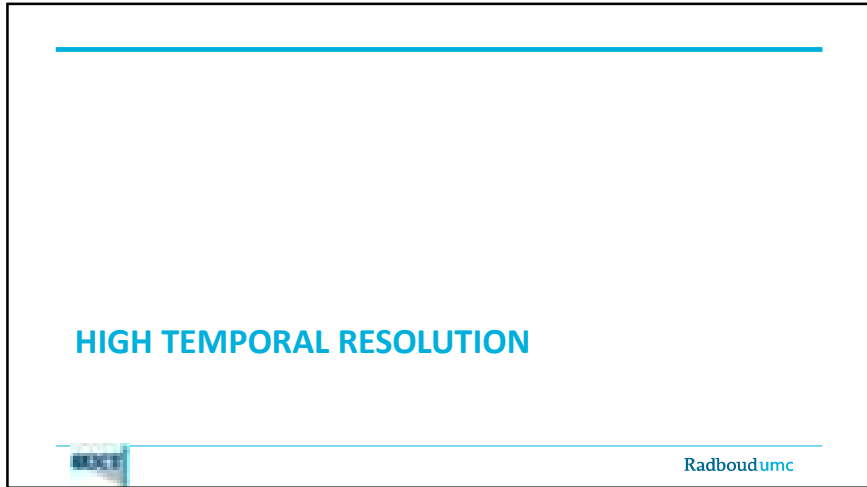
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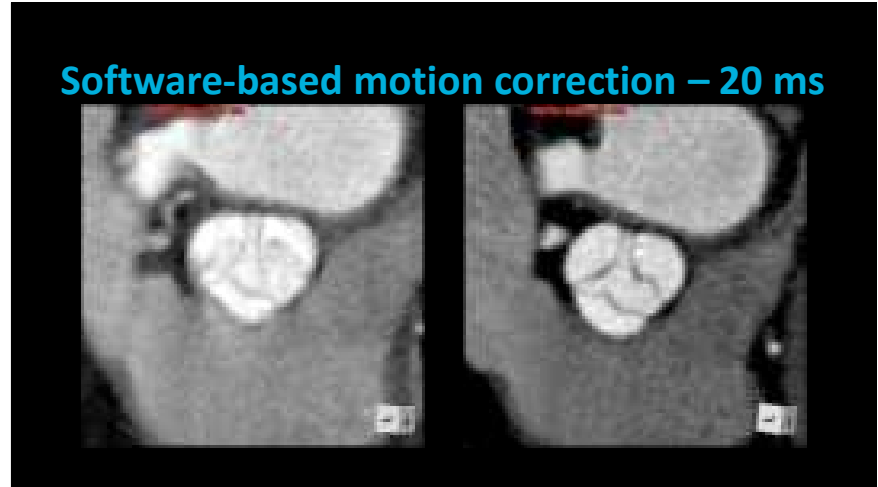
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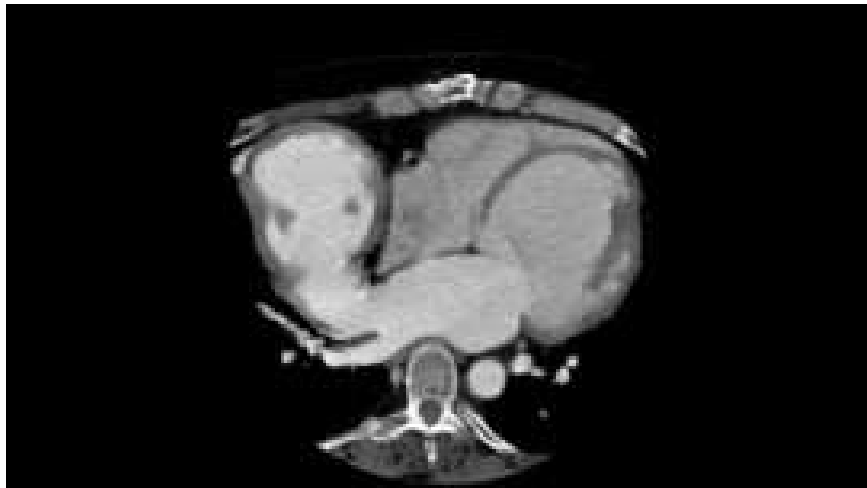
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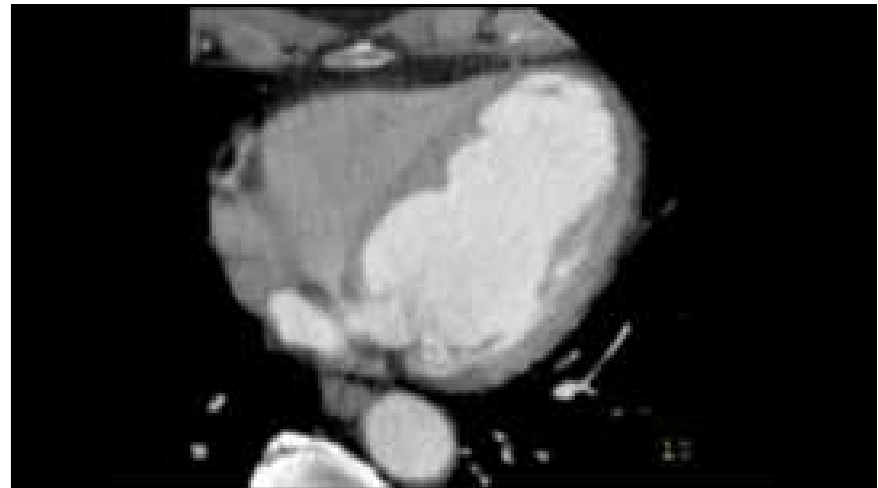
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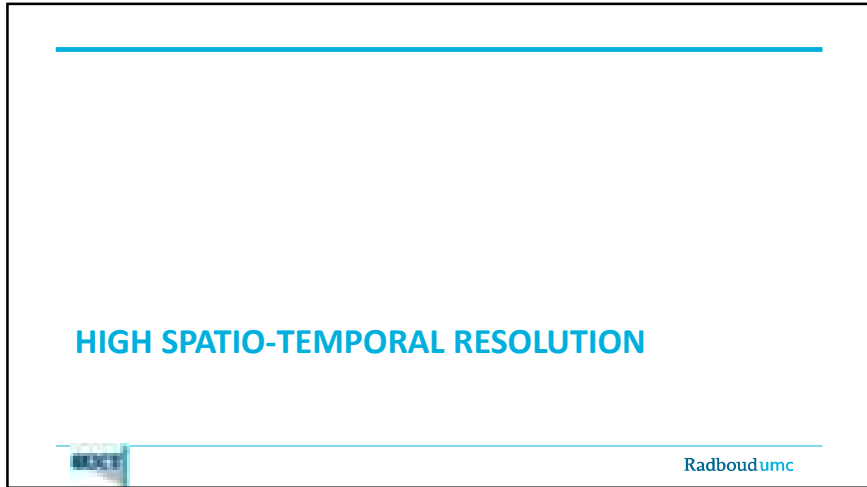
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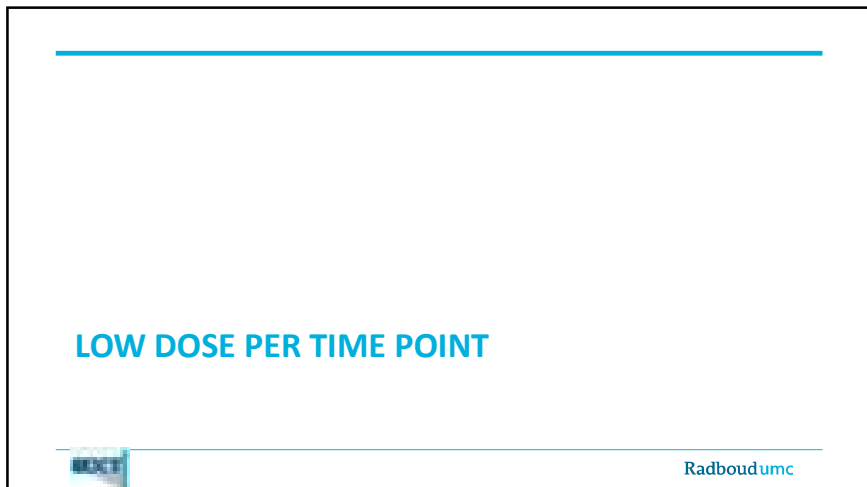
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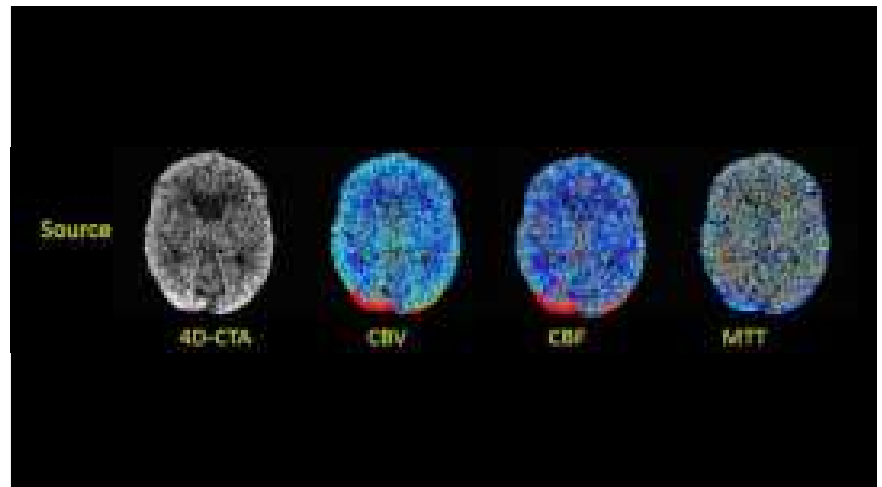
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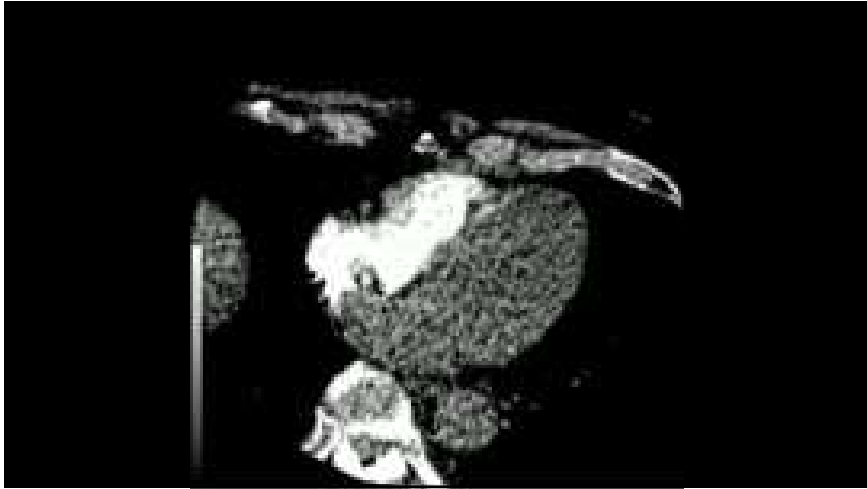
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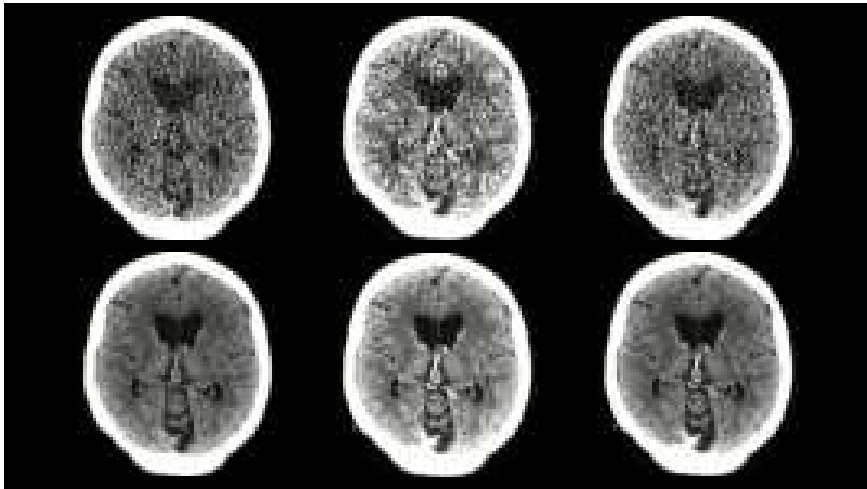


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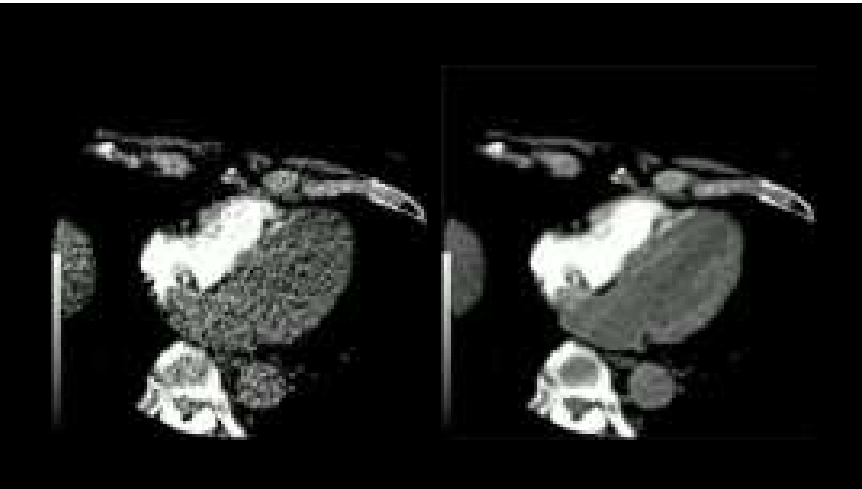
4D TISSUE SIMILARITY NOISE FILTER

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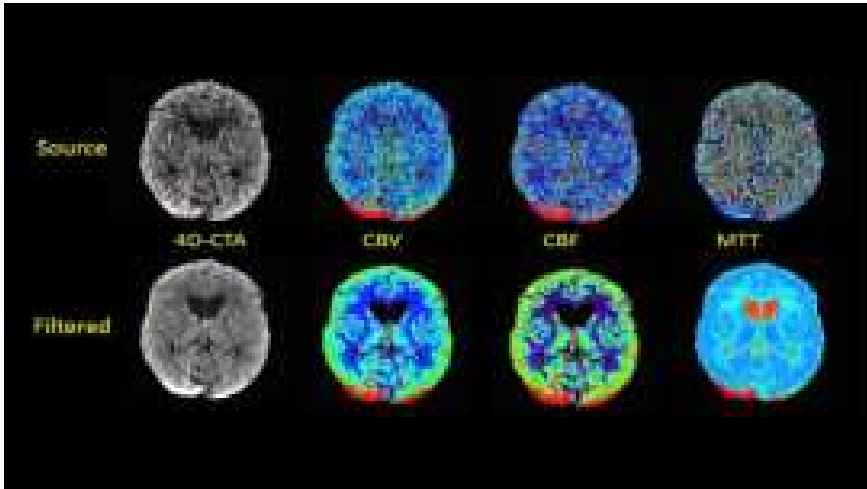
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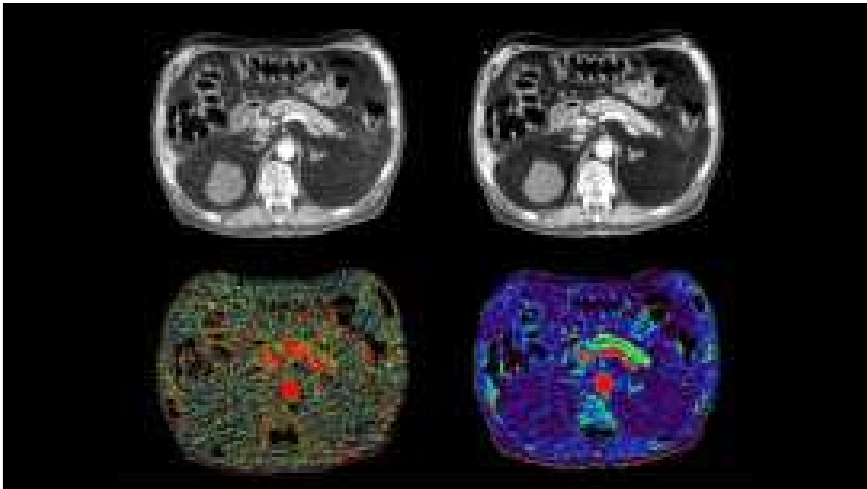
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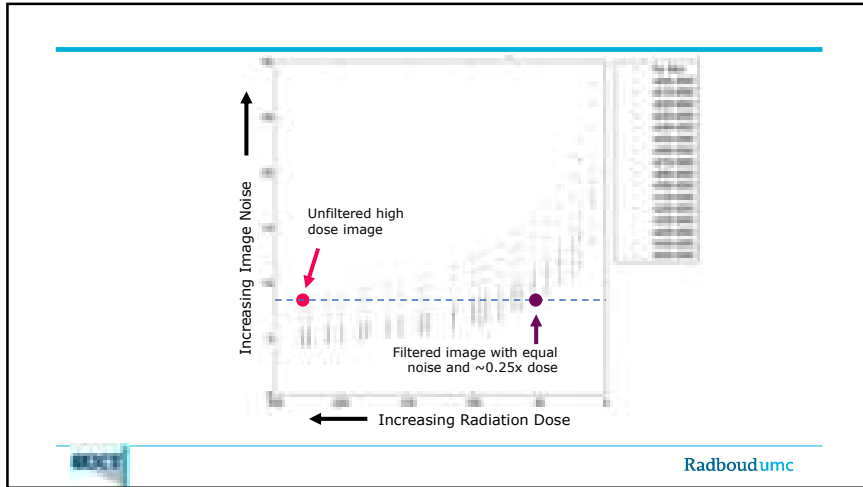
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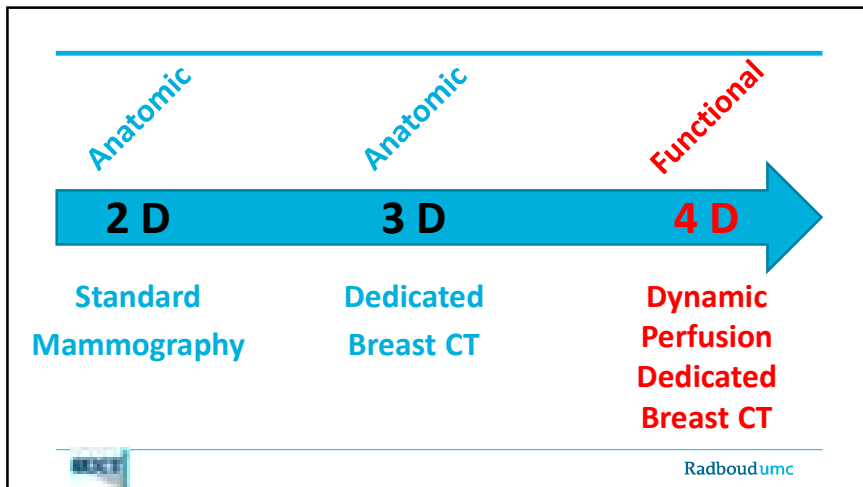
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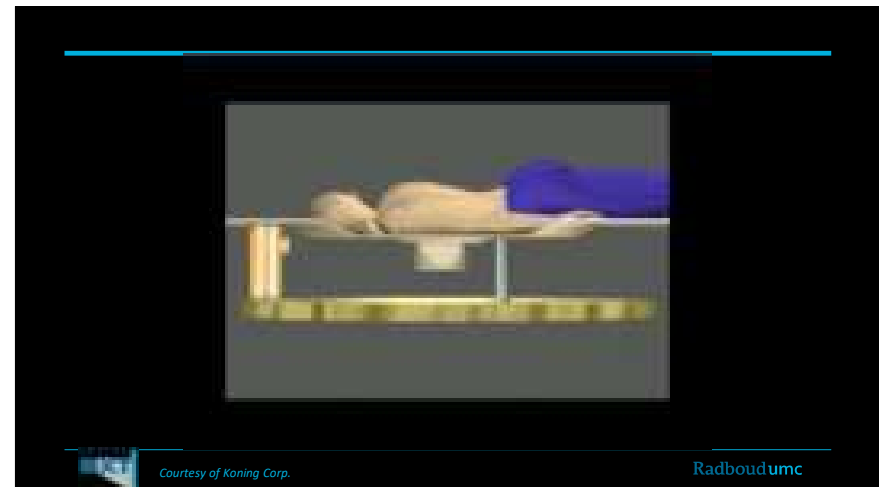
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BREAST4D: DEDICATED BREAST CT PERFUSION

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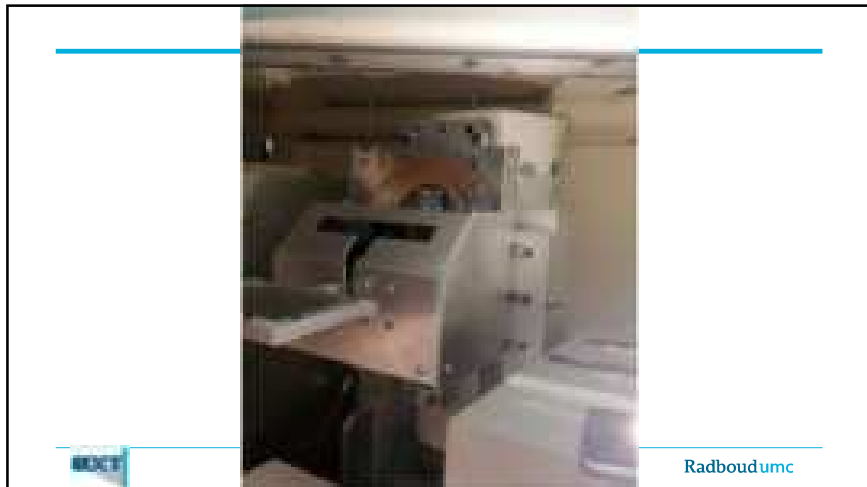
Power injector integration

 A diagrammatic view of the power injector integration setup. It shows a workstation on the left and a large piece of equipment on the right. Labels with arrows point to:

- Acquisition workstation, electronics & software (pointing to the workstation on the left)
- Computer-controlled collimator (pointing to a component in the middle)
- X-ray generator and tube for spectra up to 65 kV (pointing to a component on the right)
- CMOS-based imaging detector (pointing to a component on the right)

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Acquisition Process

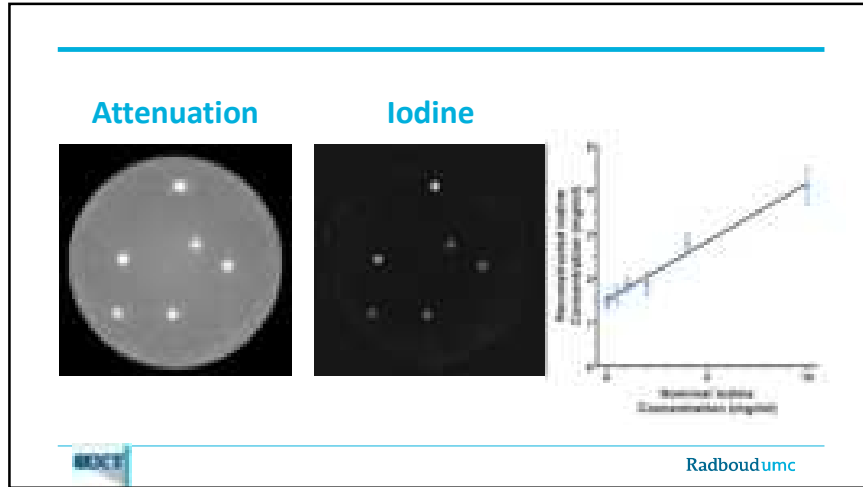
 A diagram illustrating the acquisition process. It consists of three main parts:

- On the left, a vertical image showing a wavy, dark pattern, likely representing the raw data or a specific feature being imaged.
- In the center, a yellow triangle with a black border, representing a collimator. Inside the triangle is a circular object, likely the X-ray source or target.
- On the right, a vertical image showing two distinct circular spots, representing the final acquired data or a processed image.

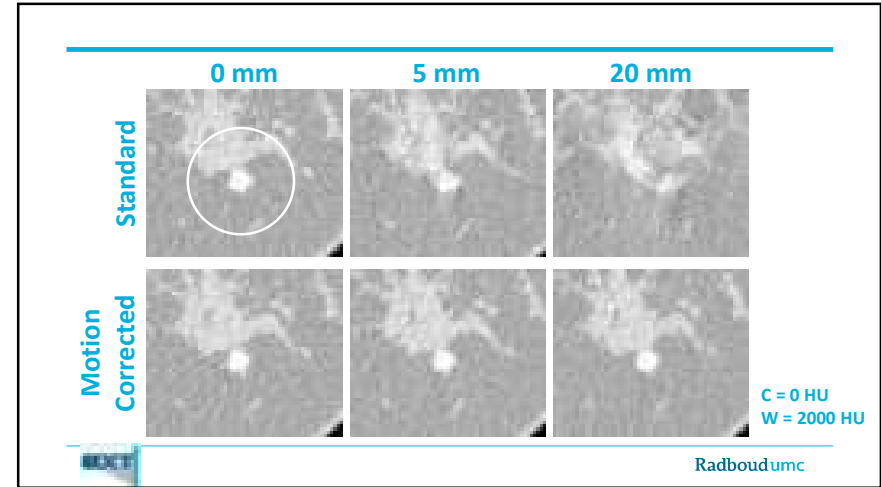
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Michielsen et al, IWBI 2018

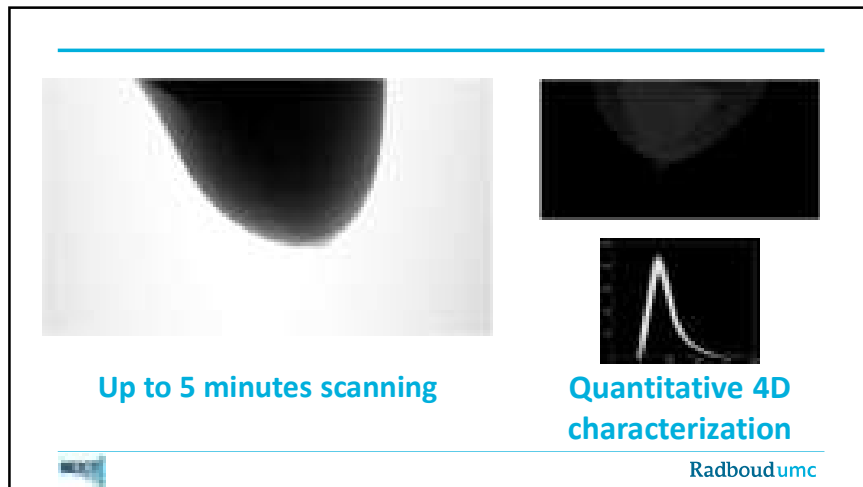
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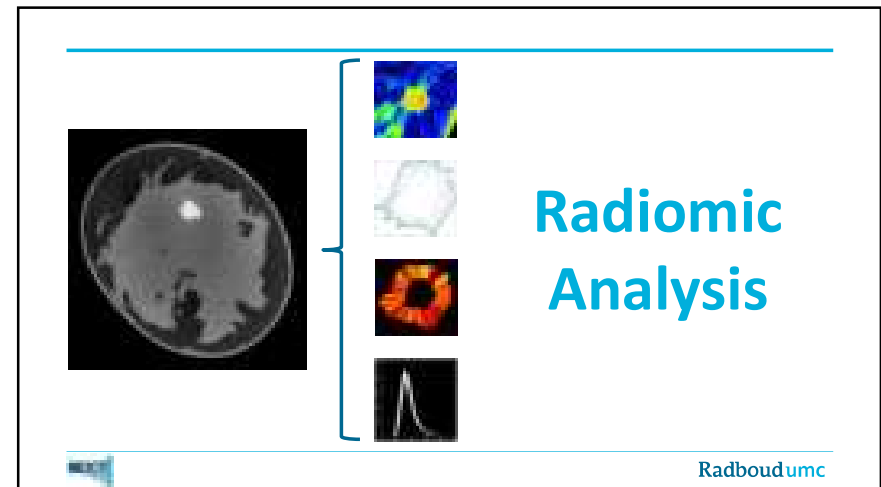
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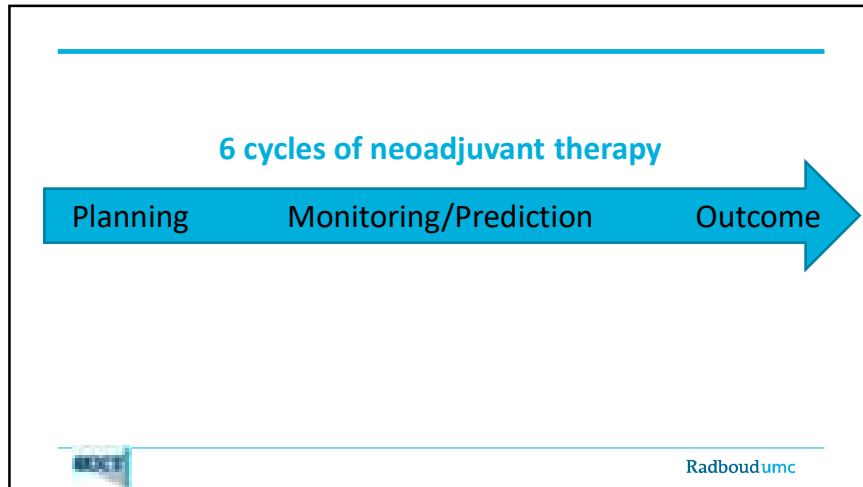
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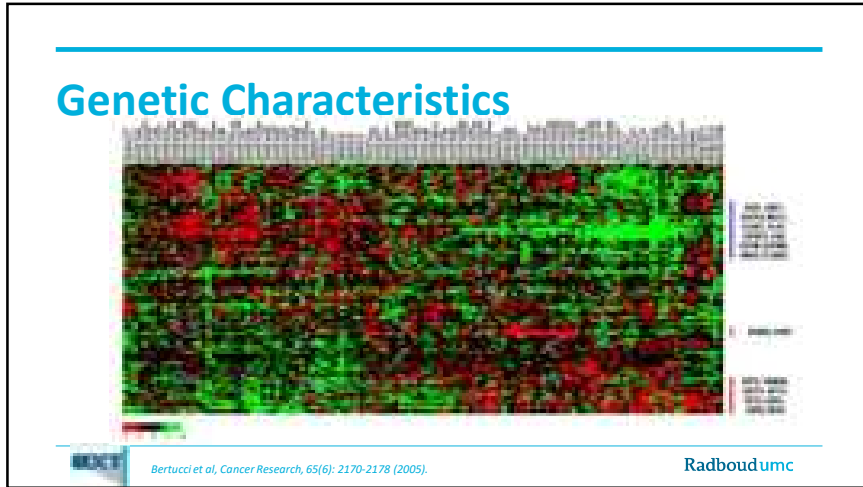
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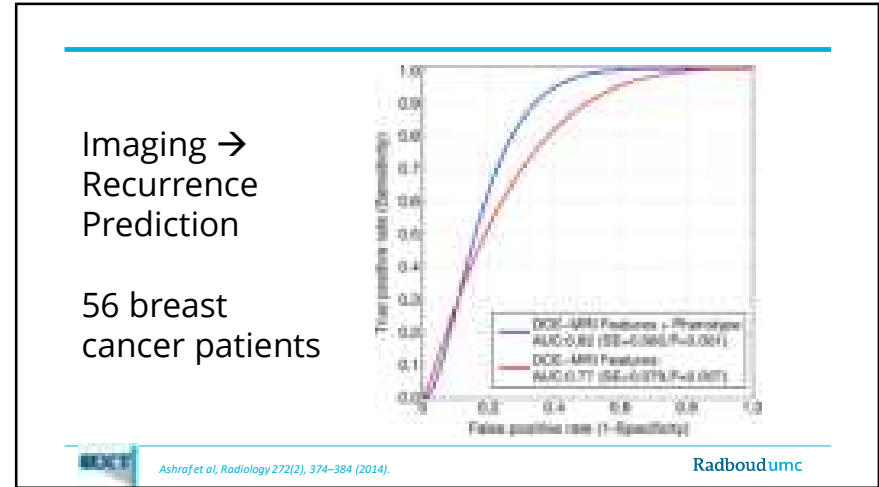
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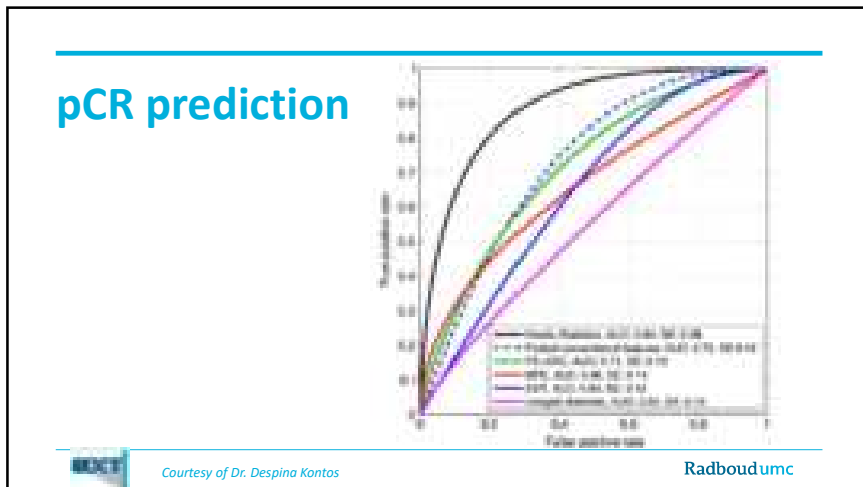
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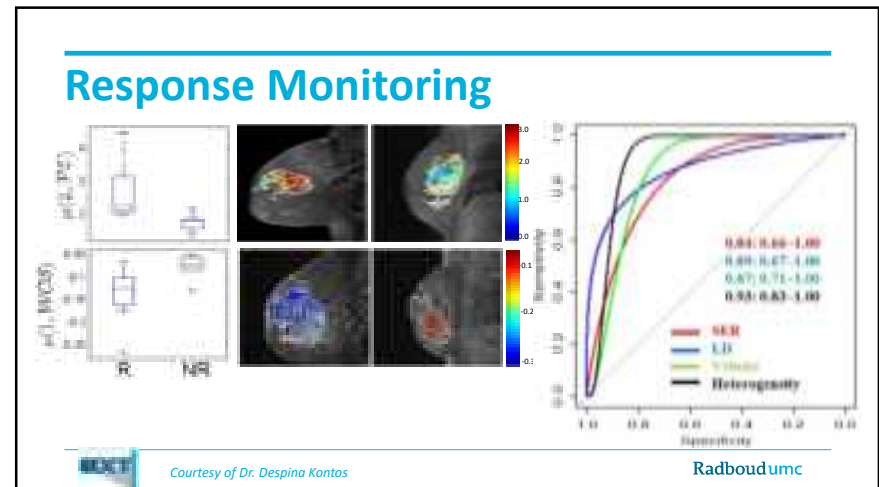
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Functional Imaging

Dynamic CT Perfusion
Beyond anatomical information
Identify the right patient
Provide the right treatment



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Requirements

High spatio-temporal resolution
Quantitative accuracy
Low radiation dose (per time point)



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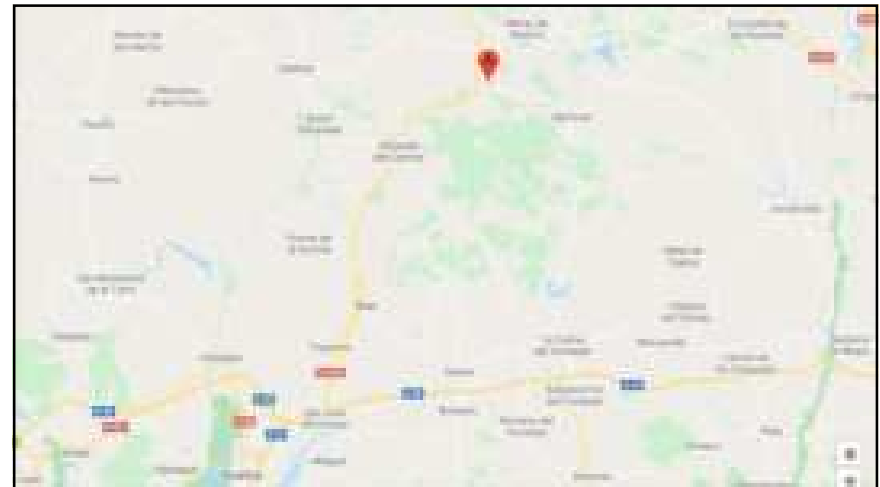
**We need to generate the software
(algorithms) for this!**

It's a 4D world!!



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