



Přehled technických novinek z pohledu společnosti Philips

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Přehled bodů

- Kryogenní technika v MR – obrovský skok kupředu
- Gradienty Vega HP – nový pohled na specifikace
- Urychlovací techniky – Compress Sensing
- Nové směry technik – 3D APT/CEST
- Kvalitní provedení MR – možnosti využití v RT
- Informační paradox – rychlá měření s velkou informační hustotou
- AI v MR oblasti

Upozornění:

následující slidy mohou obsahovat informace typu výzkumné práce, inspirace či návrh řešení a nejsou komerčně dostupné. Produkty komerčně dostupné jsou označeny jako produkt.

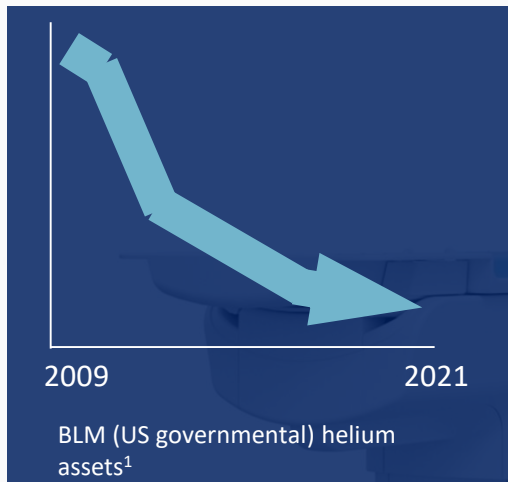
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Helium-free MR operations = new big demand to decrease consumption



Sustainability, productivity and costs



+135%¹

Crude helium price increase in 2018

3-7 days³

Downtime in case of quench

65%²

Experienced a quench in the last 10 years (across vendors)

>60,000\$³

Potential costs of a customer-initiated quench

¹ <http://www.mining.com/helium-prices-spike-35-us-federal-auction/> ² Marketech June 2017 study ³ Philips services data. Depends on service contract agreements.



Forget about helium Micro-cooling technology

From ~1,500 liters of
liquid helium...

product



Forget about helium

Micro-cooling technology



From ~1,500 liters of
liquid helium...

... to ~7 liters



PHILIPS

Low siting and construction costs

No vent-pipe



No need for long and complex vent-pipe

- Installation
- Maintenance to avoid obstruction and ice formation
- Quench and patient evacuation safety procedures
- Fire prevention measurements

Up to \$200,000

Low siting and construction costs

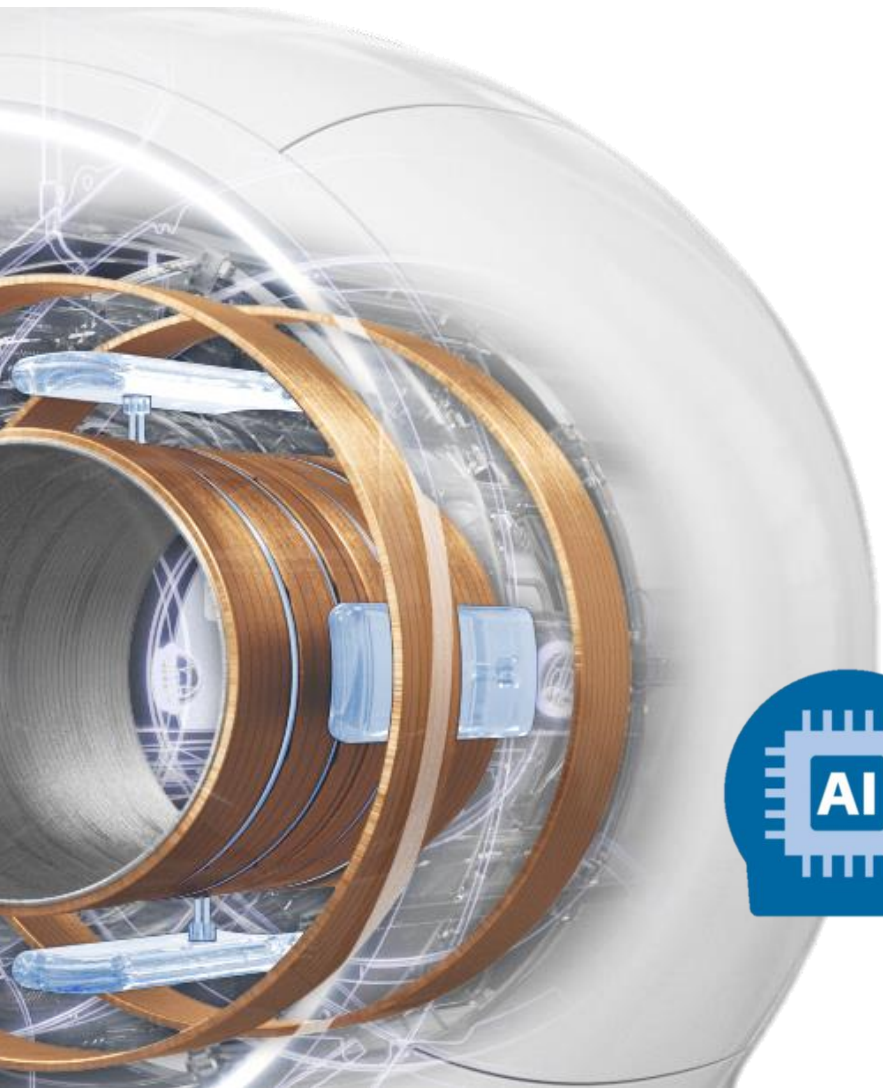
900 kg lighter.¹



900 kg lighter¹ for flexible
Installations and potentially
reduced floor adaptations

¹ Compared to Ingenia 1.5T ZBO magnet

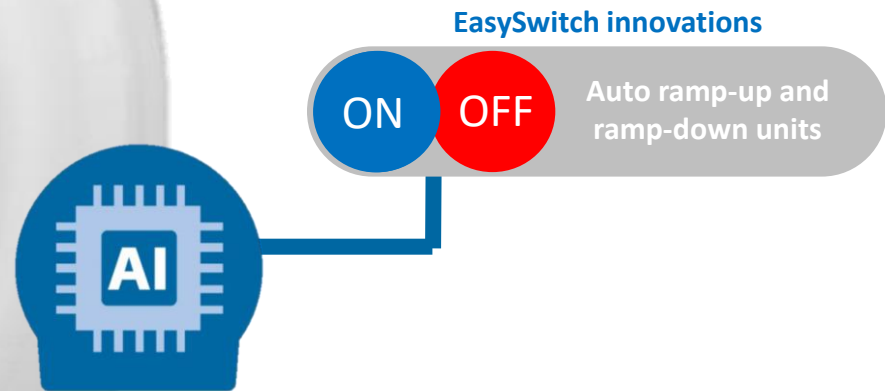
product



Towards uninterrupted MR

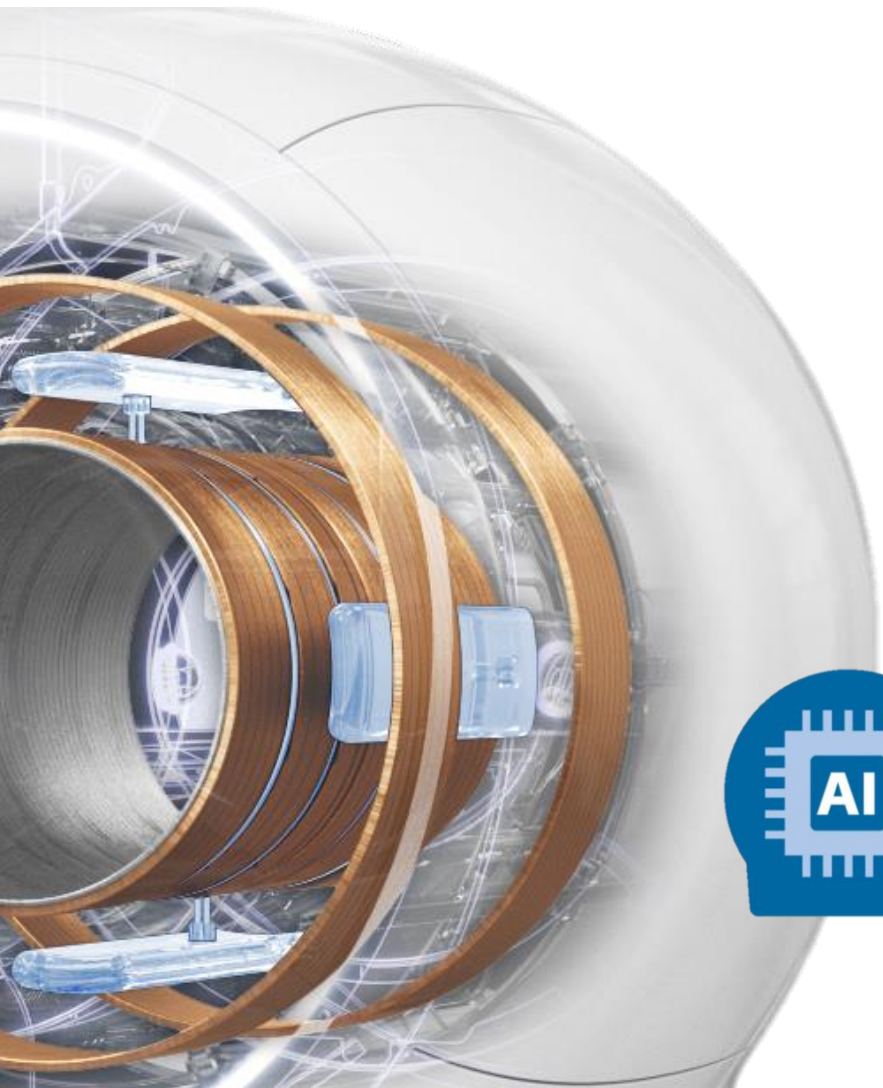
EasySwitch solutions¹

Minimize unexpected downtime
in case of MR operational issue
(item stuck in the bore, chiller failure)



¹ Service contract needed

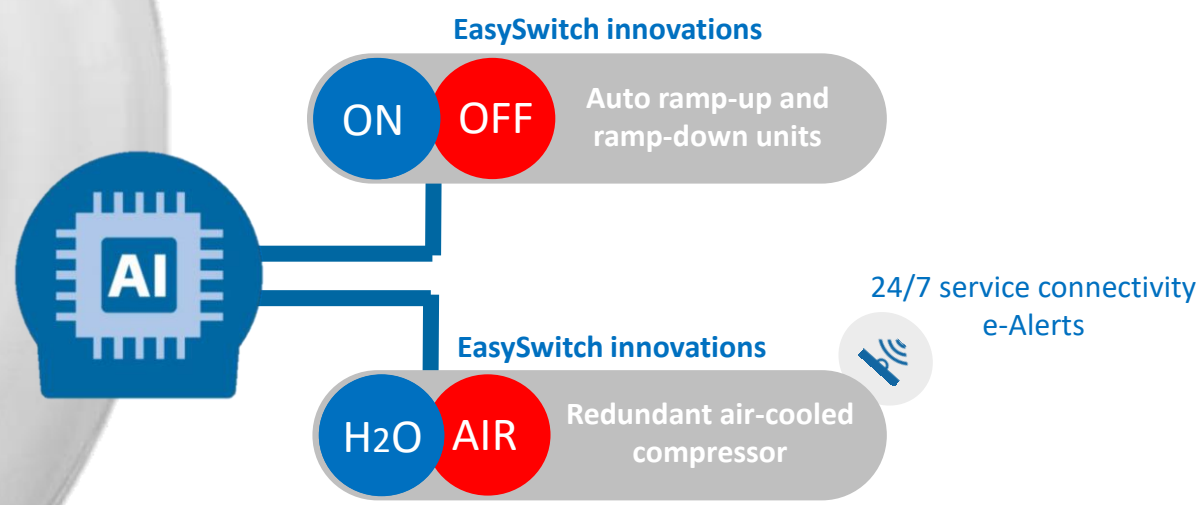
product



Towards uninterrupted MR

EasySwitch solutions¹

Minimize unexpected downtime in case of MR operational issue (item stuck in the bore, chiller failure)



¹ Subject to service agreement

Technické charakteristiky



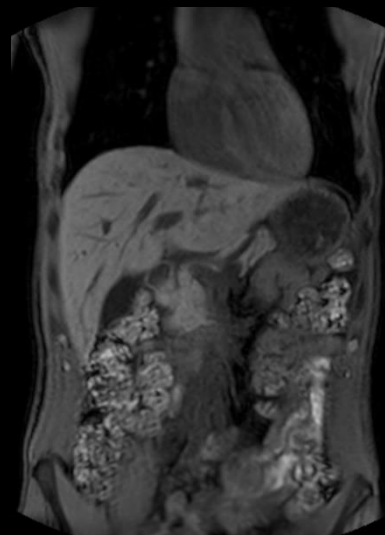
PHILIPS

Technická specifikace magnetu

- FOV - 55x55x50cm –
- B0 homogenita - 1.8ppm na 50 cm
- Linearita gradientů– 1.4% na 50 cm
- Gradienty : 45/200 mT/m-T/m/s

Plně digitální systém od cívky až po rekonstruktor

product



mDIXON XD FFE
2.0 x 2.0 x 2.0 mm
1 stack, 14 sec



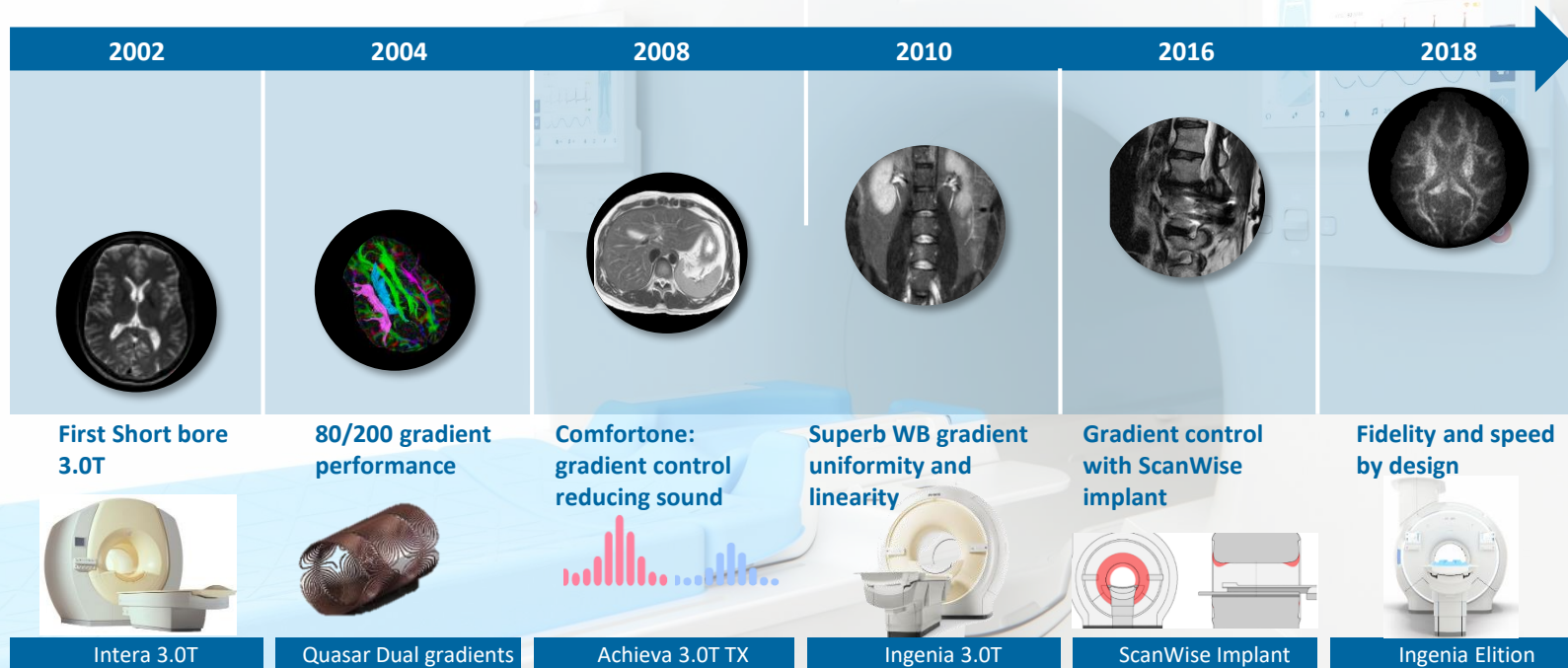
DWIBS
4.9 x 5.2 x 6.0 mm

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- **Gradients Vega HP – nový pohled na specifikace**
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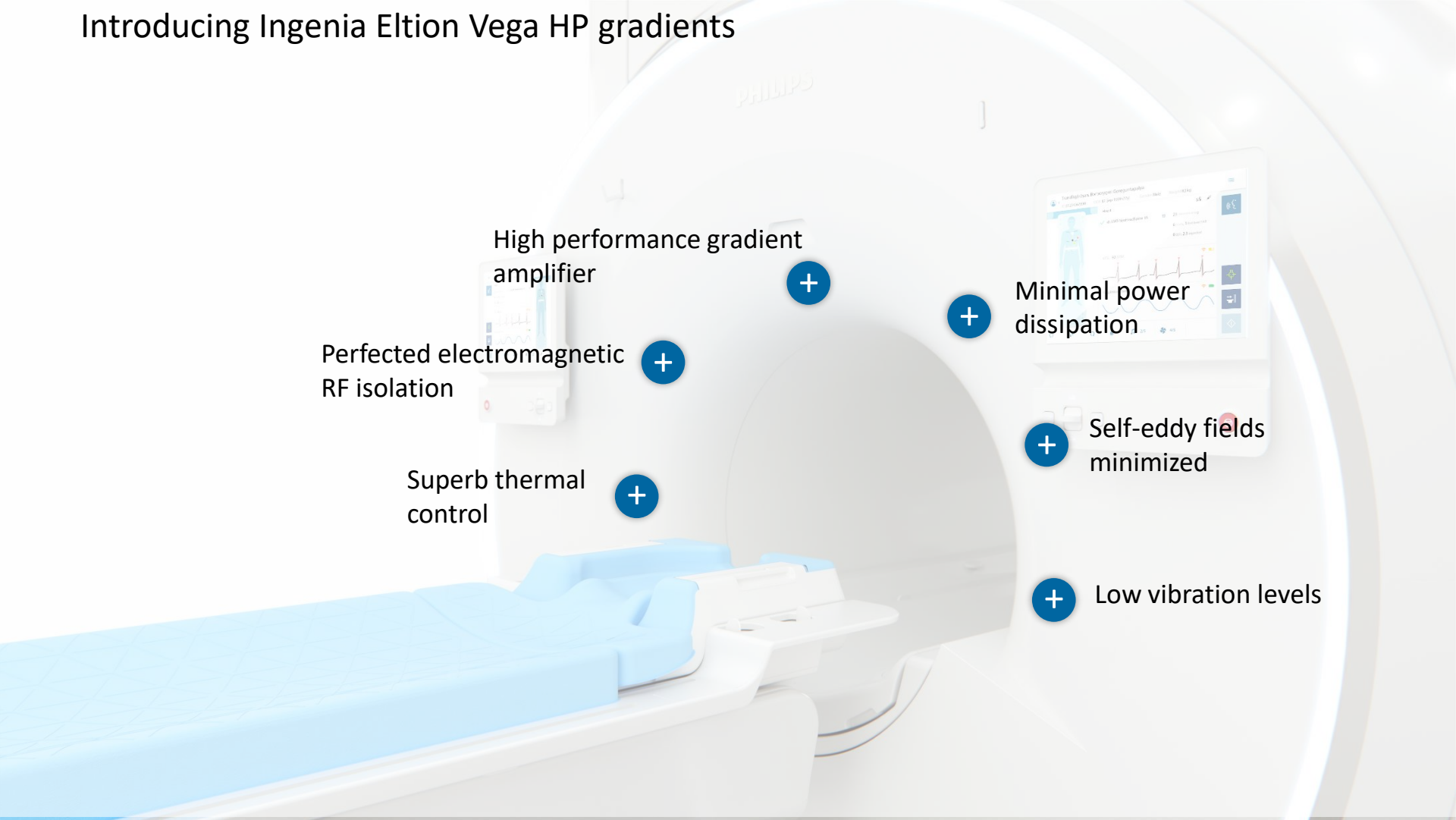
Based on 16+ years of 3.0T MR design expertise

Consistently enhancing fidelity and speed



Based on 16+ years of 3.0T Gradient design expertise

Introducing Ingenia Eltion Vega HP gradients



High performance gradient amplifier



Perfected electromagnetic RF isolation



Superb thermal control



Minimal power dissipation



Self-eddy fields minimized



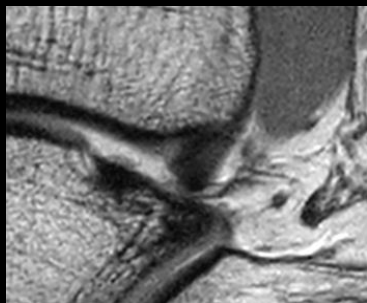
Low vibration levels

product

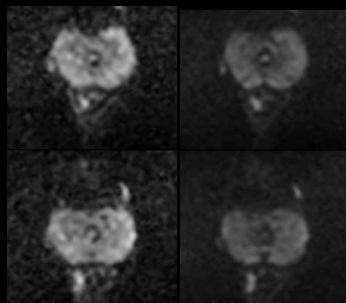
Ingenia Elition Vega HP

Fidelity ? and speed, by design

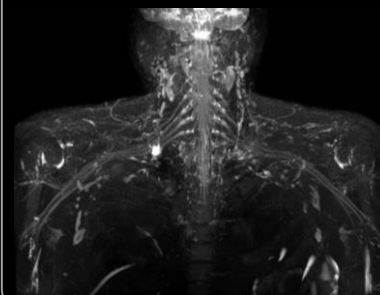
PD 0.2mm iso, 5:35



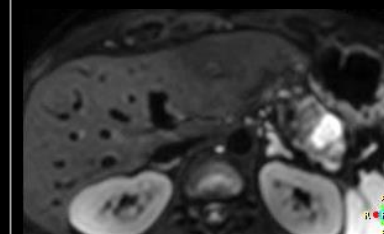
Prostate DWI



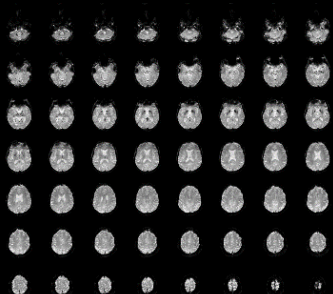
Large FOV



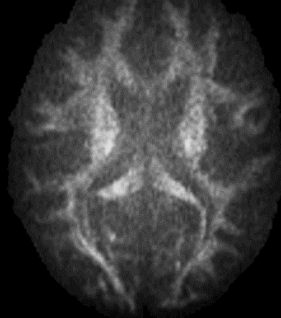
Liver DWI



fMRI 2mm iso, MB8



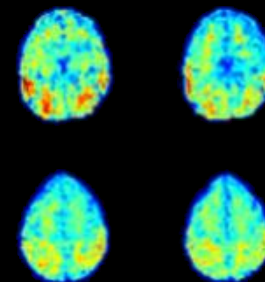
DWI, b 15.000



DSI 256, 12 min



High temporal SNR



Ingenia Elition Vega HP

Fidelity



High Fidelity

G-max	45 mT/m
Slew-max	220 T/m/s
Pmax	1.60 MW
Linearity	< 0.5%
Grms	27 mT/m
Fidelity	> 99.97%

+

HIFI [high fidelity]: sound reproduction over the full range of audible frequencies with very little distortion.

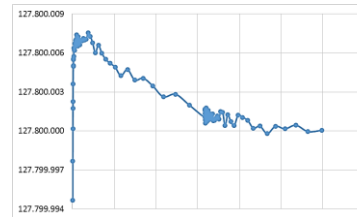
Gradient fidelity: gradient generation over the full range of necessary frequencies with very little distortion.

Ingenia Elition Vega HP

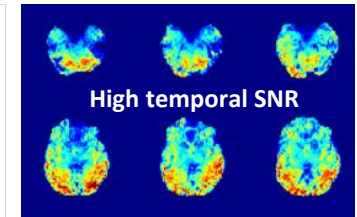
Gradient fidelity Vega HP: the deviation of the effective- from the targeted gradient waveform will never exceed more than 0.03%.



Minimal eddy currents



Low B0 effects



Minimal gradient heating

Ingenia Elition Vega HP

Efficiency

High Fidelity

G-max	45 mT/m
Slew-max	220 T/m/s
Pmax	1.60 MW
Linearity	< 0.5%
Grms	27 mT/m
Fidelity	> 99.97%

+

High Efficiency

Gradient design

- Thick gradient coil design
- Direct cooling using a thermally conductive substrate

Manufacturing

- Cutting precision < 0.1 mm
- Lateral- and rotational alignment through magnetic locking < 0.2 mm

Accurate water jet cutting approach



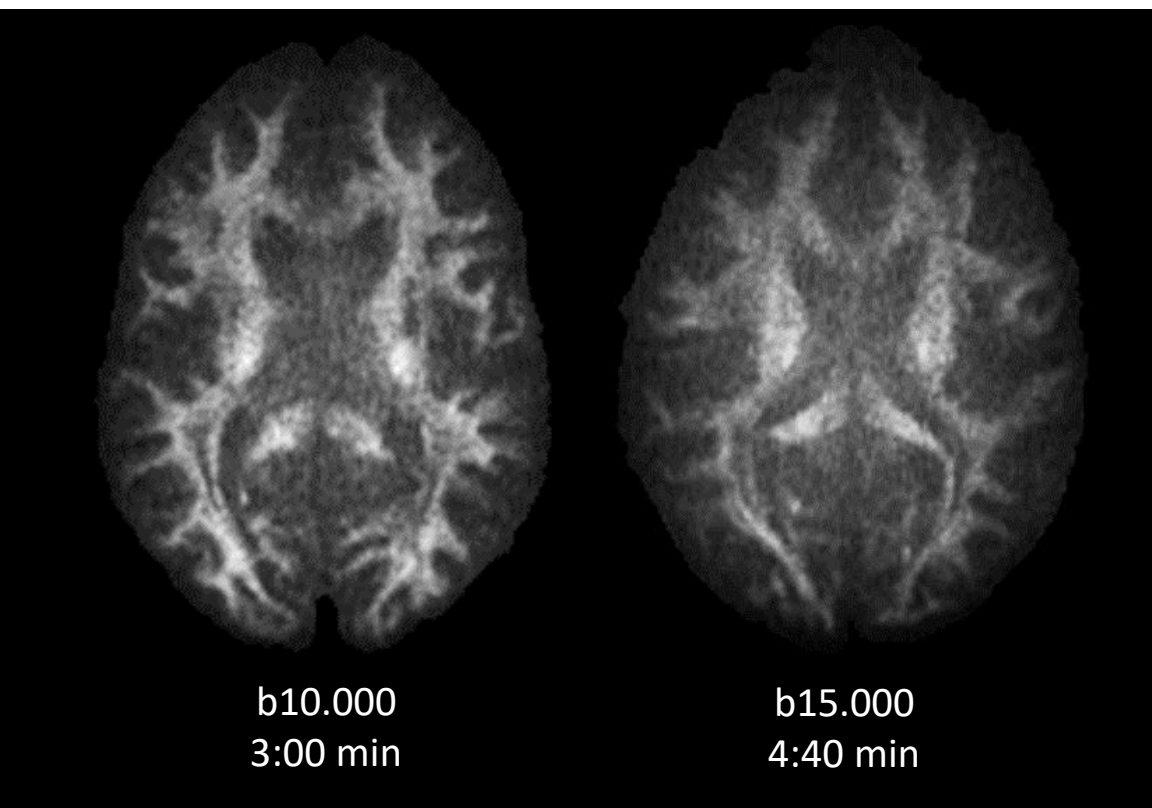
Lateral- and rotational alignment



product

Vega HP Gradients

Fidelity and speed, by design



High Fidelity

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Fidelity	> 99.97%

+



- Short TR (short scantime)
- Fast EPI (low distortion)
- Short TE (high SNR)

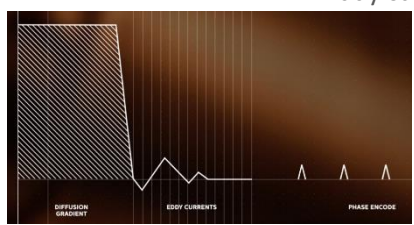
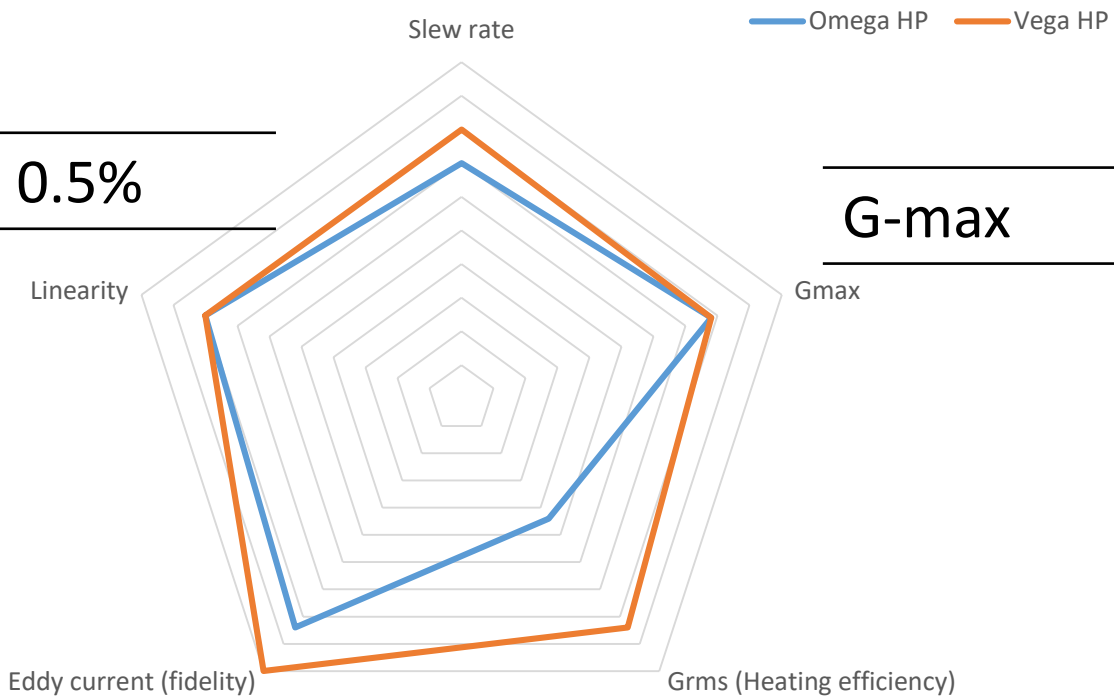
New gradient performance assessment – complex parameters

product

Slew-max 220 T/m/s

Linearity < 0.5%

G-max 45 mT/m



Grms: gradient-root-mean-square: the (rms) average gradient that we can turn on continuously.

Low Grms systems typically have a high heat dissipation, or other limitation, thus requiring artificial lengthening of TR etc.

Přehled bodů

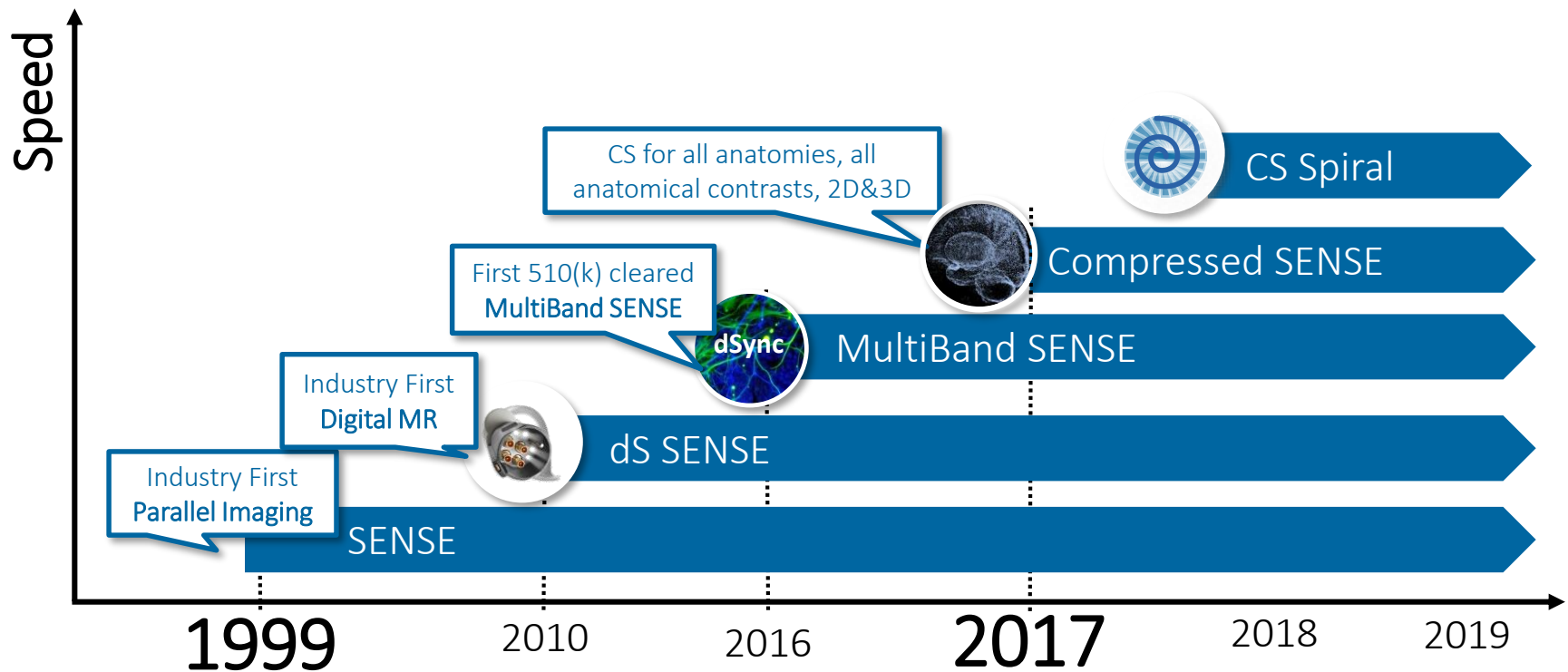
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New technologies on the board

COMPRESSED SENSE

How to accelerate without loosing IQ?
Or how to improve IQ within same
time?

Philips vision on Speed



Compressed SENSE enhances capacity

Up to **50%** acceleration with virtually equal image quality¹

2D

All anatomical contrasts

(TSE, FFE, T1, T2, PD, IR, bFFE,...)

3D

Compatible with **88%** of your **daily scans**²

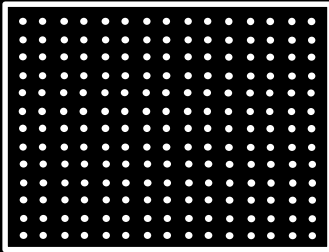


¹ Compared to Philips scans without Compressed SENSE.
² Valid for Philips Ingenia systems. Based on aggregated global clinical utilization data and C-SENSE sequence compatibility criteria.

A unique, SENSE-based, implementation

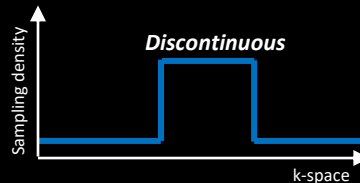
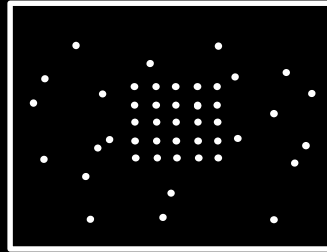
Accelerating 2D and 3D sequences to cover 88% of your Clinical operations

Conventional imaging



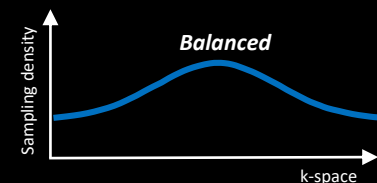
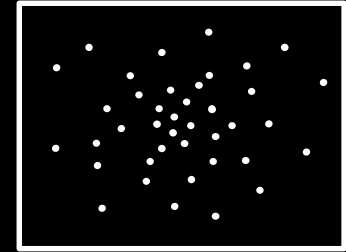
- ✓ Sharp
- ✓ High SNR
- ✗ Slow

non-SENSE
compressed sensing



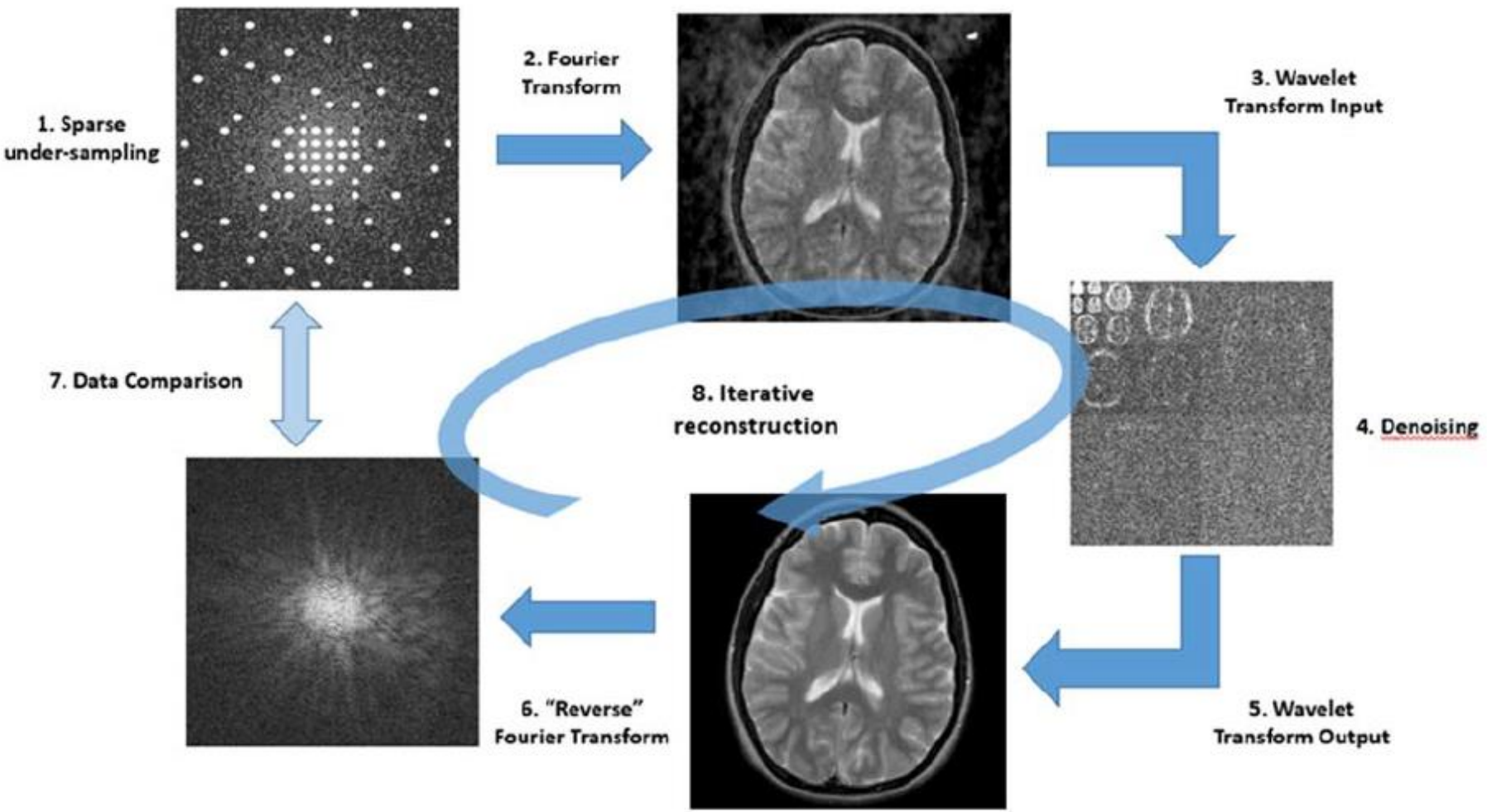
- ✗ Blurry
- ✗ Low SNR
- ✓ Fast

Philips
Compressed SENSE



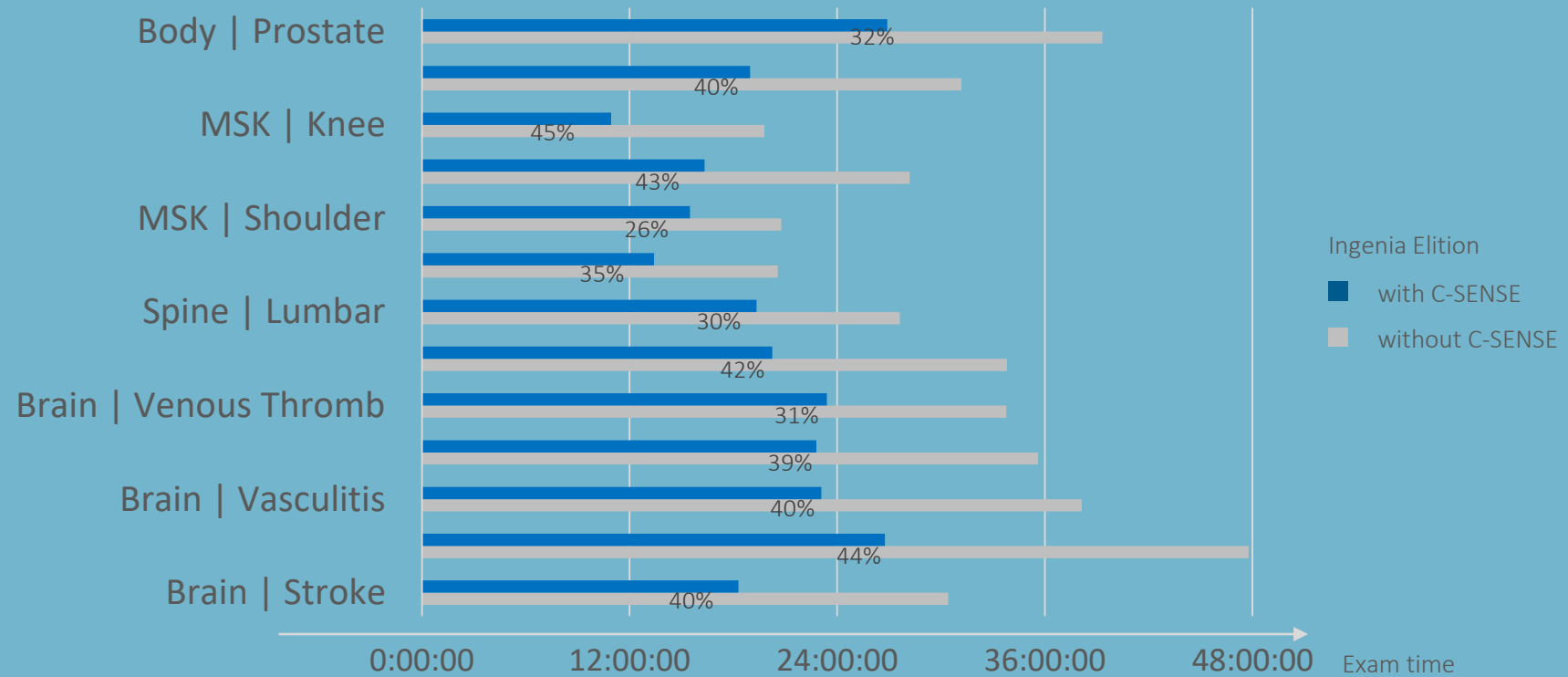
- ✓ Sharp
- ✓ High SNR
- ✓ Fast
- ✓ Enabling 2D and 3D

How C- Sense is working ?



Short exams across your procedure mix

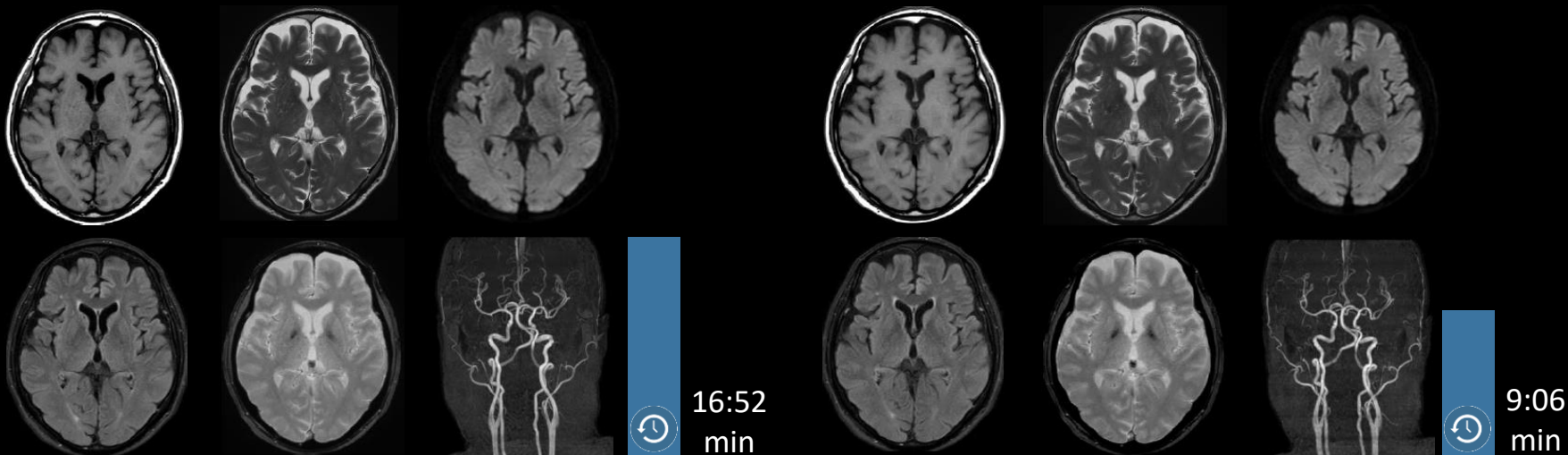
Example: Hennepin County Medical Center. Minneapolis. USA



Results from case studies are not predictive of results in other cases. Results in other cases may vary.

Up to 50% acceleration with virtually equal IQ¹

2D and 3D-based Clinical Brain Examcard



T1w SE	0.9 x 1.3 x 5.0 mm	2:35 min	S 1.0
T2w TSE	0.6 x 0.7 x 5.0 mm	2:04 min	S 1.6
DWI (b1000)	1.8 x 1.4 x 5.0 mm	0:45 min	S 2.0
T2w FLAIR	1.0 x 1.2 x 5.0 mm	2:12 min	S 1.9
T2w FFE	0.9 x 1.1 x 5.0 mm	1:15 min	S 2.0
3D Inflow	0.7 x 1.3 x 1.4 mm	7:11 min	S 2.0

T1w SE	0.9 x 1.3 x 5.0 mm	1:14 min	CS 2.8	52%
T2w TSE	0.6 x 0.7 x 5.0 mm	1:30 min	CS 3.2	27%
DWI (b1000)	1.8 x 1.4 x 5.0 mm	0:45 min	CS 2.0	
T2w FLAIR	1.0 x 1.2 x 5.0 mm	1:30 min	CS 2.5	41%
T2w FFE	0.9 x 1.1 x 5.0 mm	0:49 min	CS 3.0	35%
3D Inflow	0.7 x 1.3 x 1.4 mm	3:06 min	CS 4.5	57%

¹ Compared to Philips scans without Compressed SENSE. Results from case studies are not predictive of results in other cases. Results in other cases may vary. Courtesy: Kumamoto Chuo Hospital, Japan, Ingenia 1.5T CX

Speed for everyone... even for challenging patients

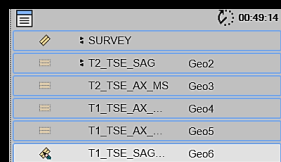
Patient with deep brain stimulator and spine implant

Challenges

1. Safety (SAR<0.1W/kg)
2. Diagnostic IQ
3. Examtime <30min

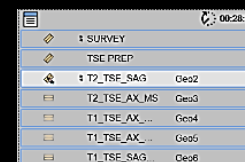
Without C-SENSE

- Low SAR protocols
- **Poor IQ**
- **Examtime: 49min**



With C-SENSE

- Low SAR protocols
- **Diagnostic IQ**
- **Examtime: 28min**

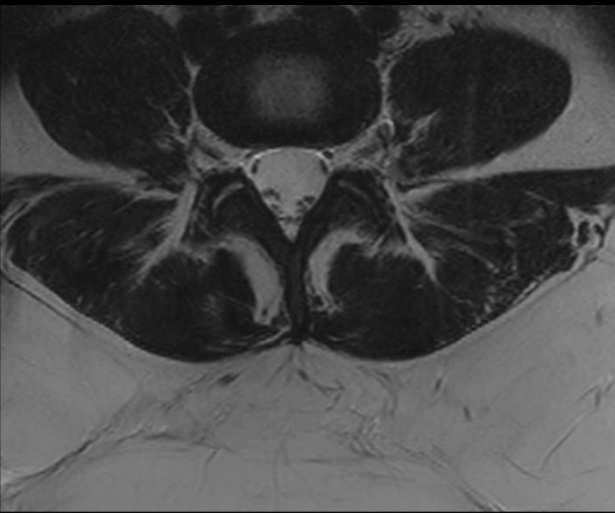


Courtesy: Bethesda Hospital East. Boynton Beach. Florida, USA

Low SAR exams within your timeslot

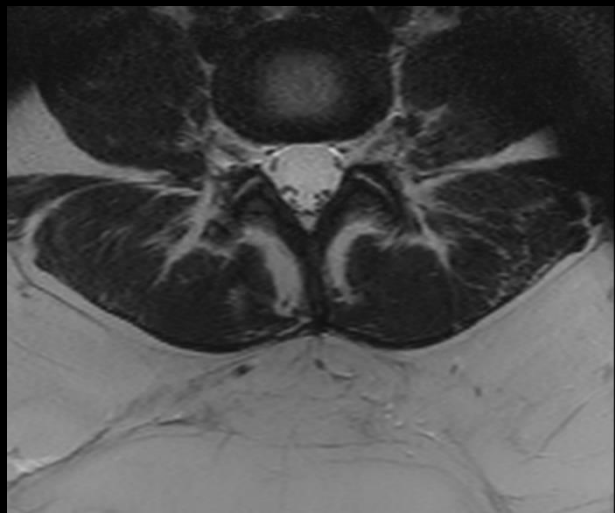
>150 kg Spine example

Ingenia Elition 3.0T X



T2w TSE
dS SENSE 1
0.6 x 1.1 x 4.0 mm

2.5 W/kg (first level SAR mode)
7:33 min



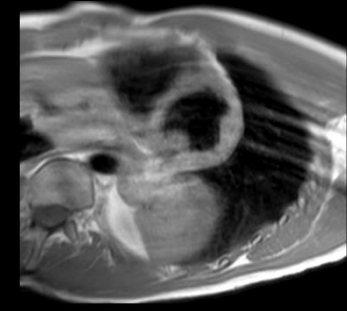
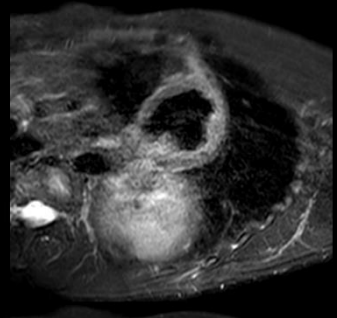
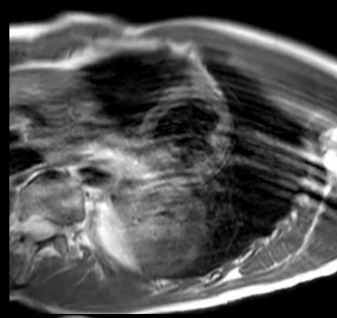
T2w TSE
Compressed SENSE 2
0.6 x 1.1 x 4.0 mm

1.9W.kg (normal level SAR mode)
3:21 min

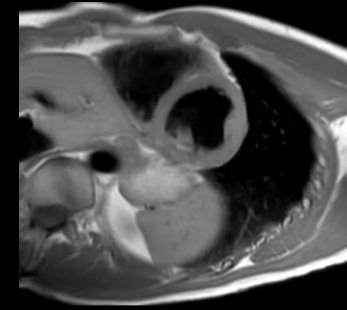
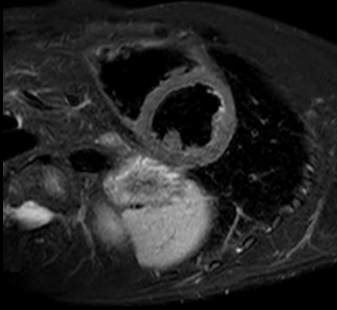
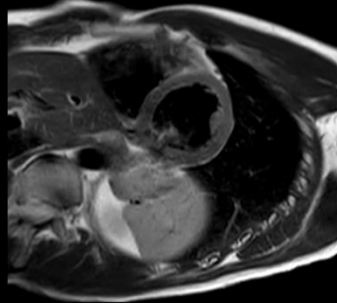
Short Breath-holds, Enhanced IQ

Cardiac example

Conventional
dS SENSE 1.5 to 2
BH: 15-17 sec



With C-SENSE
C-SENSE 2 to 3
BH: 10-12 sec



T2w TSE BB
1.4 x 1.8 x 8.0 mm

T2w STIR BB
1.4 x 1.8 x 8.0 mm

T1w TSE BB
1.4 x 1.8 x 8.0 mm

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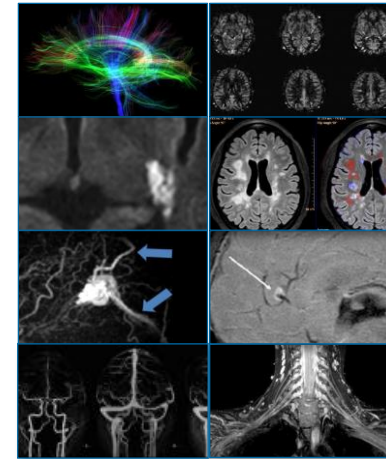
New technologies on the board

3D APT

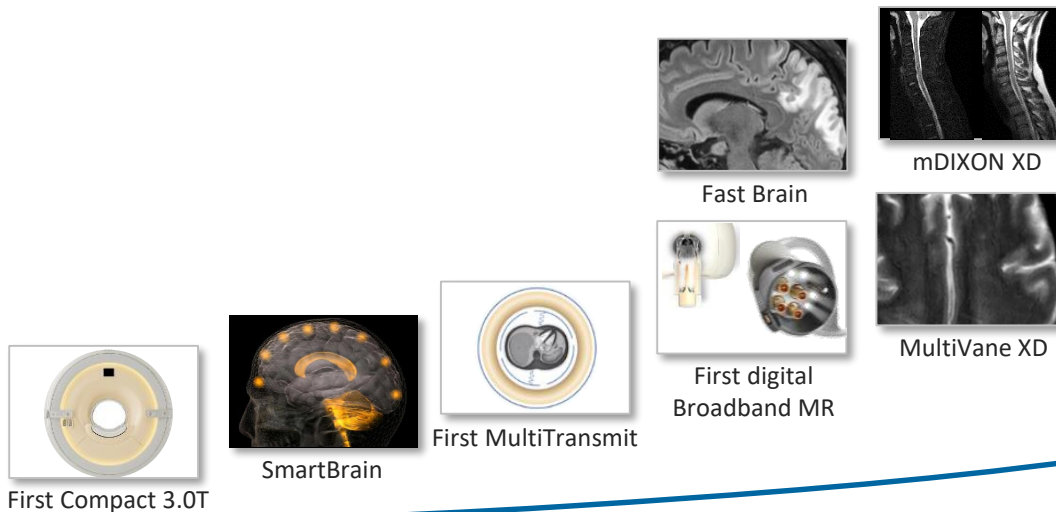
How to diagnose more exactly?

This year, Philips continues to lead the way in elevating Neuro diagnostics

Leader in Neuro Clinical applications

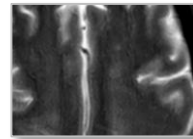
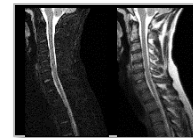
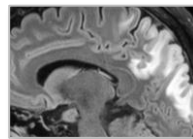
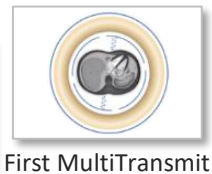


8 new Neuro applications

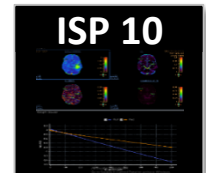
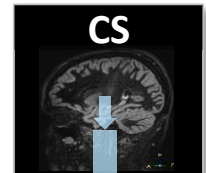
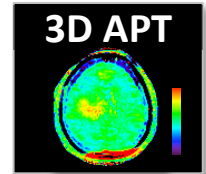
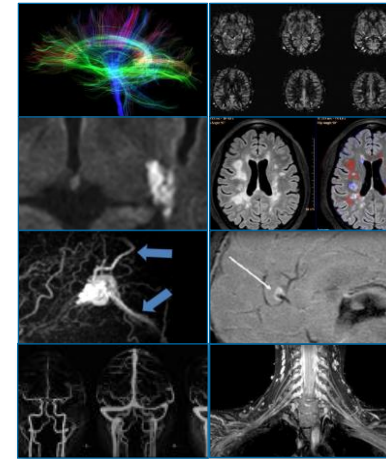


analog			digital		
2000	2005	2010	2013	2016	2017

This year, Philips continues to lead the way in elevating Neuro diagnostics



Leader in Neuro Clinical applications



5 new Neuro applications



New technologies on the board

Brain tumors/staging

3D APT – How does it work?

CEST - Hence, the principle of CEST imaging is simple: Given a chemical species of interest, capable of exchanging its ^1H protons with those of water, a radiofrequency pulse is applied at (**One** of) its resonant frequency(ies) in order to reach a saturation state.

3D APT is a **chemical exchange saturation transfer (CEST)** technique. In CEST imaging, a frequency-selective saturation prepulse is applied to the resonance frequency of hydrogen in non-water and non-fat molecules. In the case of 3D APT, this is +3.5 ppm, which is the resonance frequency of hydrogen in the amide molecule. The saturation pulse is applied for two seconds in order to reduce the MR signal of amide protons.

In vivo, amide protons continually exchange with water protons in a process known as **chemical exchange**. As the proton carries the applied saturation, this transfer results in water molecules becoming saturated. The saturated water molecules lead to a decrease in the MR signal within the voxel.

An overview of CEST MRI for non-MR physicists

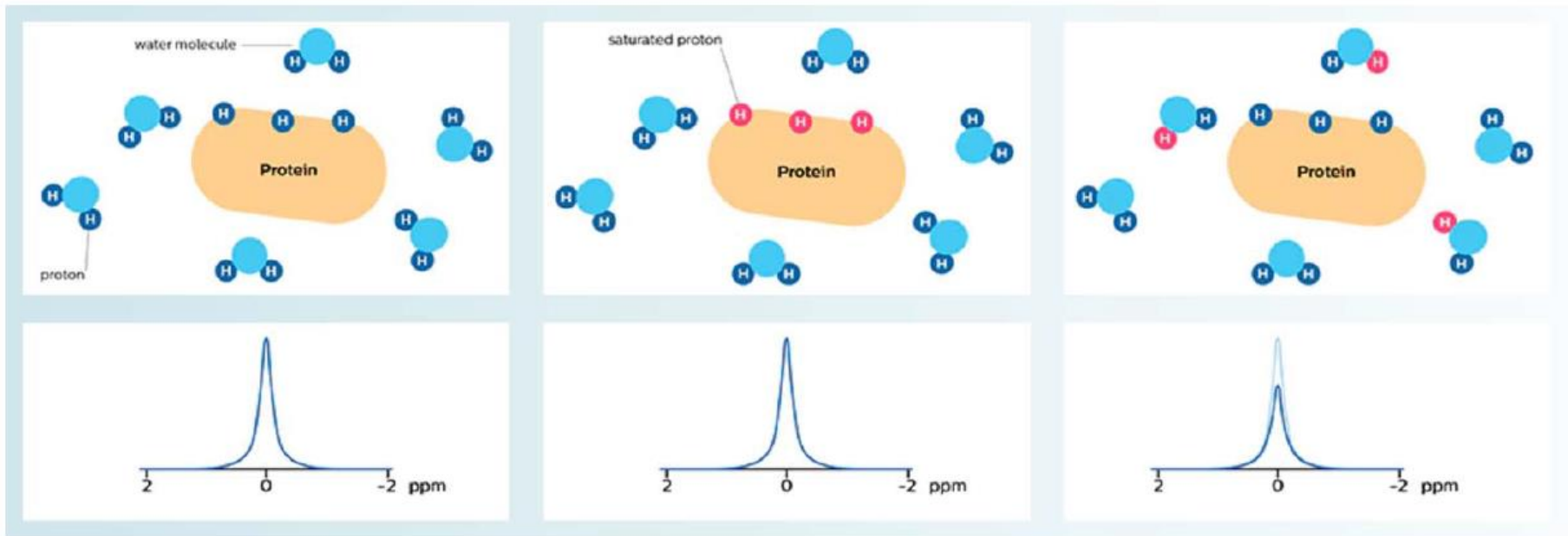
[B. Wu](#),¹ [G. Warnock](#),² [M. Zaiss](#),³ [C. Lin](#),¹ [M. Chen](#),⁴ [Z. Zhou](#),¹ [L. Mu](#),⁵ [D. Nanz](#),⁶ [R. Tuura](#),⁷ and [G. Delso](#): [EJNMMI Phys](#). 2016 Dec; 3(1): 19.

3D APT – How does it work?

1. Proteins with amide protons are surrounded by water molecules that are moving around.

2. Saturation prepulse on protein's amide proton frequency nulls MR signal of these protons.

3. As a result of chemical exchange, the nulled protons move from the protein to water molecules.



MR signal of water is high.

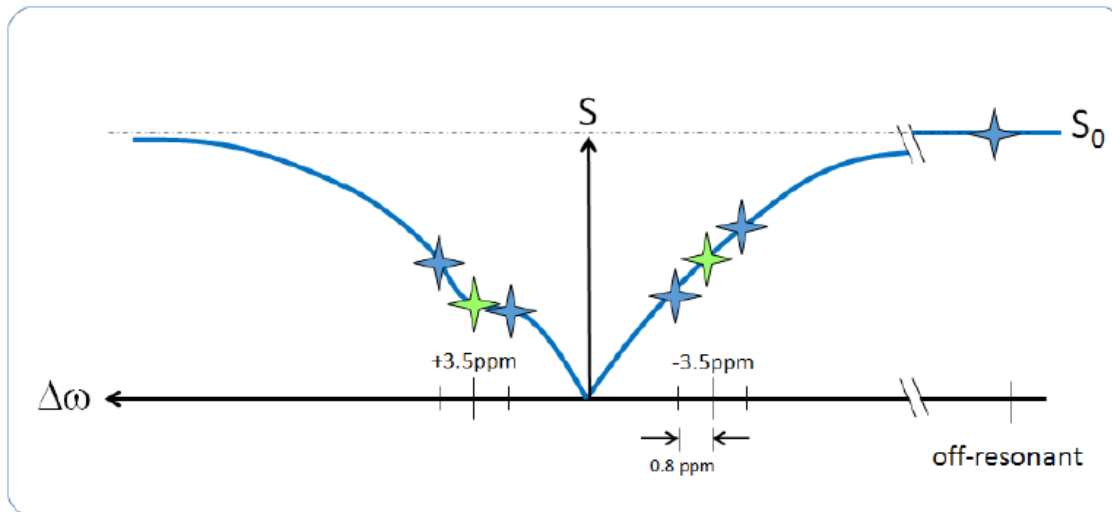
MR signal of water is high.

MR signal of water is reduced due to the proton exchange. In APT. This signal change is used to calculate an APT map that is sensitive to the concentration of the protein

3D APT – How does it work?

As the amide proton resonates at +3.5 ppm, a comparison is made with the MR signal at -3.5 ppm, the opposite frequency on the spectrum. This comparison is expressed as the **asymmetry of the magnetization transfer ratio (MTR_{asym})**.

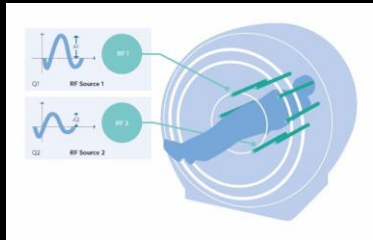
The greater the MTR_{asym}, the greater the presence of amide protons. In the following figure, the green stars show MTR asymmetry between amide resonant frequency at 3.5ppm and -3.5 ppm, which indicates the presence of amide within the voxel.



product

How did Philips make 3D APT work in clinical practice?

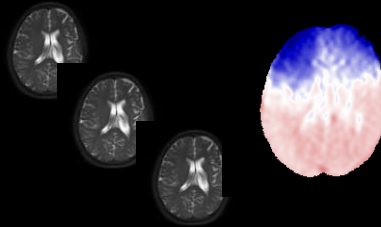
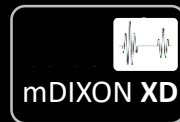
Robustness



MultiTransmit 4D

Patient-adaptive RF saturation

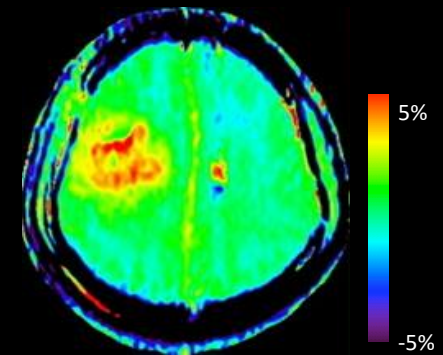
Speed



mDIXON XD

Fast integrated B0 correction

Ease of use

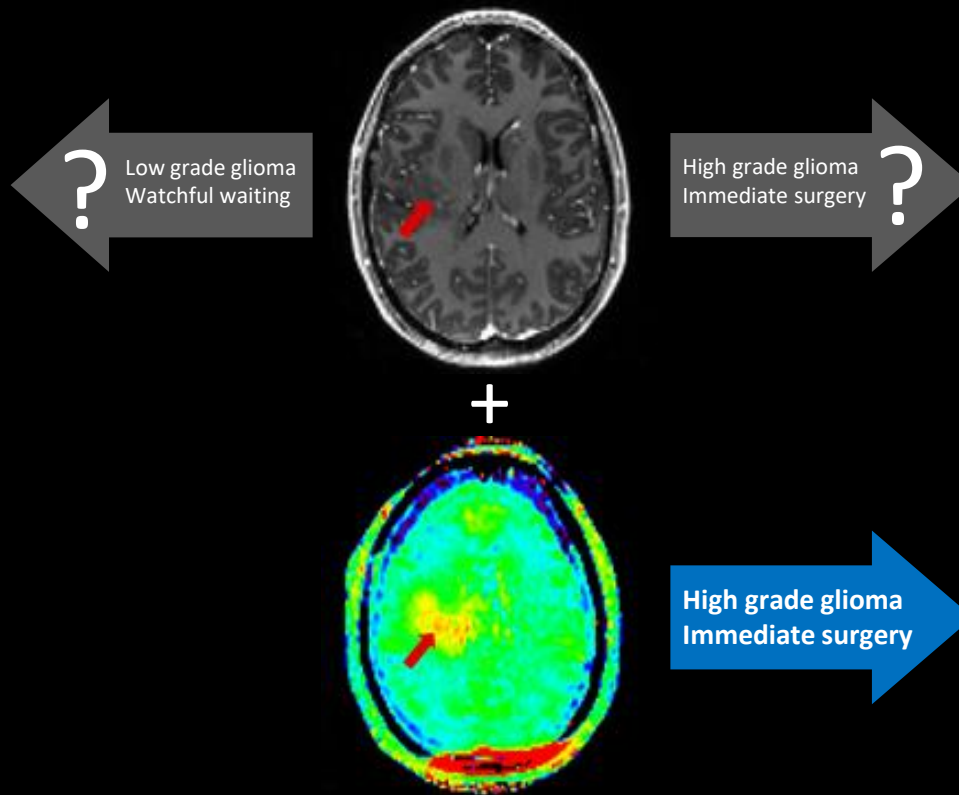


Optimized viewing

Color maps and scaling

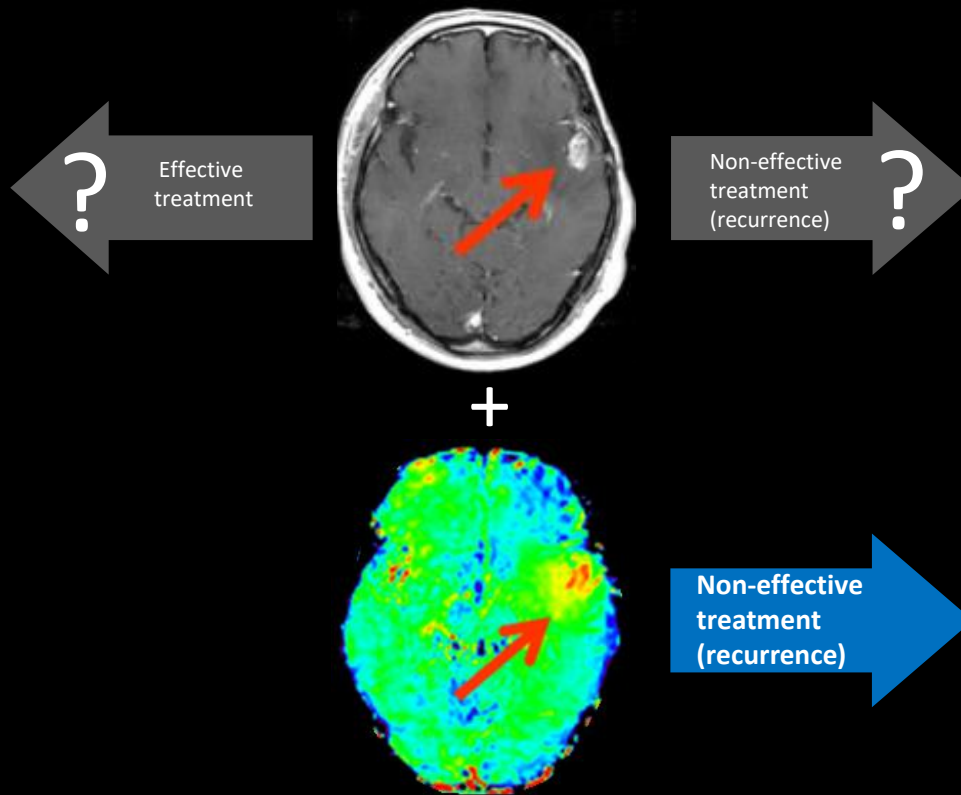
Leading in Neuro-oncology with Philips 3D APT

A new strategy to enhance confidence in grading gliomas



Leading in Neuro-oncology with Philips 3D APT

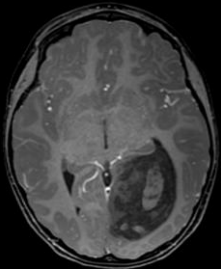
A new strategy to enhance confidence in glioma follow up assesment



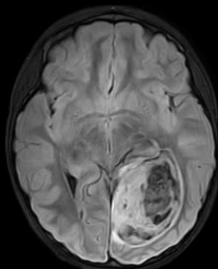
Philips 3D APT for brain tumor follow up

Clinical case: Glioblastoma multiforme

Pre Surgery

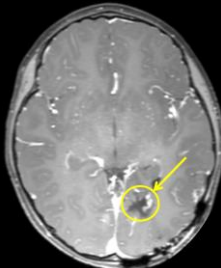


T1w Gd

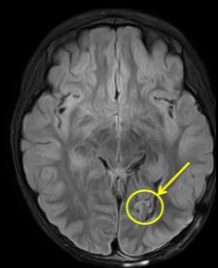


FLAIR

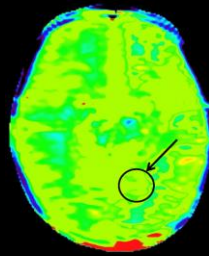
Immediate Post Surgery



T1w Gd

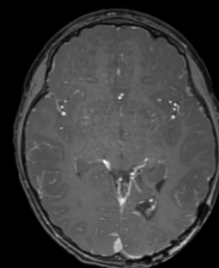


FLAIR

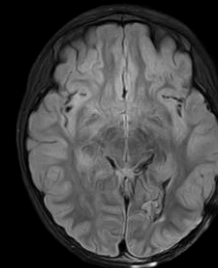


APTw

6 months follow up



T1w Gd

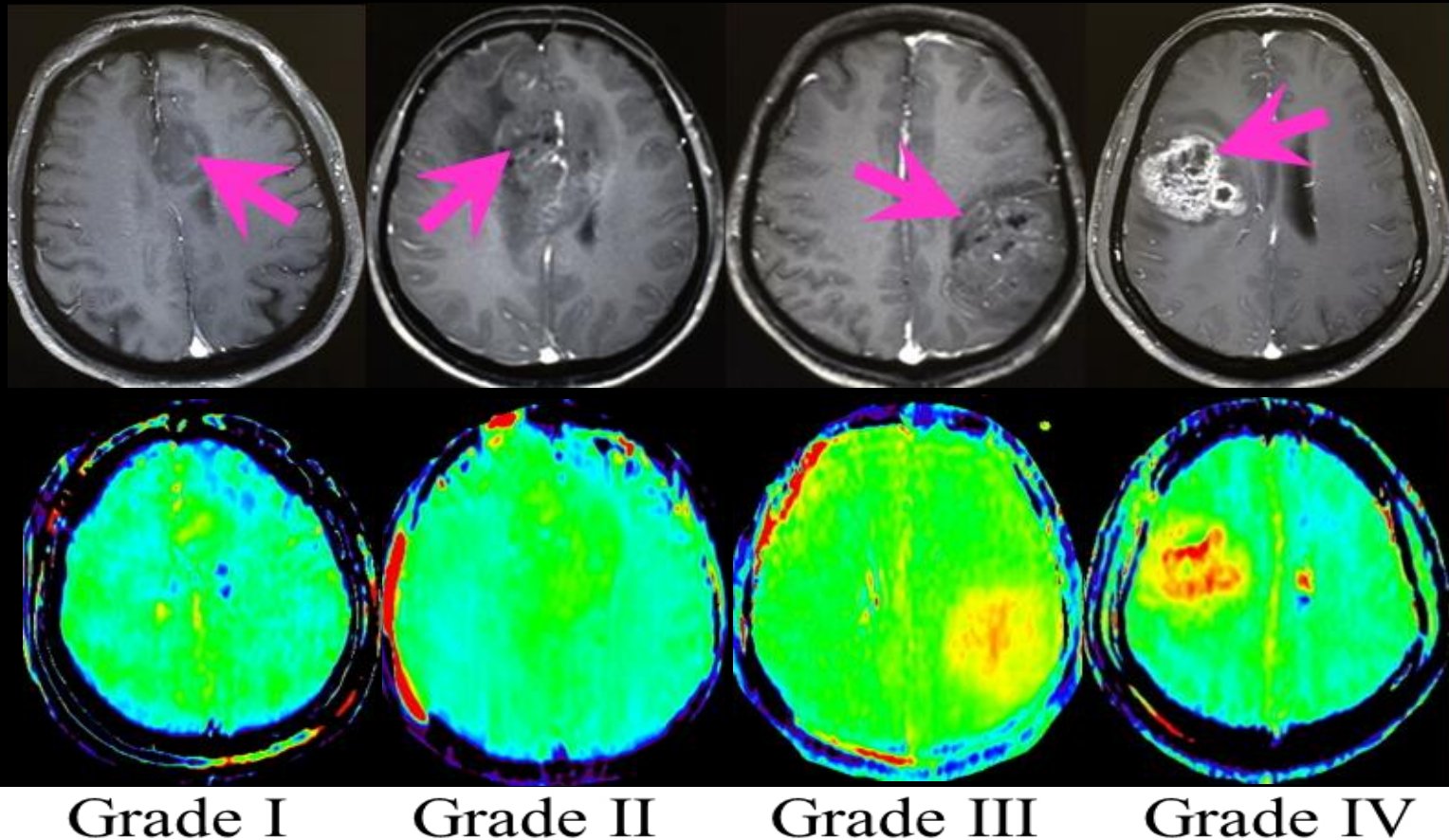


FLAIR

product

Philips 3D APT

Ability to help differentiating low-grade from high grade gliomas



Přehled bodů

- Kryogenní technika v MR – obrovský skok kupředu
- Gradienty Vega HP – nový pohled na specifikace
- Urychlovací techniky – Compress Sensing
- Nové směry technik – 3D APT/CEST
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product

Ingenia MR-RT

Designed for the needs of Radiation Oncology

Software features for MR simulation

- RT ExamCards
- One-click travel-to-scan

Tailored training

Geometric Quality Assurance Analysis Software & Phantom

Coil Support for imaging in the treatment position

VitalScreen for guided patient setup and fast workflow

Laser positioning system including dedicated calibration package

MR-only sim option to perform simulation without the need of CT sim

Integrated, flat MR-RT CouchTop Precision, Anterior coil support, indexing bar

Elition/Ambition with Compressed SENSE option for up to 50% faster RT exams

NEW: CouchTop Precision

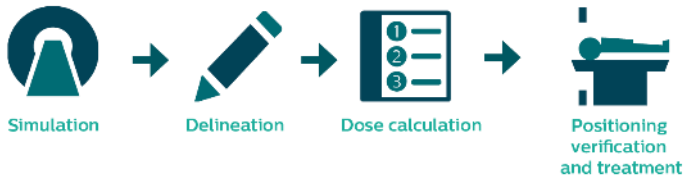
MR-only radiotherapy

Experience the true potential and drive the impact of MRI

MR + CT workflow



MR-only radiotherapy workflow

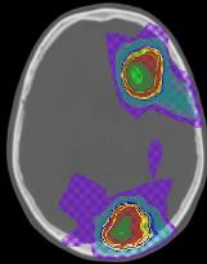


- Benefit from MRI's **superior soft-tissue contrast**
- **Eliminate tedious and error-prone MR-CT registration**
- Lower costs and make MR simulation **more affordable**
- Simplify workflows and **reduce patient burden**

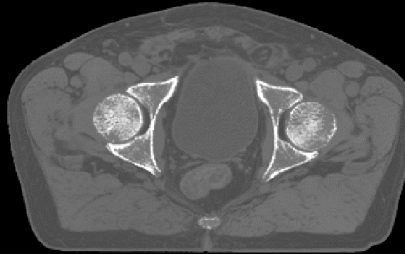
Philips MRCAT clinical applications



MRCAT Brain
(not yet available in the USA)



MRCAT Pelvis

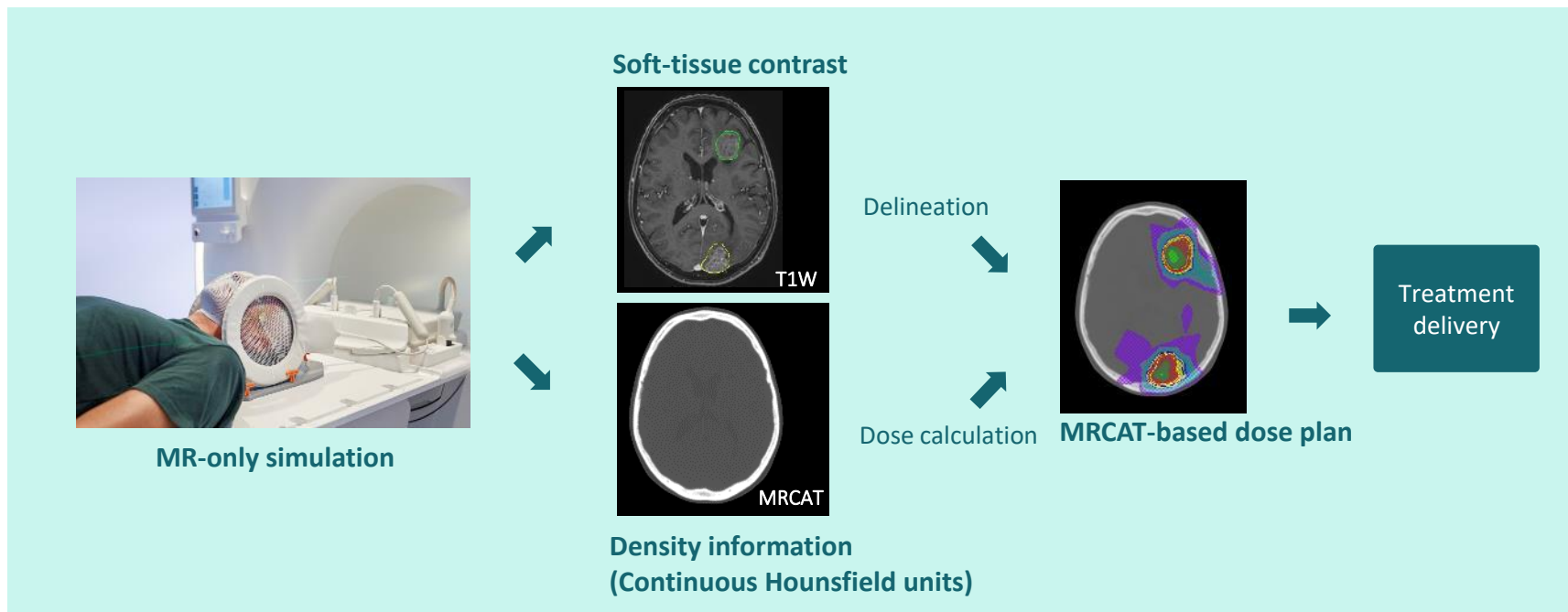


MRCAT Prostate +
Auto-Contouring



MRCAT Brain at a glance

Attenuation maps and anatomical information based on MR data only



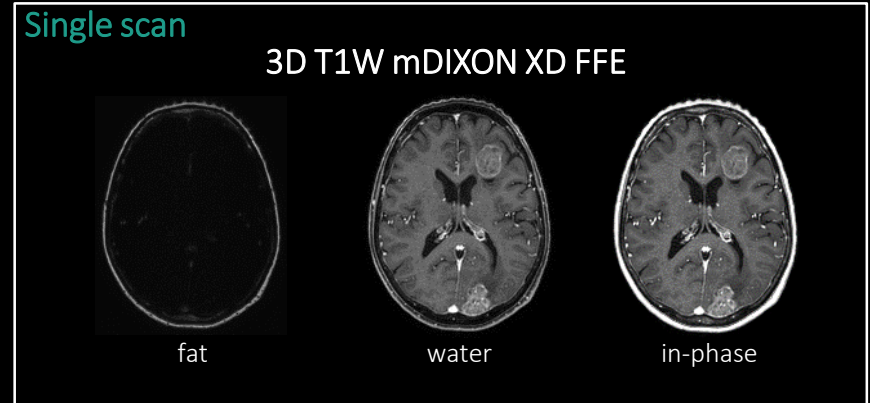
Ingenia MR-RT 1.5T. Images courtesy of Turku University Hospital, Finland.
This material is not intended for distribution in the USA

A single-scan approach

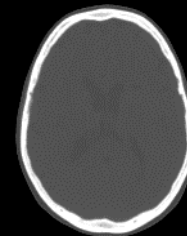
Single, fast 3D mDIXON sequence can be acquired in a **few minutes** to provide:

- Attenuation maps for dose calculations
- Detailed - submillimeter resolution - anatomical information for contouring

Anatomical and density information originate from the same scan, which ensures spatial and temporal consistency – no registration is needed



Automatic reconstruction



Continuous Hounsfield units

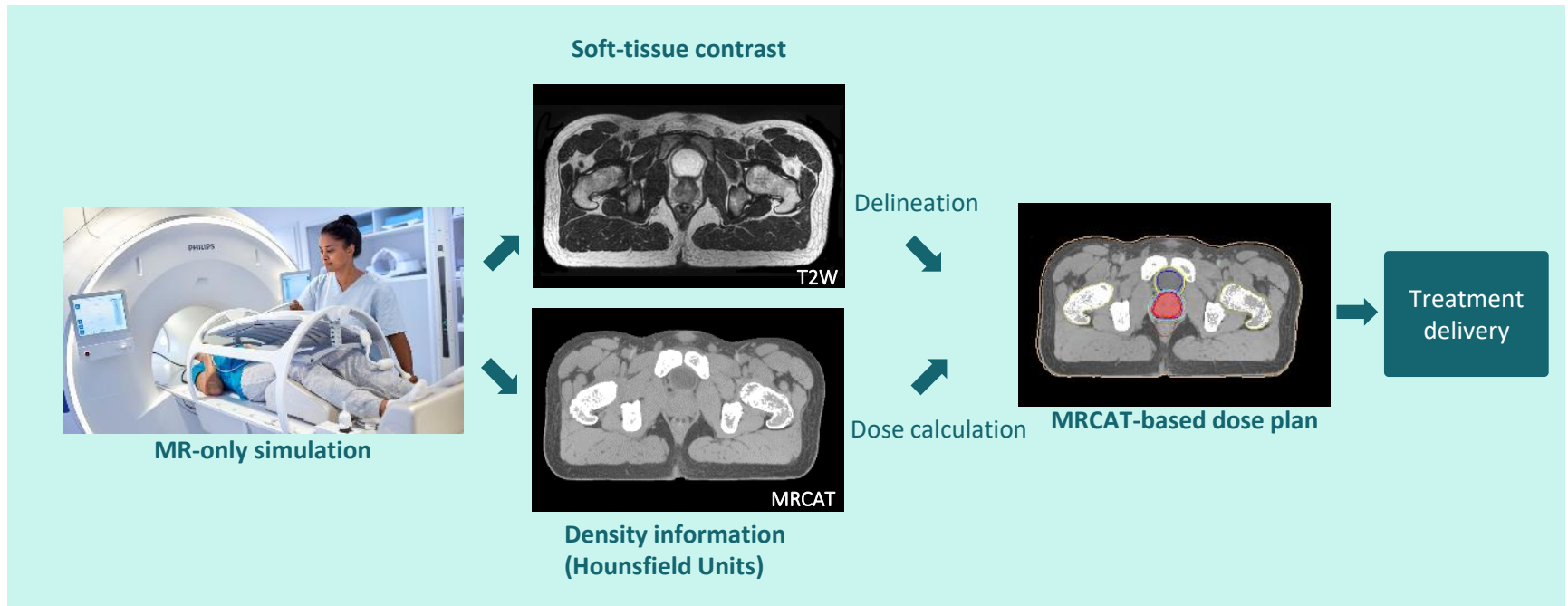


Anatomical contrast

Ingenia MR-RT 1.5T. Images courtesy of Turku University Hospital, Finland. Scan duration: 5:38 min.

MRCAT Pelvis at a glance

Perform dose calculations based on MR data only



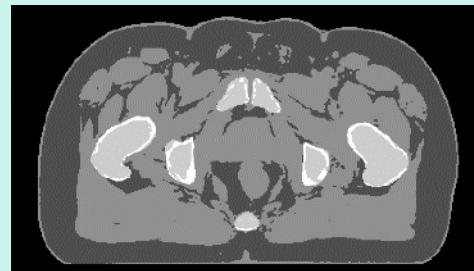
50

MR-only workflow for contouring and planning

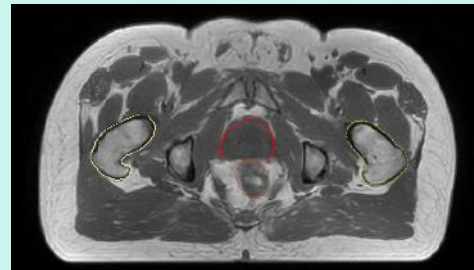
Attenuation maps and auto-contours based on MR data only



MR imaging



MRCAT Prostate
Density information

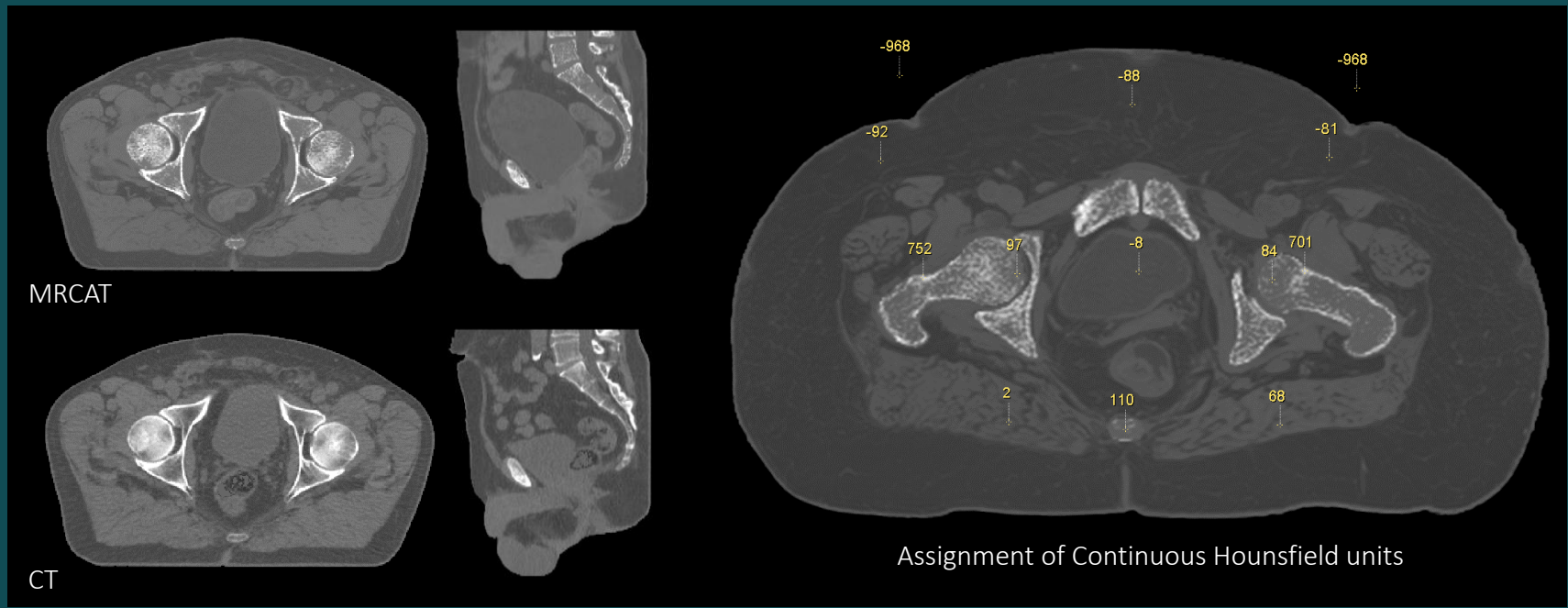


Auto-Contouring
MR-based contours

Within 20 minutes and in a repeatable 'one-click' workflow

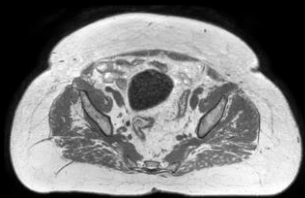
CT-like density information at the MR console

Continuous Hounsfield Units



Comprehensive MR-only simulation

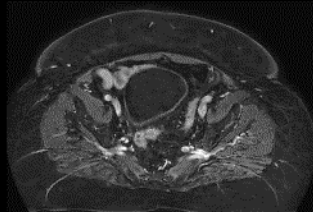
Female pelvis



3D mDIXON in-phase



3D T2W sagittal



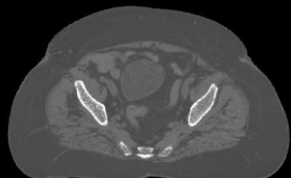
3D T1W + contrast

mDIXON XD FFE XD
4:15 min
1.4x1.4x1.4 mm

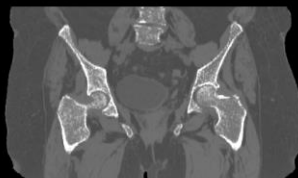
T2W TSE 3D
5:49 min
1.2x1.2x1.2 mm

T1W TFE + contrast 3D
3:01 min
1.5 x 1.5 x 1.5 mm

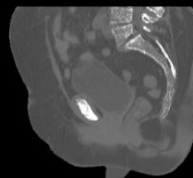
Courtesy: Turku University Hospital (TYKS) Turku, Finland. Ingenia MR-RT 1.5T



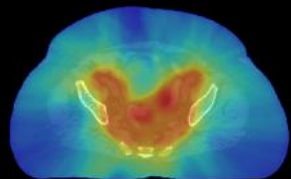
Axial MRCAT



Coronal MRCAT



Sagittal MRCAT



MRCAT-based dose plan



MRCAT-based DRR

Results from case studies are not predictive of results in other cases. Results in other cases may vary.

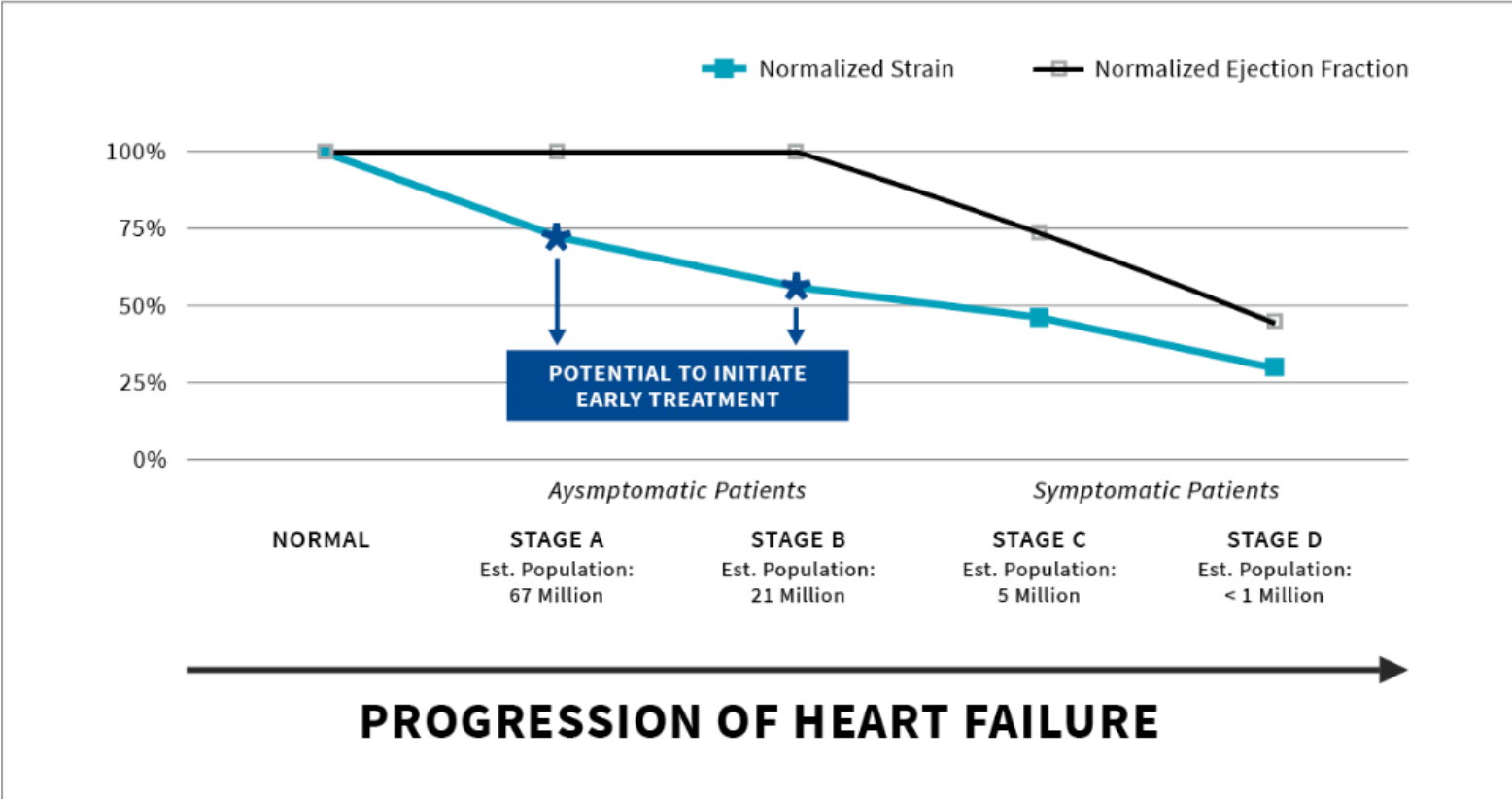
Přehled bodů

- Kryogenní technika v MR – obrovský skok kupředu
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- **Informační paradox – rychlá měření s velkou informační hustotou**
- AI v MR oblasti

Myocardial strain – MYOSTRAIN

Strain Identifies Heart Failure Early

Strain often detects heart dysfunction before ejection fraction declines



Senc – myocardial strain

WIP

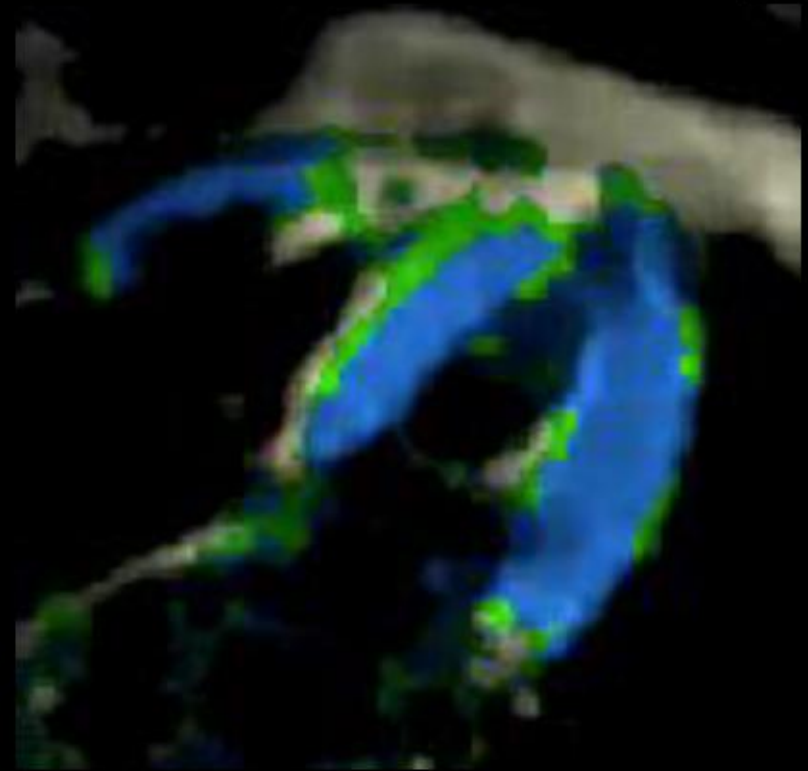
2019



SENC*

Pixel-wise measurement of myocardial strain

SENC* provides strain-encoded time-resolved images from which quantitative strain information per voxel can be extracted



* Available to selected customers only, after explicit alignment with the MR Marketing Department in Best, The Netherlands.

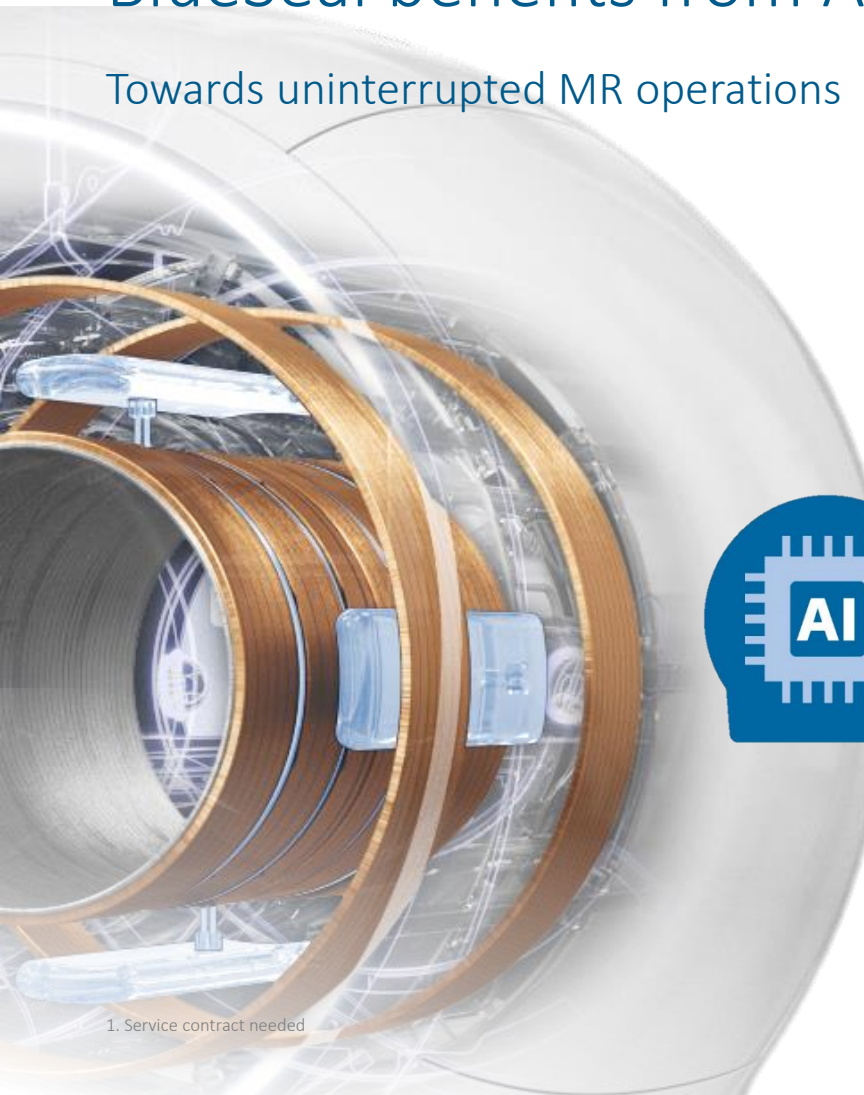
Image processing by courtesy of Myocardial Solutions Inc., USA.

Přehled bodů

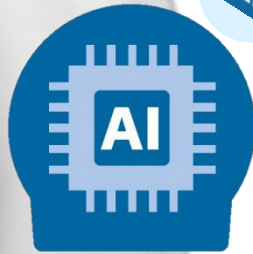
- Kryogenní technika v MR – obrovský skok kupředu
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- Informační paradox – rychlá měření s velkou informační hustotou
- **AI v MR oblasti**

BlueSeal benefits from AI-driven magnet controls

Towards uninterrupted MR operations



24/7 e-Alerts connectivity



Power supply management

- Automatic switch to back-up or ramp-down depending on power situation



Cooling management

- Automatic switch to back-up depending on power situation



Personalized magnet controls

- Autonomous controlled ramp-down in case of operational incidents with EasySwitch solutions¹



Emergency ramp-down recovery

- Autonomous recovery after emergency

1. Service contract needed

SmartExam: learns and automates MR planning

Automates planning for 80% of scans

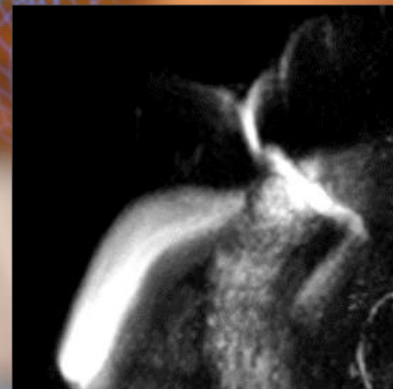
- **Learns** scanning preferences from operator
- Uses 3D model with anatomical landmarks
- **Automatically** positions imaging stack
- E.G. = Brain, Spine, Shoulder, Knee, Breast



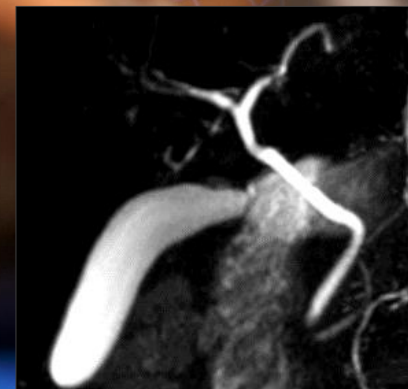
SmartExam is not available to patients with MR Conditional Implants

Improved quality of physiology signal¹

- No operator handling needed
- Continuous presence of respiratory triggering and breath hold monitoring



Respiratory belt



VitalEye

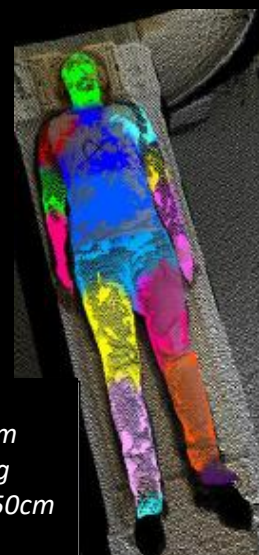
¹ Compared to Philips belt-based signal. Requires an unobstructed line of sight

Contact-less patient sensing 2.0

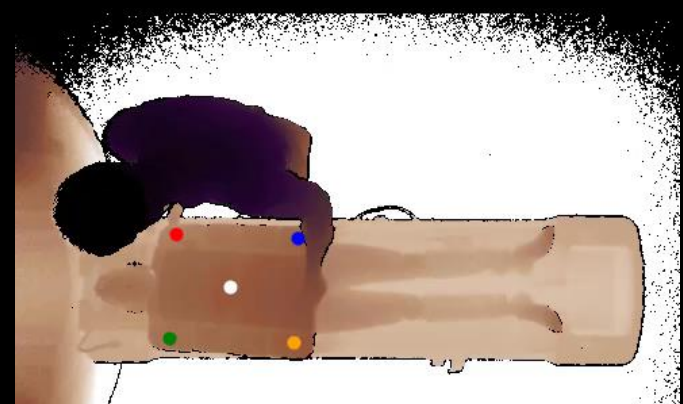
AI 3D camera based patient and coil recognition

Workflow benefits:

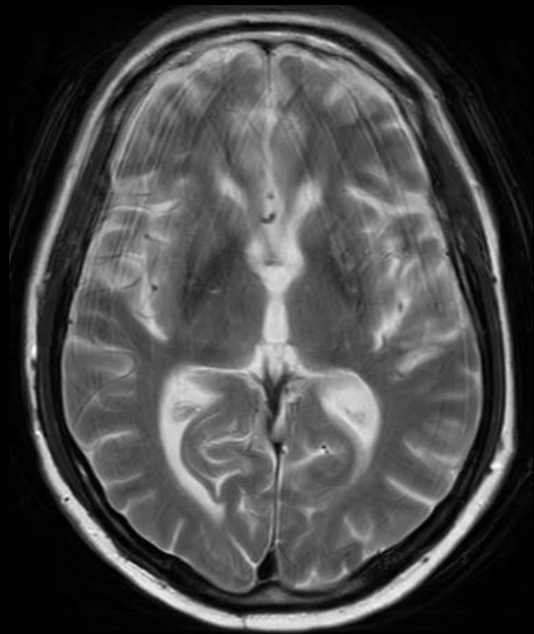
- Patient biometric information
- Guided patient preparation
- Image planning through automatic organ localization
- Patient motion monitoring and motion management



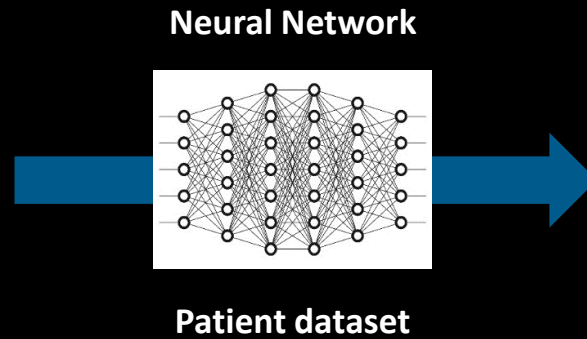
Height: 1.92m
Weight: 84Kg
Max width: 50cm



Deep learning motion correction

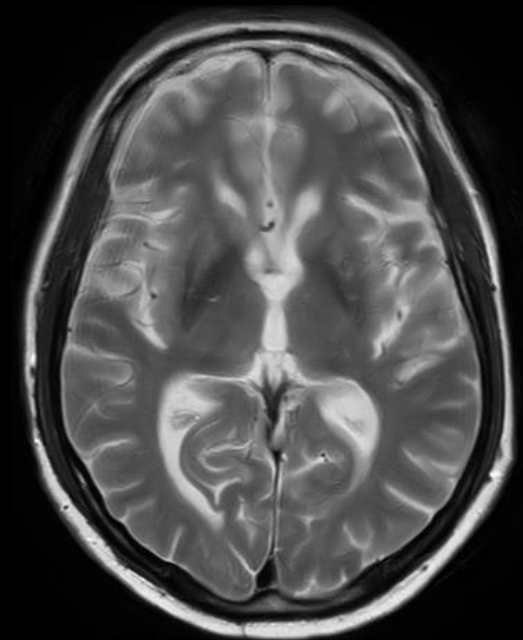


Motion artifacts



Neural Network

Patient dataset



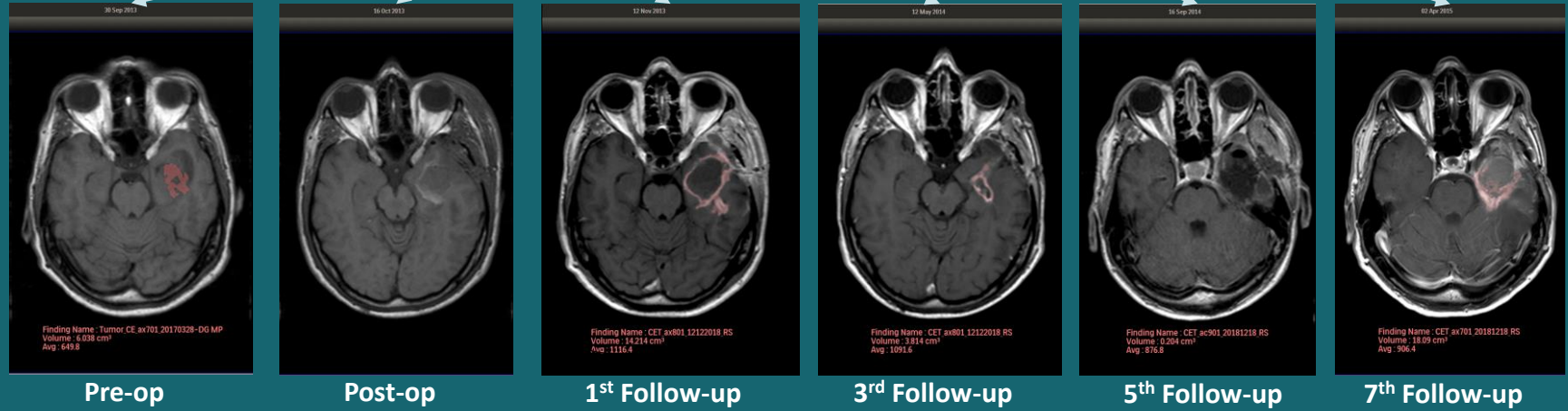
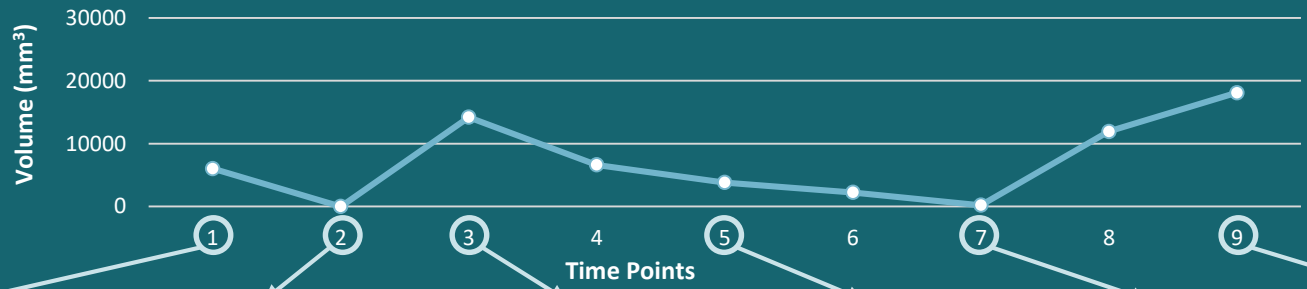
AI-based motion correction

Deep learning motion correction is for research application only and not for clinical use.
Research performed in collaboration with our clinical partners under a research agreement. Image courtesy: Dr. J. Andre,
University of Washington



Automated diagnostic support

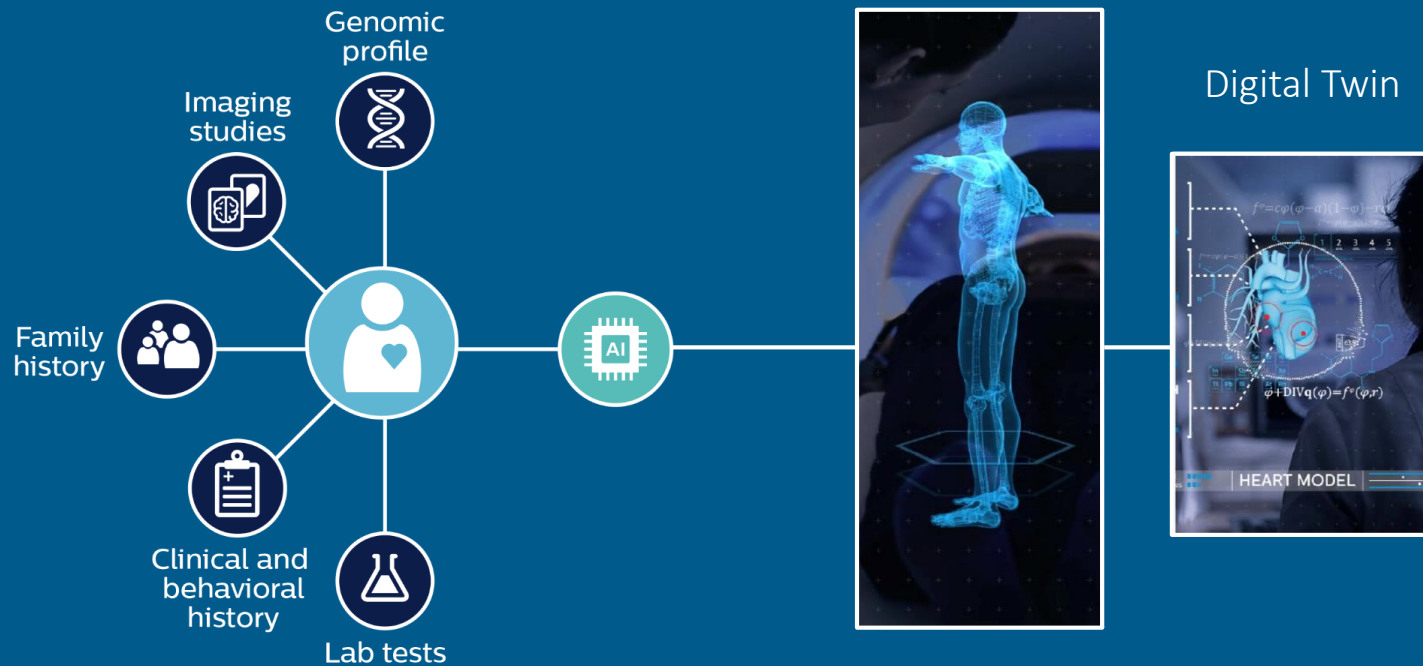
Longitudinal tracking of glioblastoma contrast-enhancing tumor using AI



Longitudinal tracking of glioblastoma contrast-enhancing tumor for research applications only. Not for clinical use.

Driving towards a single patient view

The right diagnosis, at the right time, leading to the right therapy



Your digital twin

Detailed digital models of anatomy, physiology, and pathology

MR. BURKE
MALE // AGE 65 // 1.82M //
DIAGNOSIS: ATRIAL FIBRILLATION

MR SCAN
12.02.2017 6:00 AM

24H ECG
Holtor measurement
23.0

CT SCAN
05.01.2017 2:33

HEALTH WATCH
Heart rate // Blood pressure //
Activity //

MR SCAN
12.02.2017 6:32 PM

24H ECG
Holtor measurement
23.04.2017

CT SCAN
05.01.2017 2:33 PM

HEALTH WATCH
Heart rate // Blood pressure //
Activity // Pulse

MR. BURKE Field Spaces **HEART MODEL**

MALE // AGE 65 // 1.82M //
DIAGNOSIS: ATRIAL FIBRILLATION

$f^\phi = c\phi(\phi - \alpha)(1 - \phi) - r\phi$

$\phi + \text{DIV } q(\phi) = f^\phi(\phi, r)$

1 2 3 4 5

menu



Děkuji vám za pozornost!

Otázky?