

PHILIPS

SmartSpeed

MR Clinical application

**No compromise
image quality and speed
at your fingertips**



Our vision

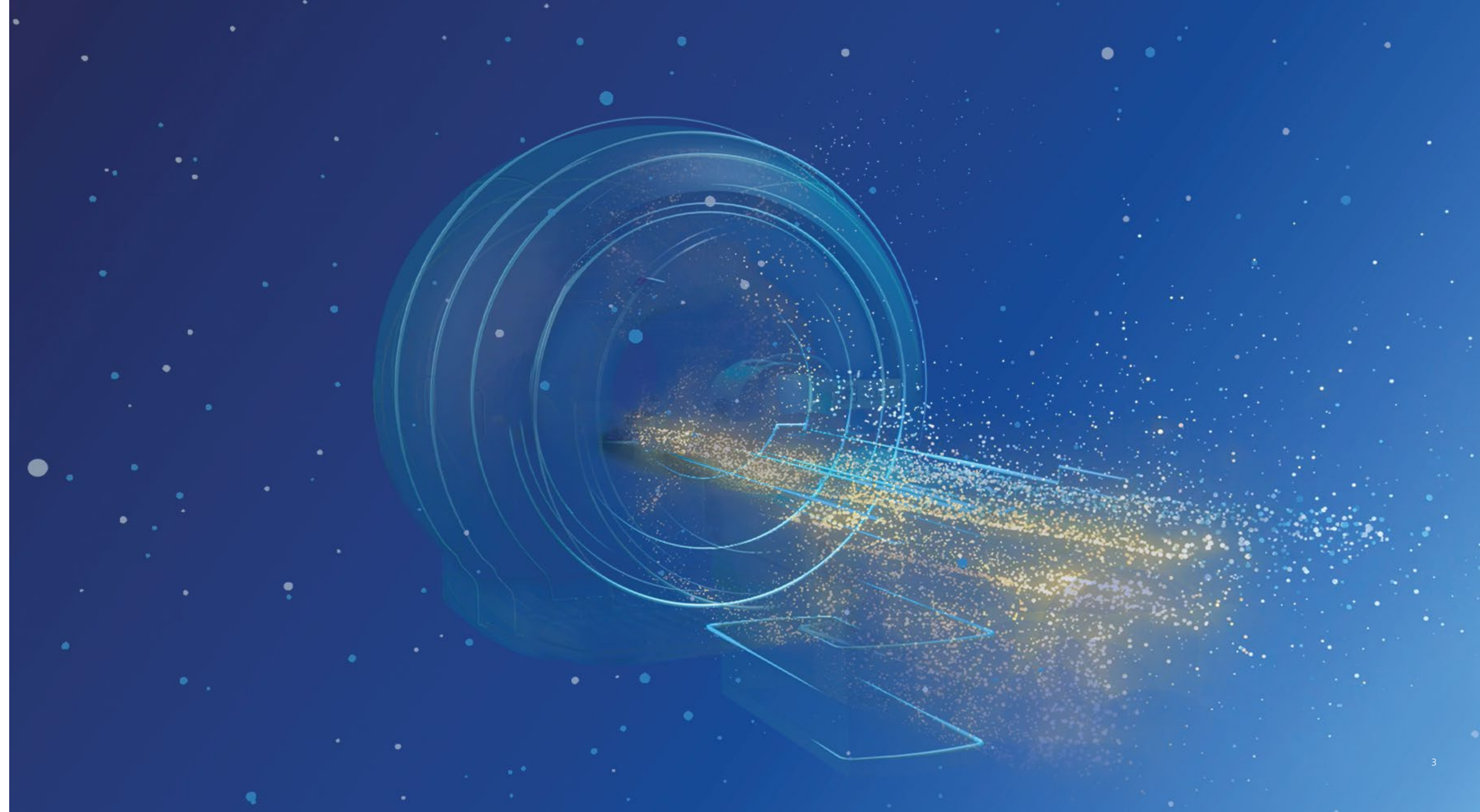
For more than 130 years, we have been creating meaningful innovations to improve people's lives and make the world more sustainable.

We are inspired to continually advance the state of precision diagnosis with customer- and patient-centric solutions that deliver clear care pathways and predictable outcomes.

In MR, our mission is to achieve a fast, fully automated, and personalized exam for every patient, while acting responsibly towards our planet and society.

With Artificial Intelligence*(AI)-driven, smart, connected imaging; smart workflows; and integrated clinical solution, we improve your MR department's productivity, enhance patient and staff experience, and deliver high-quality diagnostic imaging.

This vision inspired Philips SmartSpeed, our breakthrough new MRI application that delivers image and speed without compromise.





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Addressing your most urgent priorities

According to a recent study,¹ most MRI departments share three priorities: increasing productivity, patient satisfaction and referring physician satisfaction.



Productivity



Patient satisfaction



Referring physician satisfaction

These priorities are directly related to three trends. First, the rising clinical utility of MR is increasing the pressure to efficiently scan more patients and to shorten the path from initial scan to final diagnosis. Second, to maintain profit margins in the face of declining reimbursement², MR departments are looking for ways reduce the cost per scan, as well as to reduce rescans, 20% of which are necessitated by motion artifacts.³ Third, the pause in elective procedures due to the Covid-19 pandemic is creating a surge in demand when restrictions are lifted, resulting in an exam backlog in many MR departments.

Solutions that increase productivity address all these challenges. And when productivity rises while preserving diagnostic confidence, both patient satisfaction and referring physician satisfaction increase as well.

Speed without compromises is the answer

We have long recognized that speed that doesn't compromise on image quality is a significant answer to the challenges facing MR departments.

- Speed – particularly when available for a broad range of patients -- enables more exams per day, increasing productivity
- Speed shortens exam length, helping to increase patient satisfaction
- Speed can improve image quality, increasing referring physician satisfaction

Understanding the primacy of speed that doesn't compromise on image quality is what drove us to pioneer SENSE, ds SENSE, Multiband SENSE and more recently our state-of-the-art speed engine, Compressed SENSE.

And now, we are building on our proven technology and leveraging AI to take fast MRI technology to the next level.



Philips SmartSpeed No compromise

Image quality and speed at your fingertips

Fast and high-quality imaging

Philips SmartSpeed delivers image quality and speed without compromise via award-winning AI technology⁴ and a state-of-the-art Compressed SENSE speed engine. It increases imaging speed by up to a **factor of 3***, provides up to **65% greater resolution*** to deliver outstanding image quality, and is compatible with **97% of clinical protocols****. It covers motion imaging, imaging near implants, free-breathing imaging and diffusion-weighted imaging to address the needs of a broad range of patients in various conditions.

* Compared to Philips SENSE

** 97% applicability on average, measured across a sample of sites from Philips MR installed base



Increase Productivity

- Up to **3 times faster** with no loss in image quality*
- Improve workflow



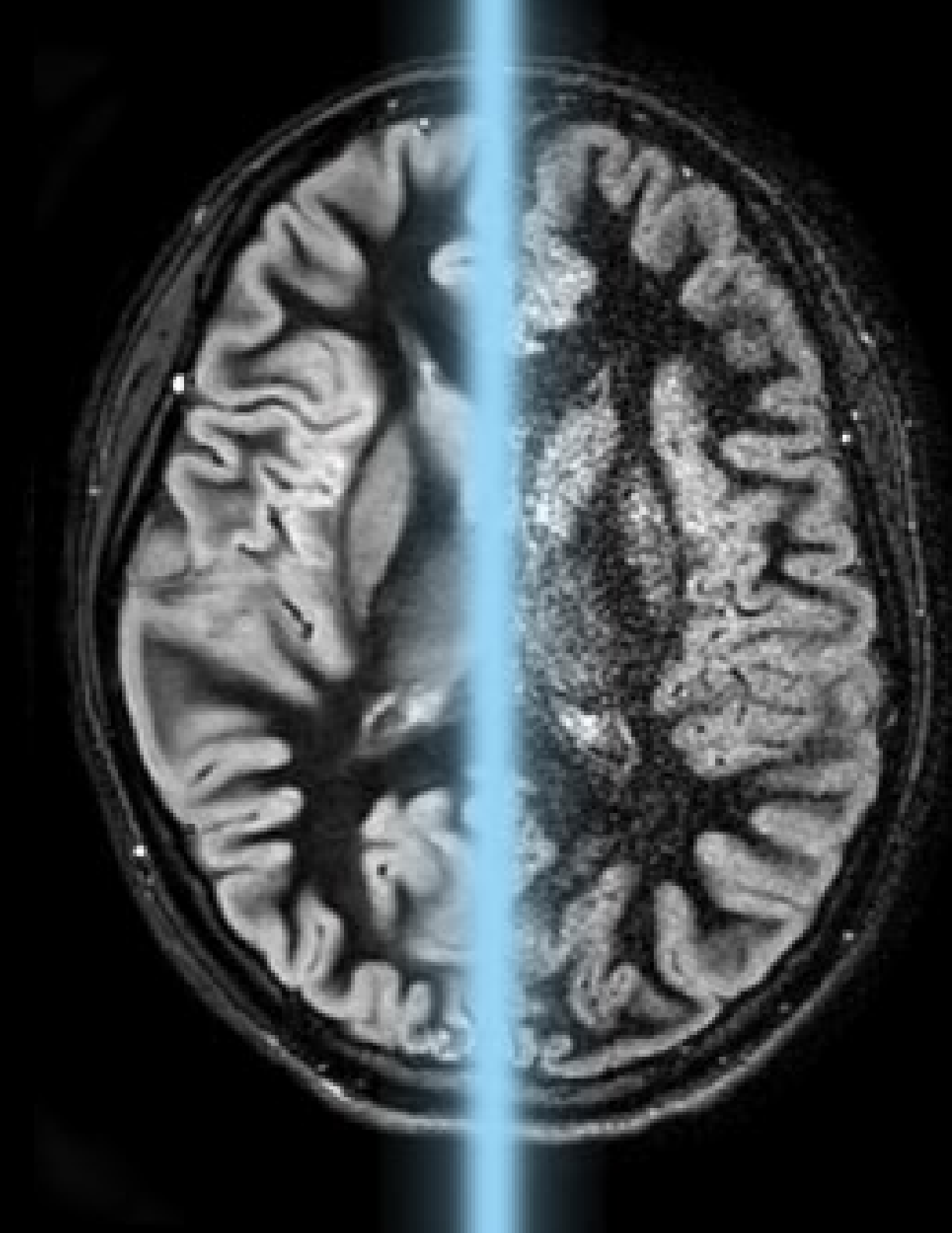
Enhance Diagnostic Confidence

- Up to **65% higher resolution** and improved SNR*
- Add sequences



Increase Patient Accessibility

- **97% compatibility**
 - Motion Free
 - 3D Free-breathing
 - Implant
 - Diffusion
 - Advanced contrasts

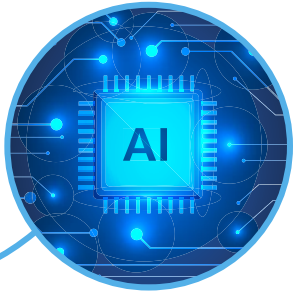


A unique technology based on a leading speed engine and award-winning AI



Compressed SENSE

A speed engine that uses a full balanced k-space sampling approach



Adaptive-CS-Net

Deep learning implemented at the source of MR signal

Philips SmartSpeed enabling technologies

Philips SmartSpeed builds on two key technologies:

- **Compressed SENSE:** A state-of-the-art speed engine that uses a unique, balanced k-space sampling approach to achieve maximum speed while preserving details so that there is no compromise in image quality
- **Adaptive-CS-Net:** An award-winning⁴, deep-learning Artificial Intelligence (AI) reconstruction that has been trained with Compressed SENSE data as input, which is applied at the source of the MR signal to remove noise and preserve details

Together, these technologies can be used to speed up scan time and boost image quality significantly on all anatomical areas and contrasts in 2D and 3D sequences. In fact, the Adaptive-C-SENSE technology used by Philips SmartSpeed so outpaces other acceleration solutions that Philips SmartSpeed won the Fast MRI Challenge hosted by Facebook and New York University.

Improve productivity

At imaging speeds nearly three times faster than parallel imaging, Philips SmartSpeed reduces examination time. It can also improve workflow to support higher throughput and greater productivity.

You can use the time gained to scan more patients and reduce the cost per scan, to add unplanned patients to the schedule and to reduce staff overtime.

“The AI-based Philips SmartSpeed reconstruction is the new benchmark among acceleration techniques for us. It improves Compressed SENSE in all aspects and allows a reduction in scan times with unchanged excellent image quality and diagnostic confidence.”

Dr. Grischa Bratke,
Radiologist - Expert in Musculoskeletal Imaging
University Hospital of Cologne

Up to
3 times faster
scans with no loss
in image quality



Up to **3 times faster** scans with similar image quality

Shorter scan time for 2D spine imaging



Conventional
0.8 x 1.0 x 4 mm
3m 13s



Philips SmartSpeed
1.0 x 1.0 x 4 mm
1m 16s

≈ 2.5 times faster



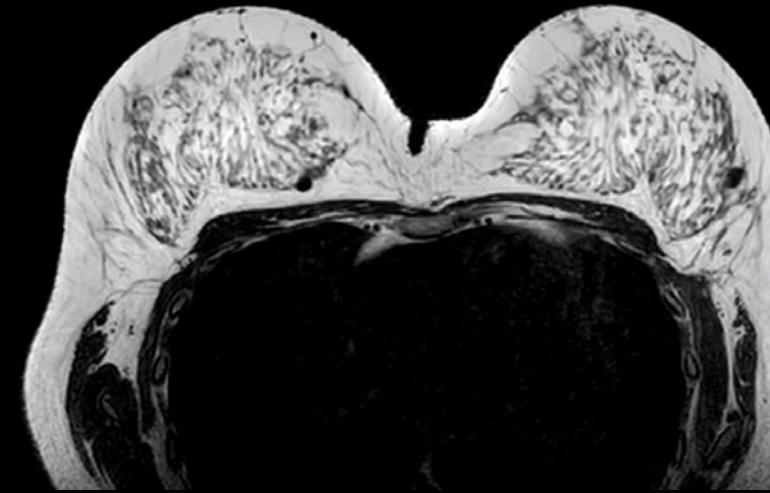
Conventional
0.8 x 1.0 x 4 mm
3m 03s



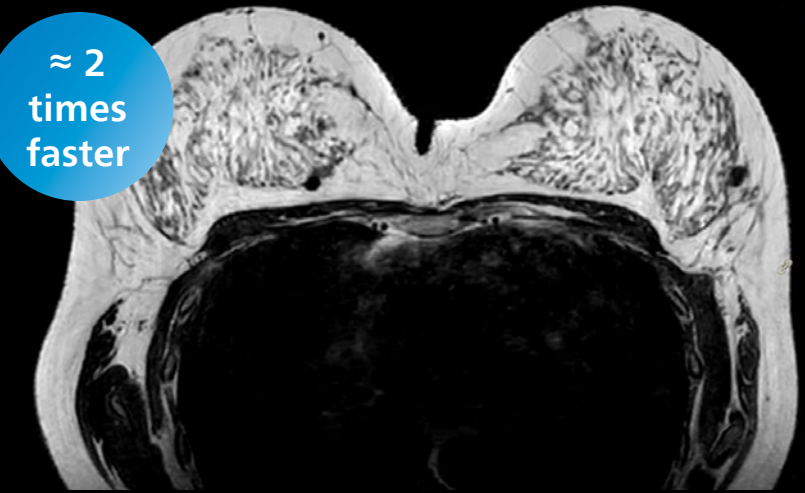
Philips SmartSpeed
1.0 x 1.0 x 4 mm
0m 59s

≈ 3 times faster

Shorter scan slots for 3D breast imaging



Compressed SENSE
3D T2w TSE
1.0 x 1.0 x 2 mm
2m 26s



Philips SmartSpeed
3D T2w TSE
1.0 x 1.0 x 2 mm
1m 26s

≈ 2 times faster

Improve your productivity with reduced exam time without losing image quality

2D T2w TSE	2D T2w FFE	3D T1w TFE	3D BrainView FLAIR	DWI b1000	2D T2w TSE	2D T2w FFE	3D T1w TFE	3D BrainView FLAIR	DWI b1000
2:31 min 0.6 x 0.75 x 5.0 mm	3:32 min 0.9 x 1.1 x 5.0 mm	5:11 min 1.1 x 1.1 x 1.1 mm	4:43 min 1.2 x 1.2 x 1.2 mm	35 secs 1.5 x 2 x 5 mm	1:25 min 0.6 x 0.75 x 5.0 mm	2:00 min 0.9 x 1.1 x 5.0 mm	2:08 min 1.1 x 1.1 x 1.1 mm	2:24 min 1.2 x 1.2 x 1.2 mm	35 secs 1.5 x 2 x 5 mm

Conventional
Exam time: 16m 32s

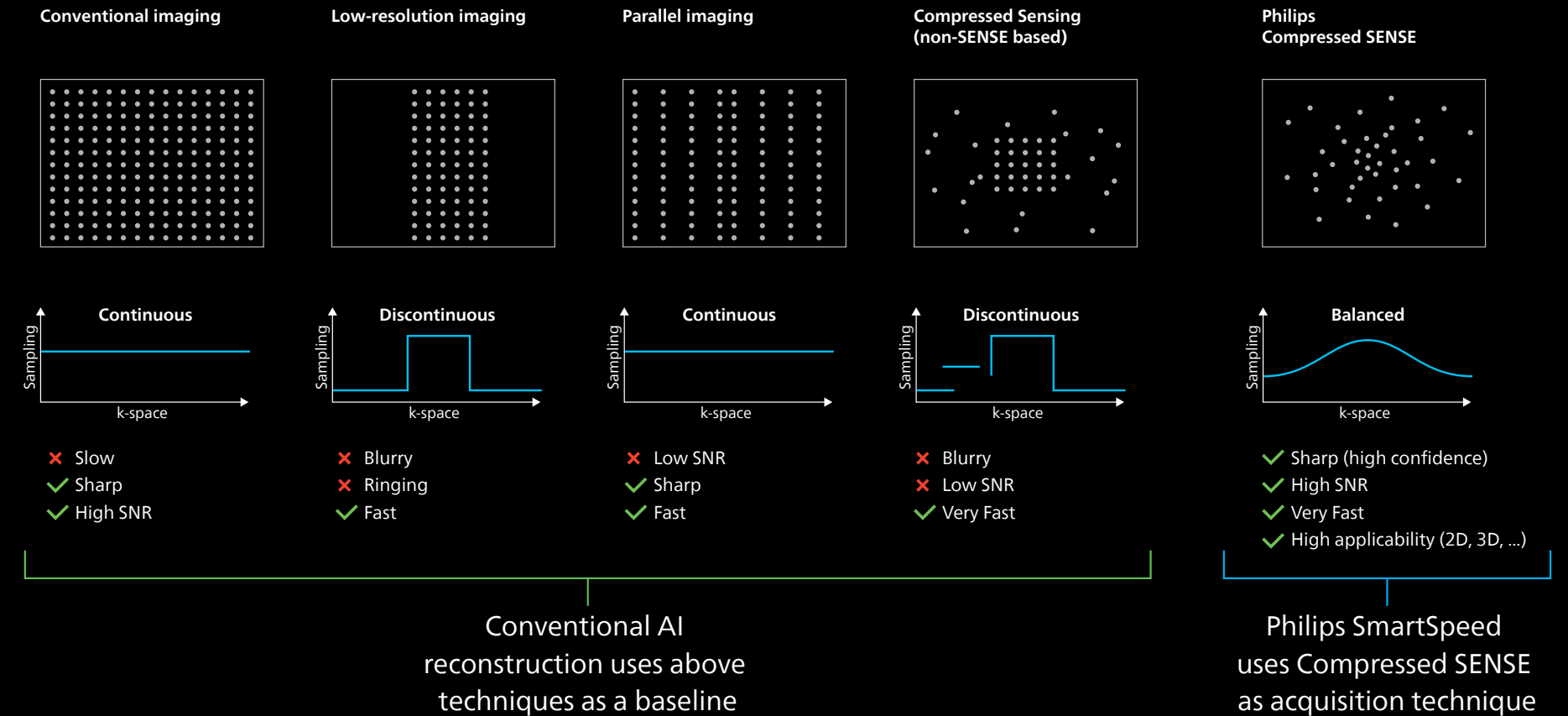
Philips SmartSpeed
Exam time: 8m 32s

Ingenia Ambition 1.5T
Courtesy: Tokyo Metropolitan Police Hospital, Japan. Elition X 3.0T

Maximize information, remove noise, preserve details

In contrast to other industry speed solutions that combine AI with conventional acceleration techniques and apply AI much later in the reconstruction chain, Philips SmartSpeed utilizes Compressed SENSE as a speed engine and applies AI early, to collect just the right amount of data in the shortest amount of time, ensuring fast imaging without compromising image quality.

Why do we use AI reconstruction with Compressed SENSE?



1) IEEE Access, Oct. 2020, An Adaptive Intelligence Algorithm for Undersampled Knee MRI Reconstruction

2) MLMIR, MICCAI, Oct. 2021, Evaluation of the Robustness of Learned MR Image Reconstruction to Systematic Deviations Between Training and Test Data for the Models from the MRI Challenge

Enhance diagnostic confidence

Philips SmartSpeed delivers up to 65% more resolution and high signal-to-noise for exceptional diagnostic confidence.

Because Philips SmartSpeed applies deep learning AI reconstruction at the source – as close as possible to the beginning of the image acquisition process enabling k-space data consistency check for trustworthy AI and minimizing data loss. And less data lost means more information in the reconstructed image. If desired, users can use the time gained with Philips SmartSpeed to add sequences for even more diagnostic information.

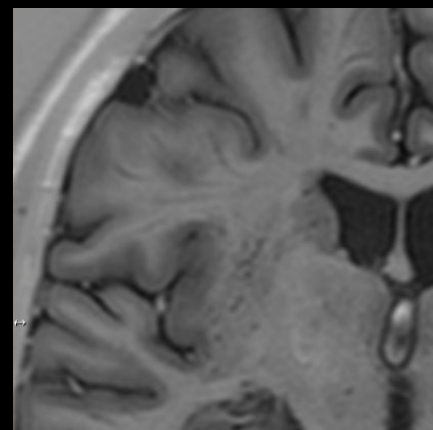
“The excellent denoising capability in Philips SmartSpeed allows imaging with extremely high resolution without increasing the scan time. This is particularly important in depicting small lesions in the vascular system.”

Takashige Yoshida,
RT, Ph.D.
Tokyo Metropolitan Police Hospital

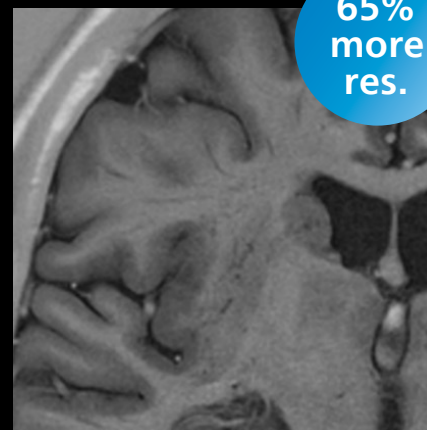
Up to
65% higher
resolution

Up to 65% more resolution

Improve your diagnostic confidence for all anatomies



Conventional
T1w IR
0.8 x 0.9 x 5.0 mm
4m 56s

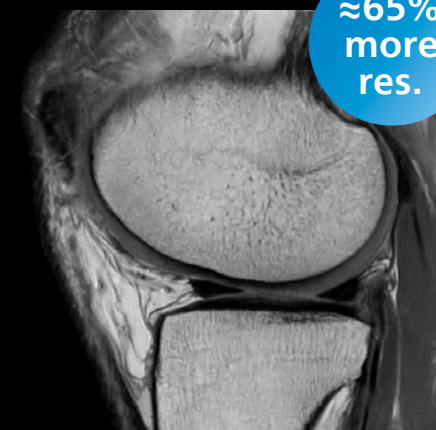


Philips SmartSpeed
T1w IR
0.45 x 0.45 x 5.0 mm
4m 56s

65% more res.



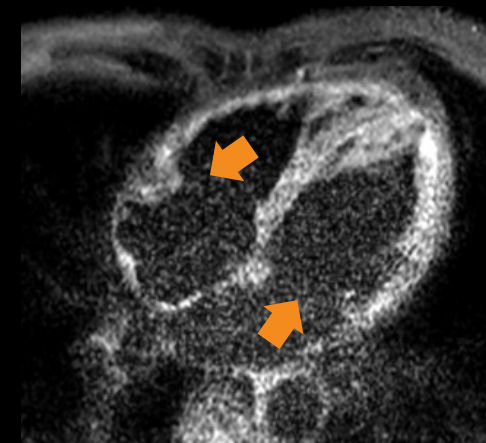
Conventional
PDw TSE
0.45 x 0.47 x 3 mm
3min 10s



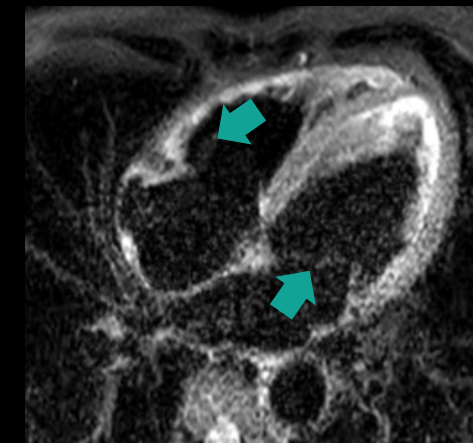
Philips SmartSpeed
PDw TSE
0.34 x 0.34 x 2 mm
3min 10s

≈65% more res.

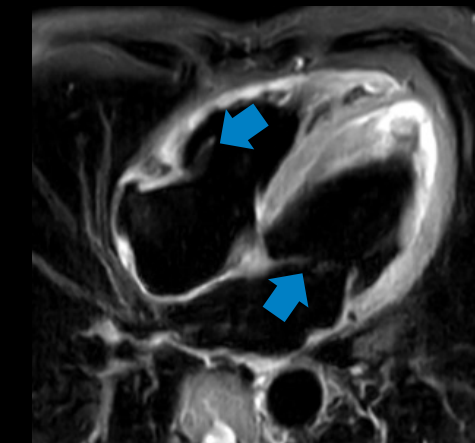
Improve signal to noise ratio for challenging anatomies



Conventional
T2w STIR
1.4 x 1.9 x 8 mm
7.3s
Ingenia Evolution 1.5T



Compressed SENSE
T2w STIR
1.4 x 1.9 x 8 mm
7.3s



Philips SmartSpeed
T2w STIR
1.4 x 1.9 x 8 mm
7.3s



Compressed SENSE
Fracture mFFE
0.98 x 0.98 x 1.0 mm
2min 45s



Philips SmartSpeed
Fracture mFFE
0.98 x 0.98 x 1.0 mm
2min 45s



Conventional
Ax T2w TSE
0.4x0.7x3 mm
4m 32s
Ingenia 3T



Philips SmartSpeed
Ax T2w TSE
0.4x 0.4x3 mm
3m 03s

Increase patient accessibility with 97% applicability

The advantages of SmartSpeed are not confined to a small number of patients. Philips SmartSpeed is compatible with 97% of clinical protocols, so you can use it to address the imaging needs of the vast majority of your patients. It has been trained on an extensive set of data so that it can be used not only with 2D sequences, but also with 3D sequences, as well as for all anatomies and a wide variety of advanced contrasts such as DIXON for fat-free imaging, angiography, SWI and even quantitative imaging such as T1- or T2-mapping. Philips SmartSpeed is also compatible with non-cartesian imaging for uncooperative patients or challenging anatomies that are sensitive to motion.

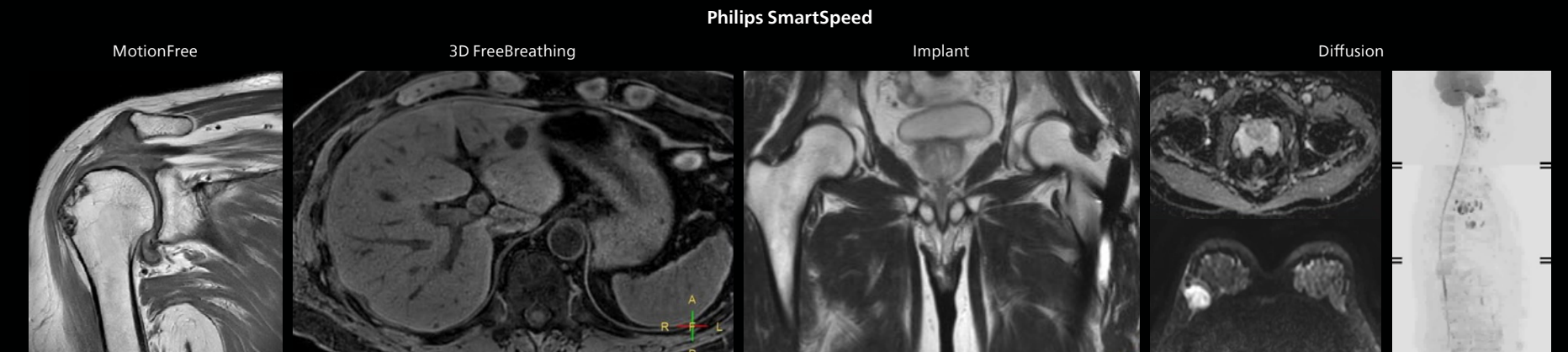
A comfortable exam experience

Philips SmartSpeed's speed increases MR accessibility for patients who are stressed, anxious or in pain. Because it shortens exams and provides first-time-right scans regardless of patient condition, patients spend less time in the scanner. It also helps to reduce breath holds and supports free-breathing exams to create a more comfortable exam experience. In addition, technologists can free up more time for patient interaction, ultimately making the MRI exam experience better for patients.

"Philips SmartSpeed MotionFree is the best technique for routine clinical examinations because it is robust, really motion-free and delivers excellent imaging quality with faster acquisition time. We do not worry about re-scans or extra scans due to patients' motion."

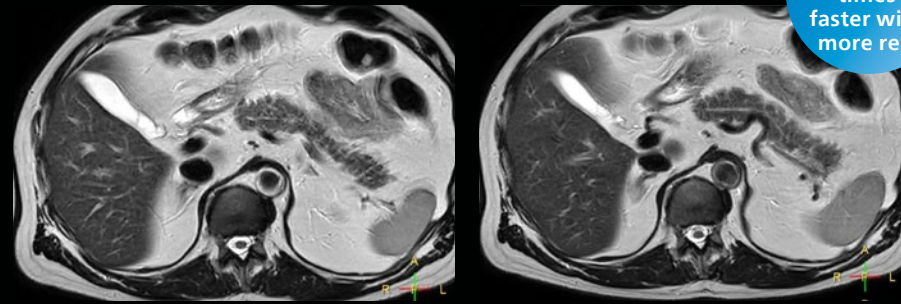
Prof. Mamoru Niitsu,
Saitama Medical University

Philips SmartSpeed's enabling technologies for patient accessibility



- **SmartSpeed MotionFree** utilizes dedicated imaging techniques to acquire ultra-fast, motion-free images even when patients are in pain and struggling to hold still
- **SmartSpeed Implant** utilizes dedicated imaging techniques to acquire ultra-fast, artifact-free images even in the presence of implants
- **SmartSpeed 3D Free Breathing** helps to acquire ultra-fast, high-quality imaging with reduced artifacts
- **SmartSpeed Diffusion** utilizes dedicated imaging techniques to acquire ultra-fast, high-quality diffusion images, especially for oncology patients

Ultra-fast and high-quality imaging with Philips SmartSpeed MotionFree

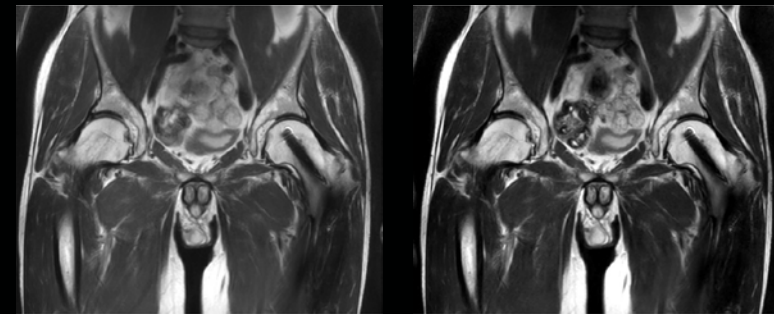


Conventional
Motion-free (Multivane XD)
2m 33s

Philips SmartSpeed
Motion-free
1m 39s

~2.5%
times
faster with
more res.

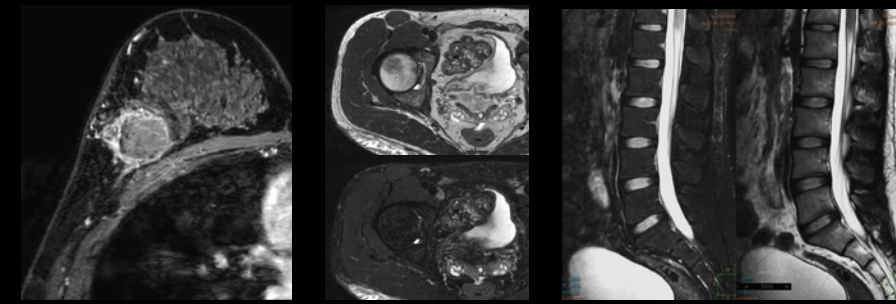
Fast imaging in the presence of metallic implants with Philips SmartSpeed Implant



Conventional
T2w OMAR XD
1.67x1.86x3.5mm
6m 42s

Philips SmartSpeed
T2w SmartSpeed Implant
1.67x1.86x3.5mm
4m 30s

Fast fat-free imaging

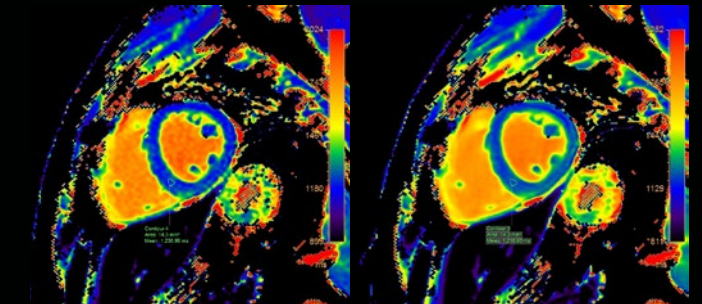


Philips SmartSpeed
3D mDIXON T1w FFE
1m 57s

Philips SmartSpeed
2D mDIXON T2w TSE
3m 38s

Philips SmartSpeed
2D mDIXON T2w TSE
4m 10s

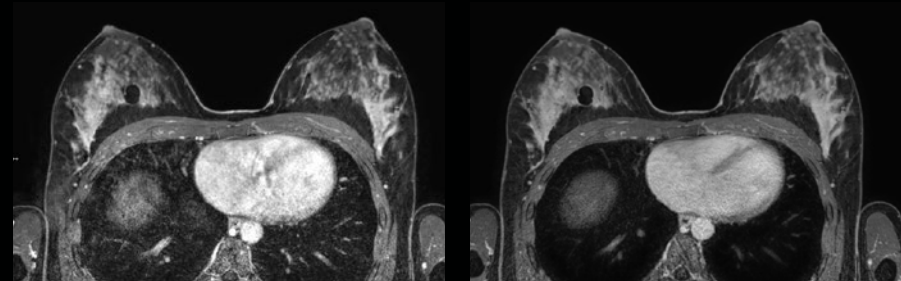
Quantitative imaging, T1 mapping



Conventional acceleration
T1 Mapping
2x2x10mm
11s

Philips SmartSpeed
T1 Mapping
2x2x10mm
11s

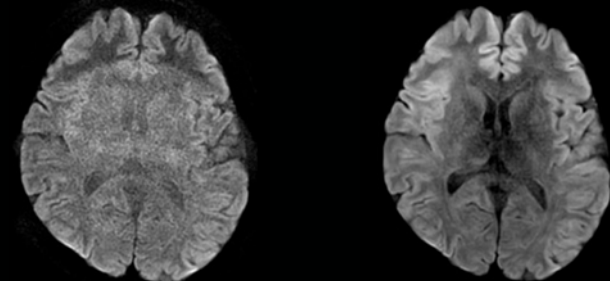
Fewer artifacts with Philips SmartSpeed 3D FreeBreathing



Conventional
3D T1 mDixon
2m 33s

Philips SmartSpeed
3D FreeBreathing T1 mDixon
1m 39s

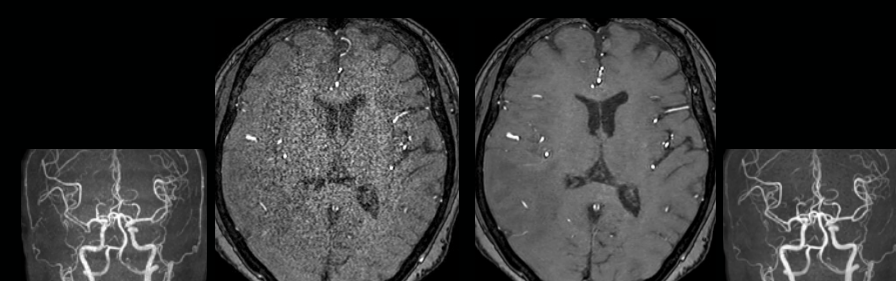
Higher image quality with Philips SmartSpeed Diffusion at the same acceleration factor



Conventional DWI

Philips SmartSpeed Diffusion

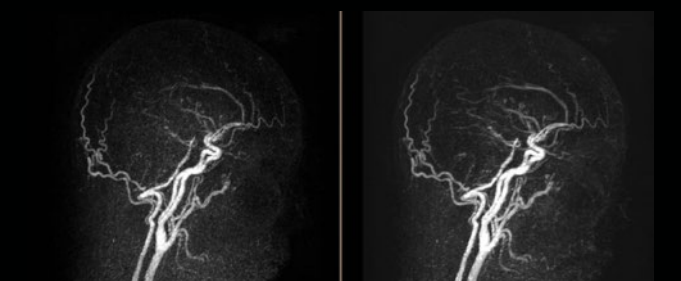
Angiography



Conventional
3D TOF
0.5 x 0.8 x 1.1 mm
3m 00s

Philips SmartSpeed
3D TOF
0.5 x 0.8 x 1.1 mm
3m 11s

Better image quality for 4D Angiography with Gadolinium



Compressed SENSE
4D Trak XD
1.0 x 0.9 x 1.0 mm
2.6s

Philips SmartSpeed
4D Trak XD
1.0 x 0.9 x 1.0 mm
2.6s

Philips SmartSpeed packages

Philips SmartSpeed is available in multiple clinical packages, so you can choose the right fit for your patient population. With the **Essential Package** you can experience the award-winning AI technology for brain and spine and with the **Plus Package** and above, you'll also experience the benefits of increased productivity, enhanced diagnostic confidence and increased patient accessibility.

	Essential	Plus	Pro	Premium	
Package	SmartSpeed Essential	SmartSpeed Plus	SmartSpeed Pro Body	SmartSpeed Pro Cardiac	SmartSpeed Premium
Benefits	SmartSpeed Essential powered by AI brings greater speed and image quality to brain and spine imaging.	SmartSpeed Plus brings greater speed and image quality to MSK and neuro/spine imaging via a unique speed engine and AI technology at the source, plus provides SmartSpeed MotionFree, SmartSpeed Implant, and SmartSpeed DWI for robust imaging. Enjoy all the benefits of fast, high quality and robust imaging for Neuro & MSK.	SmartSpeed Pro Body brings greater speed and image quality to body, neuro/spine and MSK imaging via a unique speed engine and AI technology at the source. In addition to robust imaging solutions provided by SmartSpeed Plus, SmartSpeed Pro Body also includes options designed specifically for the challenges of body imaging: SmartSpeed MotionFree Body, SmartSpeed 3D FreeBreathing, and SmartSpeed DWI Body. Enjoy all the benefits of fast, high quality and robust imaging for Body, Neuro & MSK.	SmartSpeed Pro Cardiac brings greater speed and image quality to cardiac, neuro/spine and MSK imaging, in addition to robust imaging solutions SmartSpeed MotionFree, SmartSpeed Implant, and SmartSpeed DWI options. Enjoy all the benefits of fast, high quality and robust imaging for Cardiac, Neuro & MSK.	SmartSpeed Premium delivers the advantages of SmartSpeed for cardiac, body, neuro/spine and MSK imaging. This premium package brings you the full complement of SmartSpeed technology powered by AI to elevate your MR imaging to the highest level.

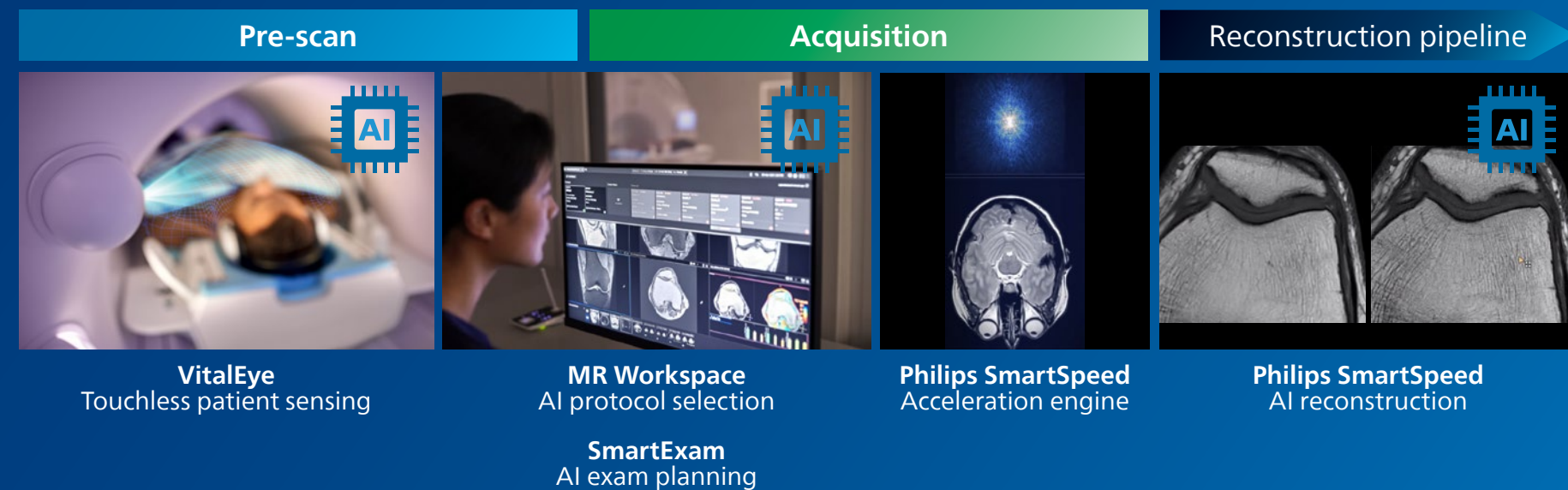
Choose the Philips SmartSpeed package that meets your clinical needs

	Essential	Plus	Pro	Premium	
Package	SmartSpeed Essential	SmartSpeed Plus	SmartSpeed Pro Body	SmartSpeed Pro Cardiac	SmartSpeed Premium
Neuro/Spine	X	X	X	X	X
MSK		X	X	X	X
Body			X		X
Cardiac				X	X
MotionFree		X	X	X	X
MotionFree Body			X		X
3D FreeBreathing			X		X
Implant		X	X	X	X
DWI		X	X	X	X
DWI Body			X		X

AI throughout MR workflow – from pre-scanning to reconstruction

Philips SmartSpeed is available via MR Workspace, our industry-unique control room solution that empowers your team to drive departmental efficiency and predictability while improving their experience. It helps to simplify the path from image acquisition to diagnosis by providing the technologist with integrated AI protocol selection. With the combination of Philips SmartSpeed and MR Workspace, VitalEye touchless patient sensing and SmartExam exam planning you can utilize AI throughout the MR workflow* – from pre-scanning to reconstruction – to increase productivity and enable staff to focus more on their patients.

AI throughout MR workflow – from pre-scanning to reconstruction



References

1. MI&A Insights Report MR. Q1. 2021.
2. <https://coder.aapc.com/cpt-codes/76498>. Accessed October 11, 2019
3. JACR, July 2015, Vol. 12:7, pp. 689-605
4. Adaptive-C-SENSE-Net technology is the winner of Fast MRI Challenge hosted by Facebook AI research and New York Langone Health
5. Kantar PEX in Imaging Research, Oct 2017



SmartSpeed is not yet CE marked, and not yet available for delivery.

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Please visit www.philips.com
healthcare@philips.com