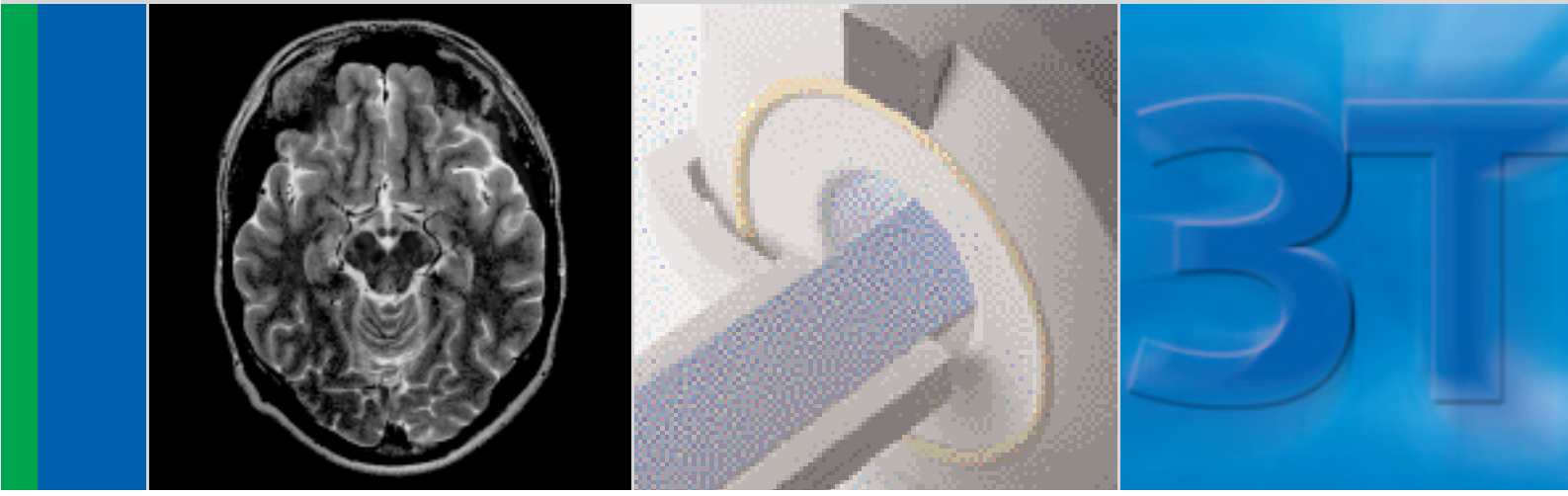
3T Unlimited



iPAT on MAGNETOM Allegra

The Importance of iPAT at 3T

SIEMENS

medical

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The Importance of iPAT at 3T

The rise of 3T MR imaging

Ultra High Field MR (3T) has flourished during recent years. The advantages of 3T field strength have led to the successful introduction of MAGNETOM® Allegra. MAGNETOM Allegra is the first and only machine providing the best of MR for brain applications: 3T field strength, extremely compact magnet, easy to site design and ultra-fast gradients (slew rate: 400 mT/m/ms).

Indeed, 3T field strength offers many advantages such as twice the signal-to noise ratio (SNR) of 1.5T field strength or increased sensitivity to T2* effects for better functional MRI studies. These benefits have boosted the interest for 3T MR systems, especially in brain applications.

However, some challenges still remain. Susceptibility effects and consequently image distortions are more pronounced compared to 1.5T. The Specific Absorption Rate (SAR – or the energy deposited in the body by the radio frequency transmission) increases by factor of 4 when going from 1.5T to 3T.

Siemens overcomes these challenges using integrated Parallel Acquisition Techniques (iPAT). iPAT describes imaging strategies that use multiple element coils to receive MR signals in parallel and therefore speed up acquisition time or increase spatial resolution. MAGNETOM Allegra, similarly to other members of the MAGNETOM family, supports iPAT.

How does iPAT serve 3T applications?

1. Overcome susceptibility effects and blurring

iPAT in single-shot techniques reduces blurring and minimizes susceptibility artifacts – which are typically more pronounced at 3T than 1.5T. While already compensating for these effects using the ultra fast gradient performance of the MAGNETOM Allegra, iPAT further overcomes susceptibility-induced geometric distortions. This is particularly useful in echo planar imaging-based techniques.

2. Keep SAR low

SAR increases by a factor of 4, when going from 1.5T to 3T. This means that SAR limits – set for patient safety – are more rapidly reached. iPAT reduces the number of RF excitation pulses and therefore reduces SAR. Note that iPAT is only one component of the unique Siemens 3TCare initiative, which consists of developing new methods to reduce SAR.

3. Utilize the extra 3T SNR to minimize acquisition time or maximize resolution

Because SNR at 3T is twice compared to 1.5T, the signal loss associated with iPAT – proportional to the square root of the acceleration factor – is less critical at 3T. This means you can use higher iPAT factors to speed up your acquisitions or increase image resolution.

For example, iPAT factor of 2 allows acquiring 27 64x64 slices per second. Alternatively, iPAT factor of 2 allows matrix sizes of 96x96 in a time that conventional EPI techniques need for the reduced matrix sizes of 64x64. The increased resolution allows more specific interpretation and diagnosis due to better image quality.

MAGNETOM Allegra RF configuration

MAGNETOM Allegra comes with 1 or 4 (option with syngo MR 2003A) fast – 1 MHz bandwidth – fully equivalent iPAT-compatible channels.

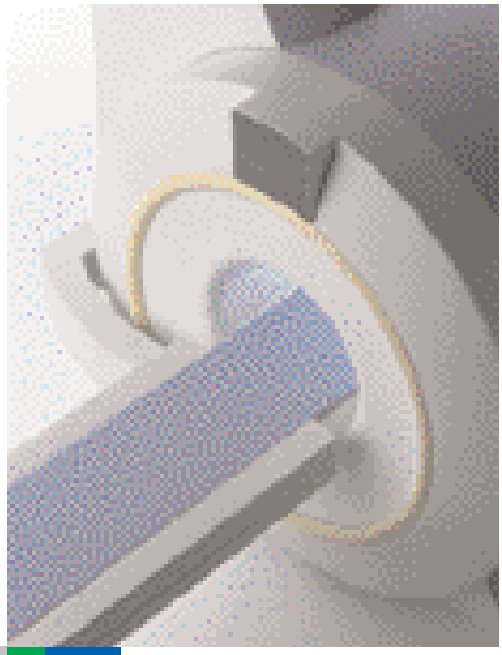
MAGNETOM Allegra iPAT coil

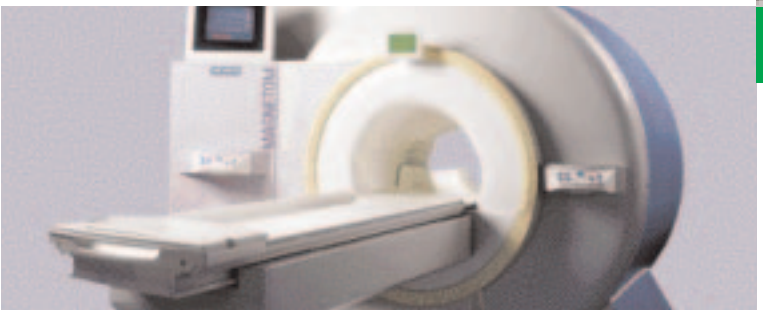
A 4-channel transmit/receive iPAT-compatible head coil is available with *syngo* MR 2003A on MAGNETOM Allegra. This coil enables running iPAT sequences with acceleration factors of 2.

MAGNETOM Allegra to take advantage of iPAT benefits at 3T

iPAT and 3T provides best image quality for brain imaging in regions affected by susceptibility effects. Secondly iPAT is an alternative to reduce deposited energy for SAR intensive sequences. It offers also an alternative to trade-off the extra 3T SNR for acquisition speed.

MAGNETOM Allegra with its very fast 400 T/m/s gradients and iPAT, is the fastest MR scanner on the market.





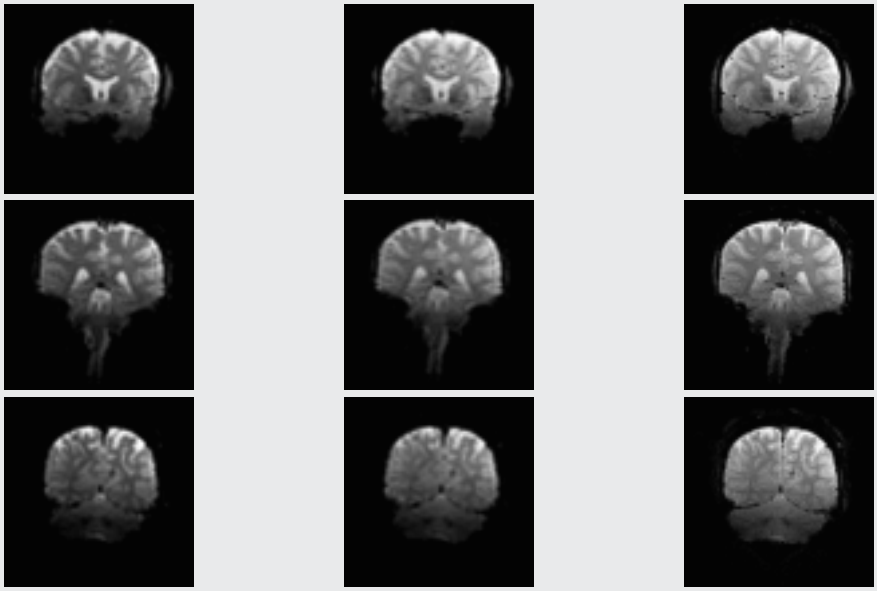
[Figure 1]

Single-shot EPI without and with iPAT, in coronal orientation.
Constant TE = 30 ms for optimal BOLD sensitivity at 3T.
4-channels head array, iPAT-compatible transmit/receive
iPAT can be used to increase spatial resolution, i.e. the specificy of fMRI experiments without an increase of the temporal resolution. Image quality improvements in regions prone to susceptibility artifacts are evident.

Conventional EPI
(matrix size 64x64),
22 slices/sec

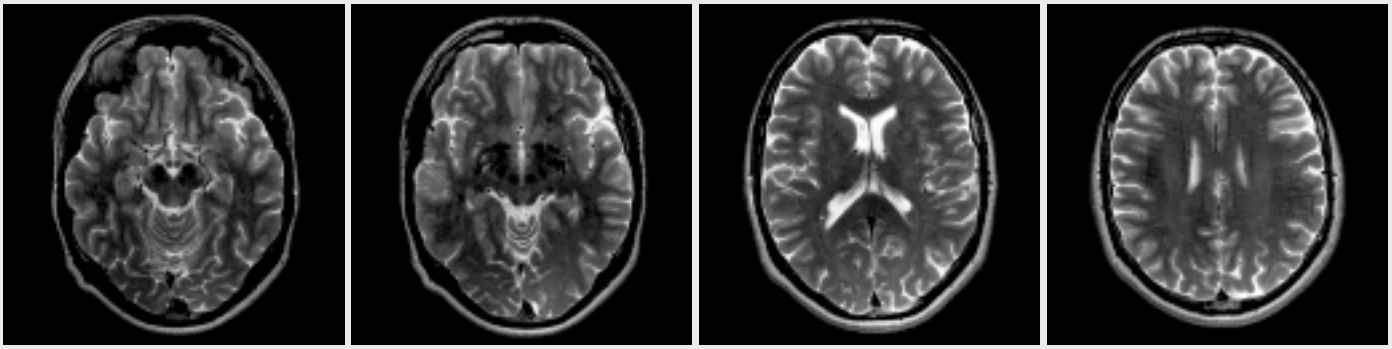
EPI with iPAT 2
EPI (matrix size 64x64),
27 slices/sec

EPI with iPAT 2
EPI (matrix size 128x128),
16 slices/sec

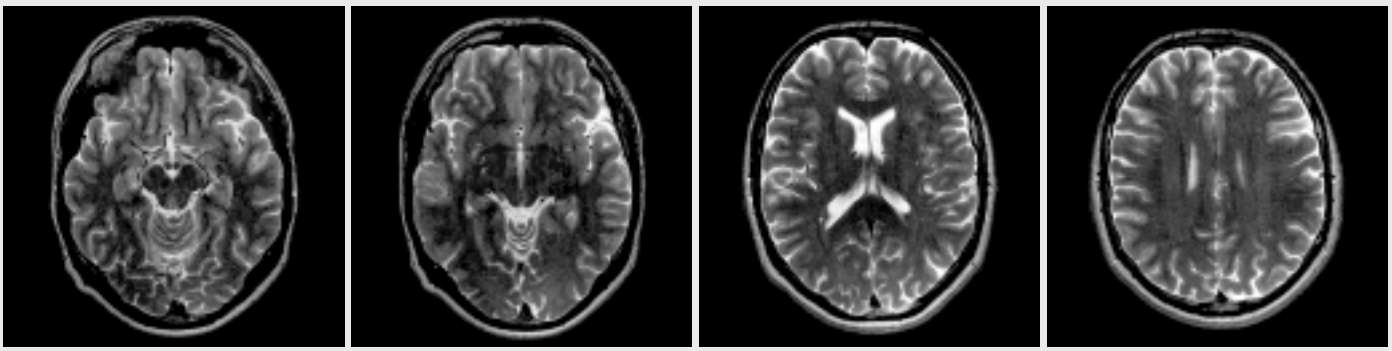


[Figure 2]

2D TSE without and with iPAT. TR/TE 5480/107 ms, 220x220 mm, 254x512 matrix, SL 3 mm
4-channels head array, iPAT-compatible transmit/receive



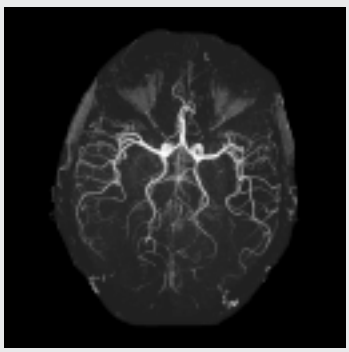
Conventional high resolution TSE (total scan time 1:44 min)



High resolution TSE with iPAT 2 (total scan time 1:00 min)

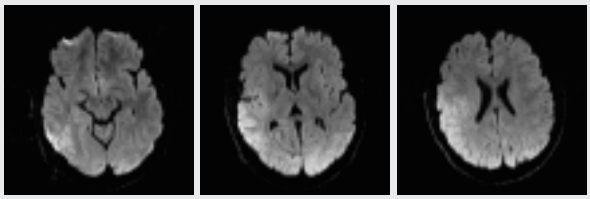
[Figure 3]

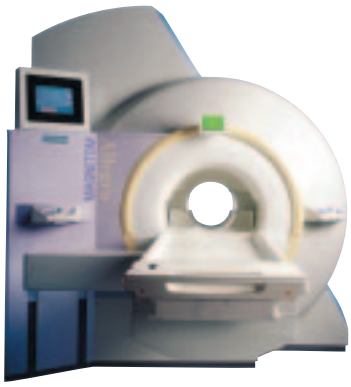
High resolution 3D ToF with iPAT 2
TR/TE 42/6.2 ms, 704 matrix, TA 6:12 min
4-channels head array, iPAT-compatible transmit/receive



[Figure 4]

High resolution single shot diffusion EPI with iPAT 2
b-value of 1000 mm²/s, TE 77 ms, 256x384 matrix
4-channels head array, iPAT-compatible transmit/receive





MAGNETOM Allegra[UHF Class]
3T Dedicated

The ultimate brain machine

The fastest MR system in the most compact design for brain imaging and spectroscopy.

Fastest gradients in the industry: 400 T/m/s

The most compact 3T MR system available

Cost-efficient siting: your 3T system can be installed in a 1.5T suite.

High patient-friendliness with a total length of only 1.25 m

The fastest MR system in the industry

Outstanding image quality and speed, thanks to the Siemens gradient and gradient amplifier technology combined with integrated Parallel Acquisition Techniques (iPAT).

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