Getting the Most out of the Boost Gradient Mode

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What is the Boost Gradient Mode?

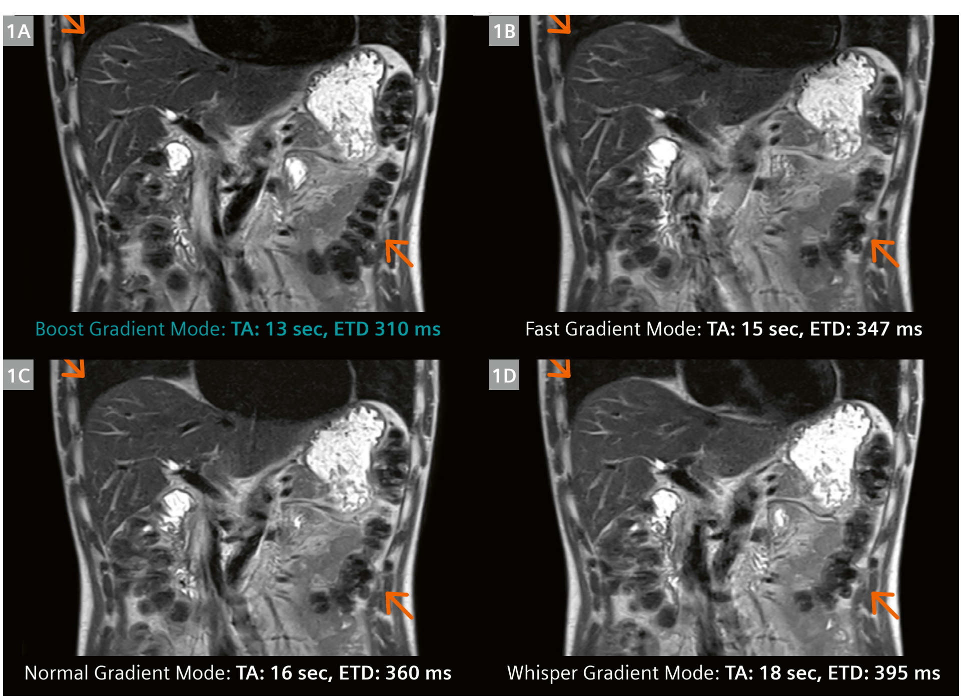
Effective application of gradient magnetic fields plays an important role in obtaining high image quality. The Boost Gradient Mode is a unique function that enables magnetic resonance imaging (MRI) systems to use the maximum gradient strength, allowing further optimization of imaging parameters. The function was first implemented on the 0.55T MAGNETOM Free. Platform and is now also available on the 1.5T MAGNETOM Flow. Platform. This article introduces clinical use cases and practical tips for leveraging the Boost Gradient Mode in routine examinations.

Benefits and considerations in clinical protocols

One of the key benefits that the Boost Gradient Mode offers when setting imaging parameters is the ability to shorten echo spacing. Reducing echo spacing does not inherently shorten acquisition time, but it does provide additional benefits that include improved signal-to-noise ratio (SNR) and reduced blurring and banding artifacts. Specifically, the following clinical cases demonstrate the practical impact of the Boost Gradient Mode across multiple anatomical regions.

Case 1: Liver HASTE with breath-hold

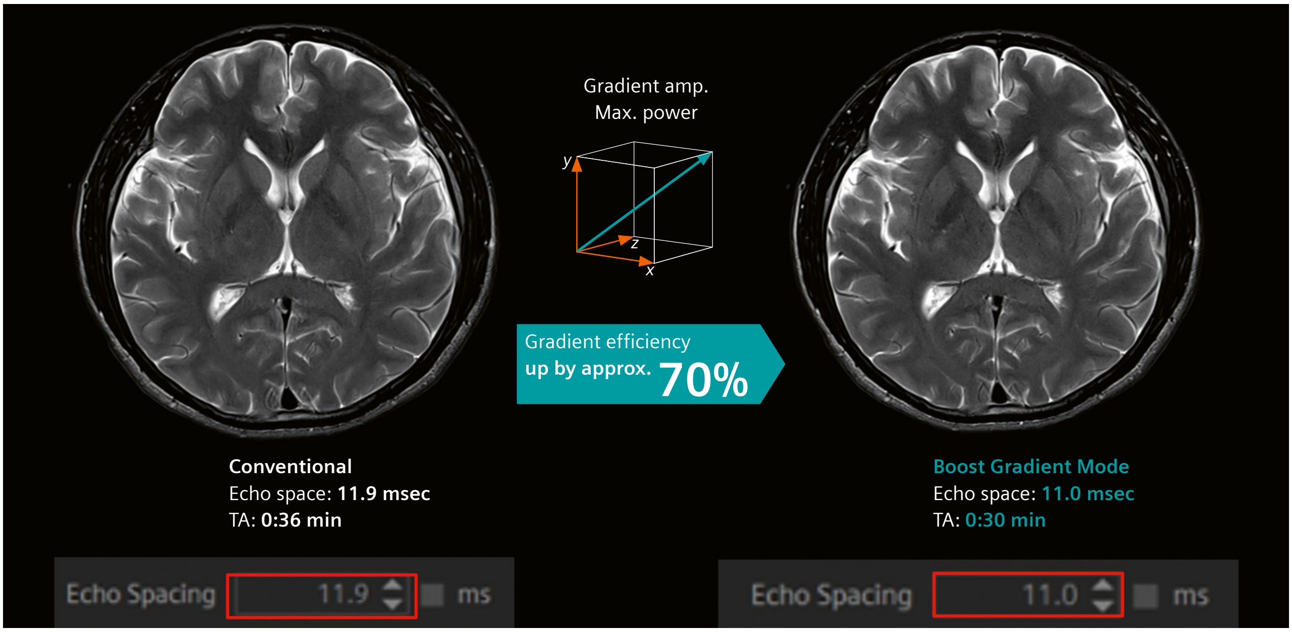
The half-Fourier single-shot turbo spin-echo (HASTE) sequence is relatively robust against motion. This makes it a beneficial sequence for body regions that are susceptible to motion, such as the abdomen and pelvis. However, as shown below, longer echo train duration (ETD) is generally more prone to blurring and deterioration in the depiction of fine organ structures. The Boost Gradient Mode (Fig. 1A) reduced ETD by 85 ms, improving visualization of intrahepatic vessels and intestinal wall structures while reducing breath-hold time by approximately 5 seconds compared to the Whisper Gradient Mode (Fig. 1D).



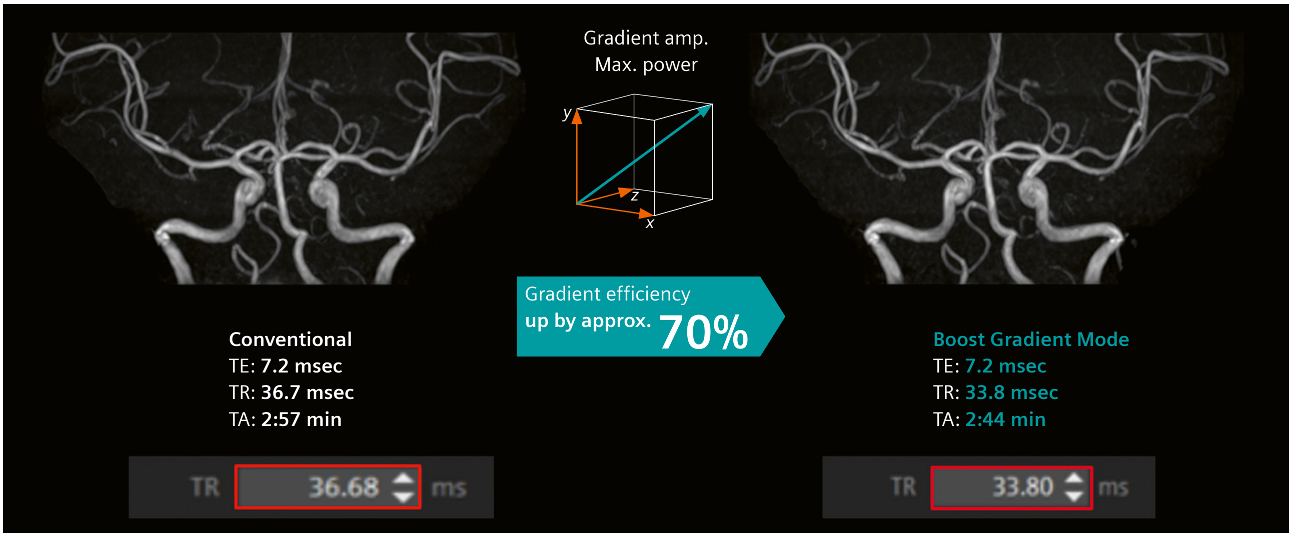
1 Liver HASTE with breath-hold: less blurring (arrows) with the Boost Gradient Mode **(1A)**.

Case 2: Brain T2W TSE and time-of-flight MR angiography

In turbo spin-echo (TSE) imaging, using the Boost Gradient Mode and shortening the echo spacing makes it possible to increase the turbo factor (TF) up to equivalent echo train duration (ETD), and the imaging time can be shortened (Fig. 2). In time-of-flight (TOF) MR angiography (MRA), shorter echo spacing also enables a reduction in repetition time (TR), leading to shorter scan times (Fig. 3). In both applications, the key point is that imaging time can be reduced while maintaining a comparable level of image quality and without sacrificing parameters related to spatial resolution or the SNR.



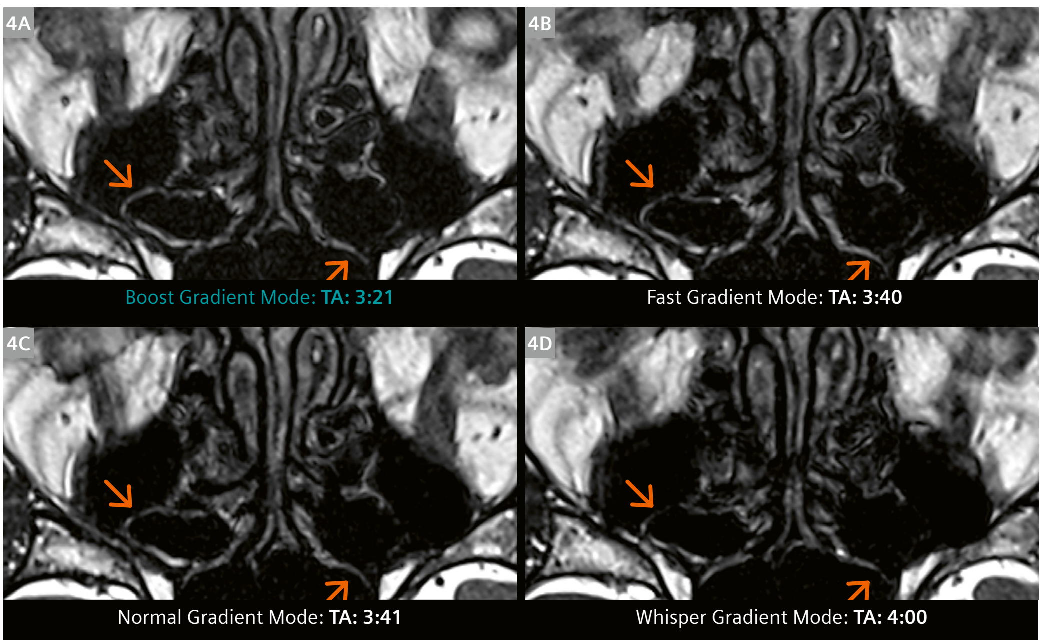
2 Brain T2-weighted TSE.



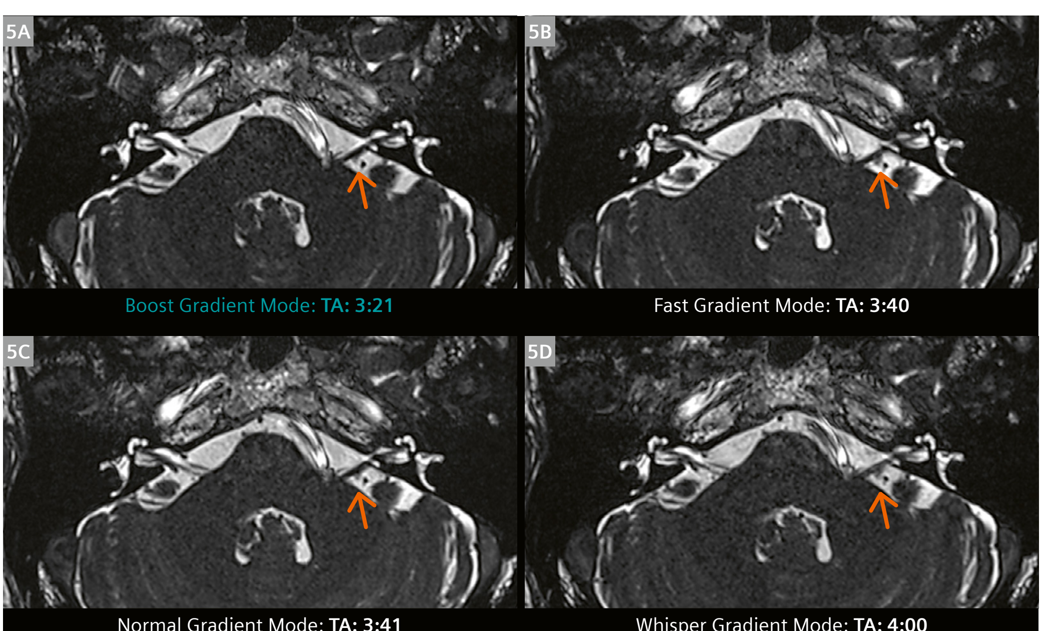
3 Brain TOF MR angiography.

Case 3: 3D CISS imaging of the internal auditory canal

Constructive interference in steady state (CISS) is a type of steady-state free precession (SSFP) sequence and has been widely used for MR cistenography. Generally speaking, SSFP sequences are inherently sensitive to banding artifacts caused by static magnetic field inhomogeneities. Longer echo spacing is more prone to cause banding artifacts and signal loss because it is harder to maintain static magnetic field homogeneities due to the signal dispersion during longer acquisition. With the Boost Gradient Mode (Fig. 4A), we were able to shorten the echo time (TE) and the TR, thereby reducing the signal loss as indicated by the arrows. The result shows that imaging time was reduced by approximately 40 seconds compared to the Whisper Gradient Mode (Fig. 4D). In addition, improved nerve delineation and reduced blurring were observed in the inner ear region (Fig. 5).



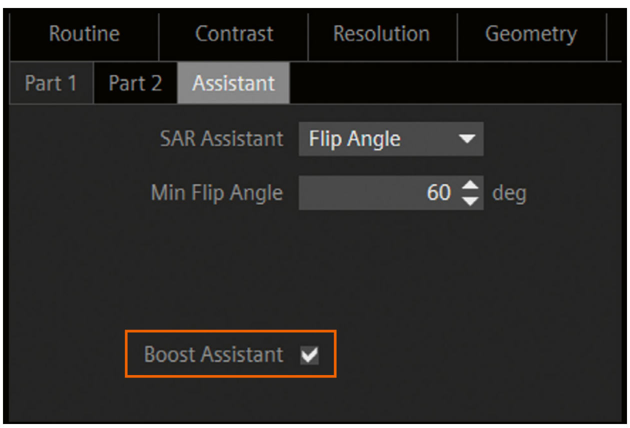
4 3D CISS of the internal auditory canal on (IAC): fewer banding artifacts (arrows) with the Boost Gradient Mode **(4A)**.



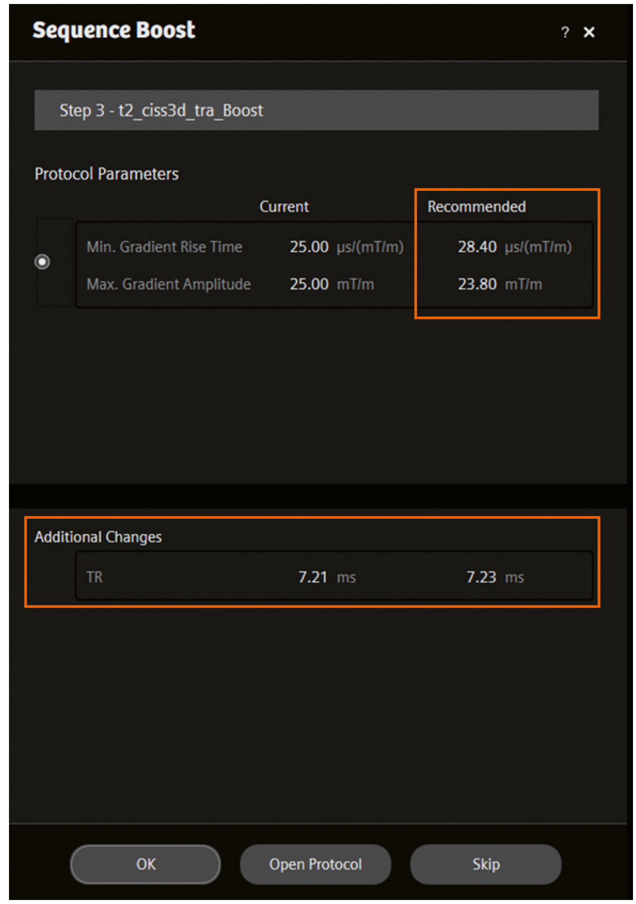
5 IAC on 3D CISS: less blurring (arrows) with the Boost Gradient Mode **(5A)**.

Managing dB/dt Limits with Boost Assistant

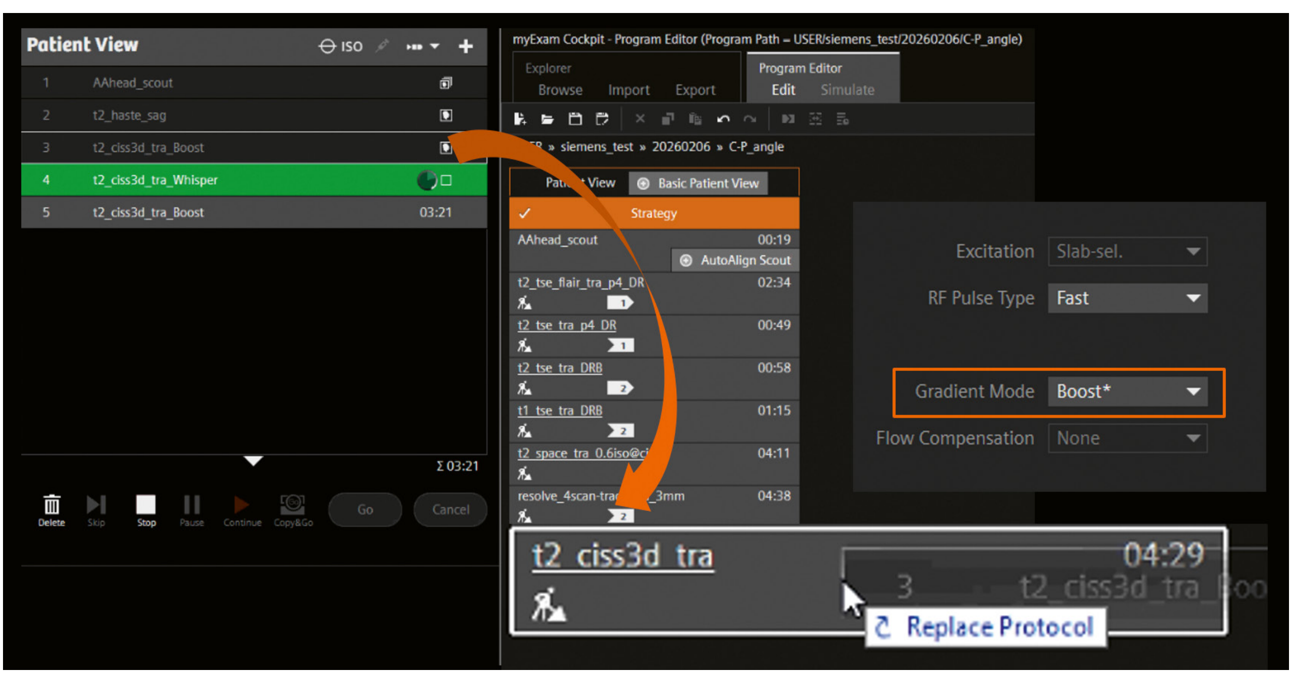
Using the Boost Gradient Mode enables a wide range of imaging benefits. However, a potential trade-off is the increased likelihood of reaching the dB/dt limit, particularly when combined with oblique imaging orientations, high bandwidth, or small field-of-view (FOV) settings. When the dB/dt limit is reached, a pop-up appears saying that the system may temporarily interrupt the measurement. The "Boost Assistance" mode is one way of minimizing this issue (Fig. 7): When the dB/dt limit is reached, the system will automatically recalculate gradient performance to a level that is compliant with dB/dt limits, allowing scanning to continue without interruption. If automatic recalculation



7 Boost Assistant (Sequence card > Assistant).



8 Sequence Boost pop-up showing the parameter optimization recommended by the scanner.



9 Saving the Boost* protocol.

is not feasible, a pop-up called "Sequence Boost" will appear (Fig. 8). In this case, the system will also suggest parameter changes, allowing users to decide with just one click, regardless of their level of experience. If the user wants to adjust the setting manually, they can do so by opening the parameters.

Protocols that have been modified due to dB/dt limits are indicated as Boost*. This label refers to a certain gradient strength that complies with the dB/dt limit. Saving Boost* protocols in myExam Cockpit will likely prevent repeated interruptions caused by dB/dt limits in subsequent scans.

Conclusion

This article demonstrated the feasibility and clinical usefulness of the Boost Gradient Mode. This mode is a powerful feature that enhances the effective use of maximum gradient performance to accelerate imaging and improve image quality. Although higher gradient performance increases the likelihood of reaching dB/dt limits, integrated tools such as Boost Assistant provide robust mitigation of these risks.

We hope that the Boost Gradient Mode will be used in a variety of clinical settings, maximizing system capabilities and contributing to an improved patient experience through efficient throughput, enhanced image quality, and shorter examination times.

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