



McGill
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Gibbs ringing and wrap-around artifacts

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To differentiate true pathology from artifacts is a significant challenge

- What does the artifact look like? how can I recognize it?
- What are the potential causes?
- What mitigation strategies can I use to eliminate or reduce the artifact

Undersampling...

Gibbs artifact

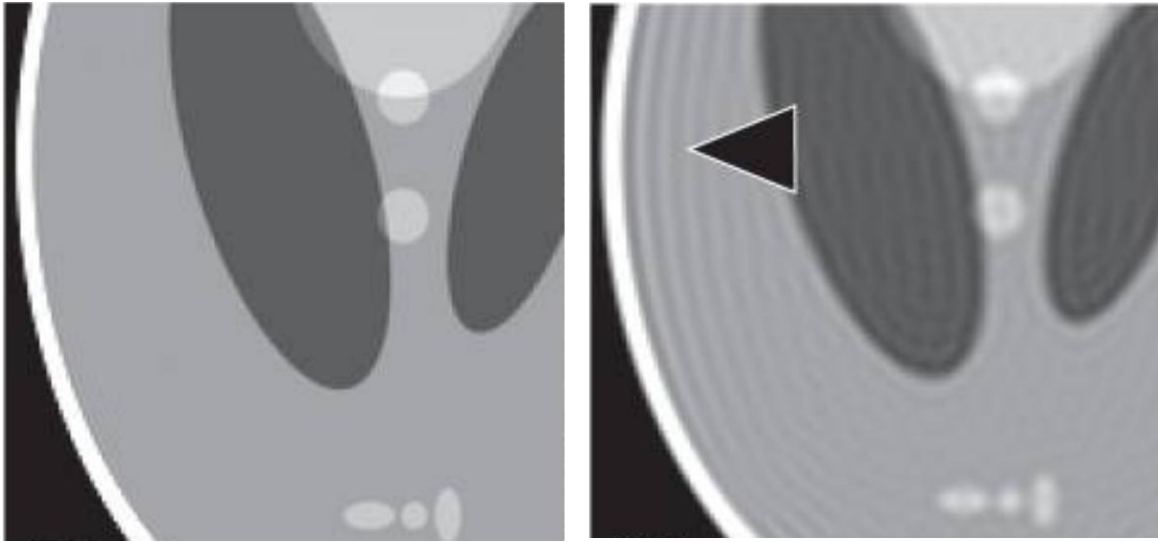


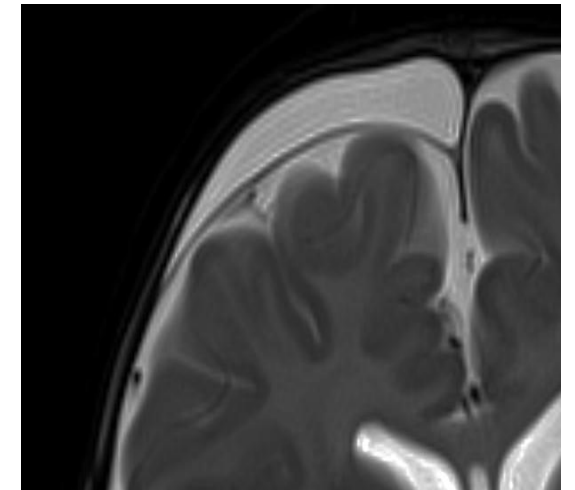
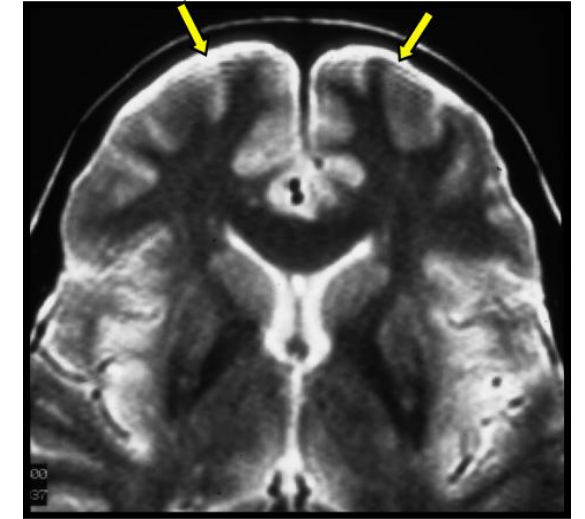
Image without Gibbs artifact

Image with Gibbs artifact

- Appears high contrast interfaces
- Multiple fine parallel lines adjacent to interface
- Also named Truncation artifact (or ring artifact)
- Skull and brain, spinal cord

<http://mriquestions.com/gibbs-artifact.html>

Examples



Gibbs artifact

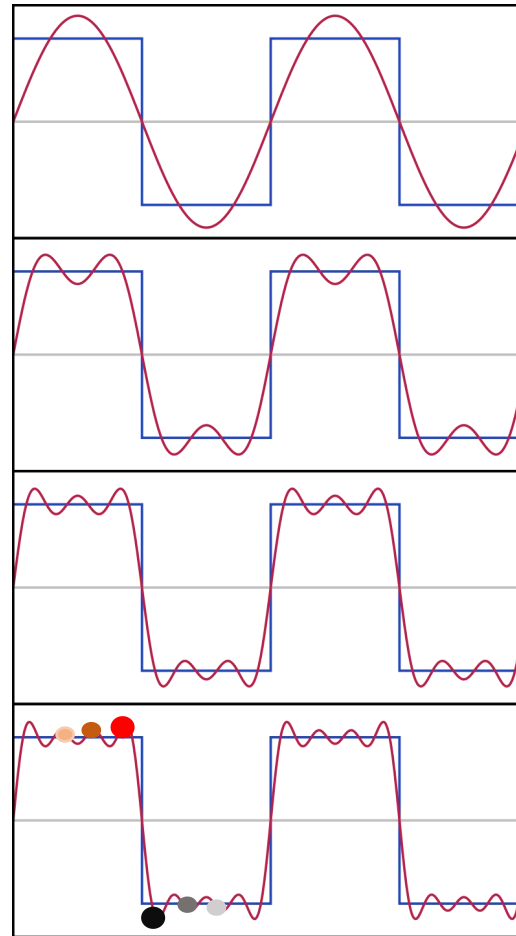
The Fourier series is cut short or *truncated*



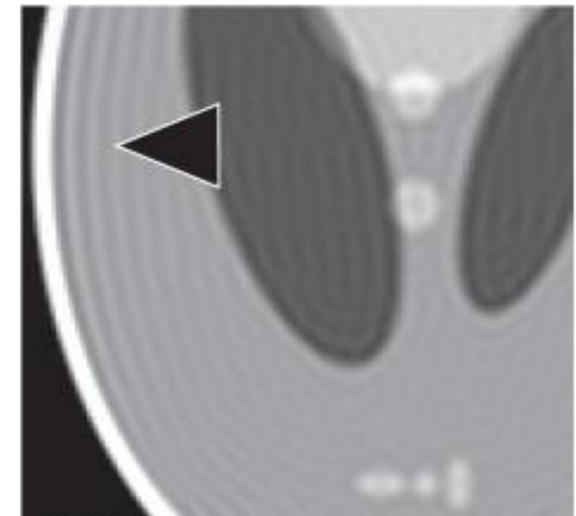
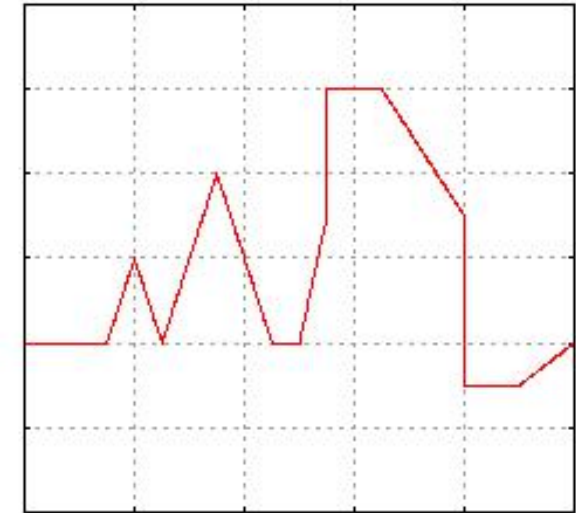
Sharp tissue interfaces



Mathematical model



Sum of sin waves with different amplitude

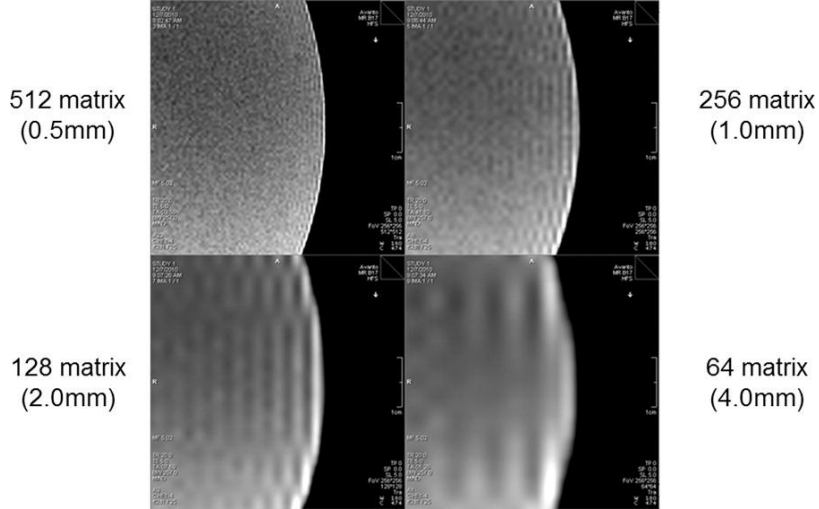


Truncation artifacts

https://en.wikipedia.org/wiki/Fourier_series

Block, Kai Tobias. 2008. "Suppression of MRI Truncation Artifacts Using Total Variation Constrained Data Extrapolation."

Gibbs artifact



Increasing matrix size

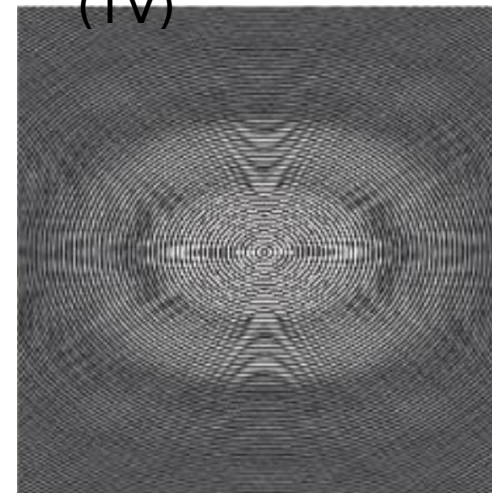
Others: reduce field of view, fat suppression.

But Gibbs artifacts can never be eliminated totally.

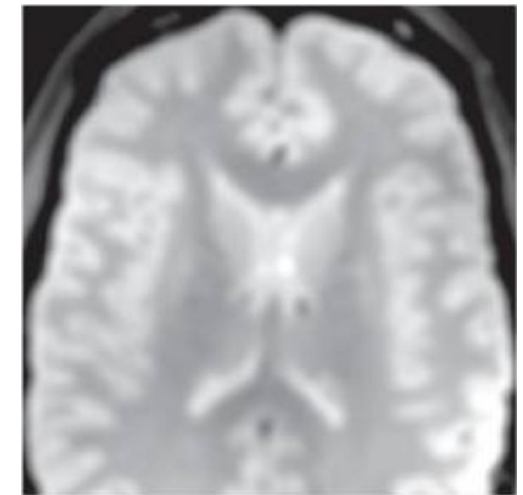
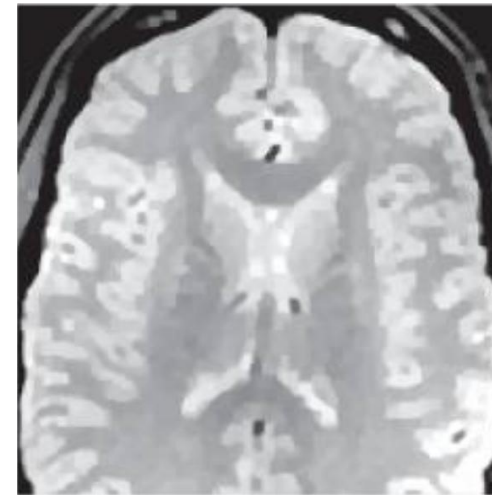
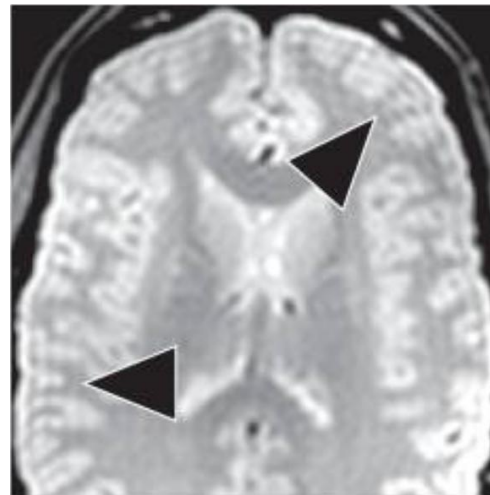
Original



Total Variation (TV)



Filtering

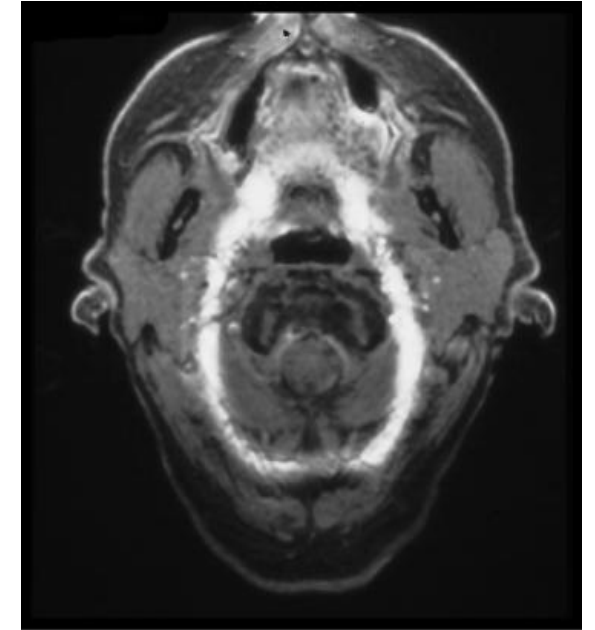
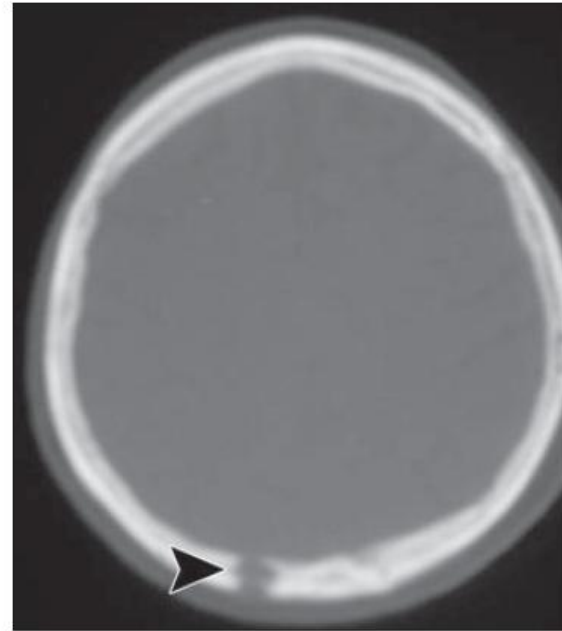
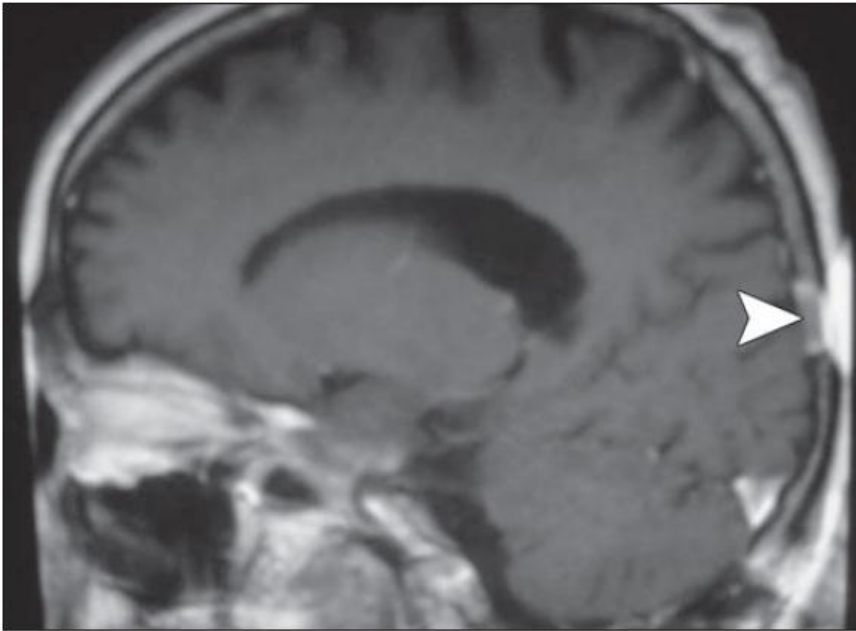


Aliasing artifact

Part of a large object lying outside the FOV projects onto the image

Hakky et al, 2013

<http://mriquestions.com>



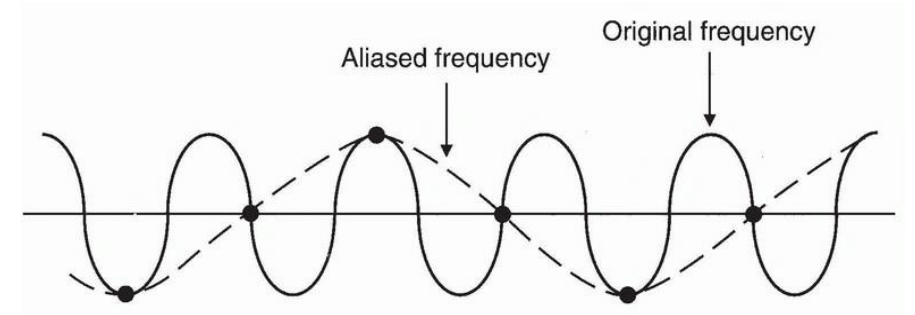
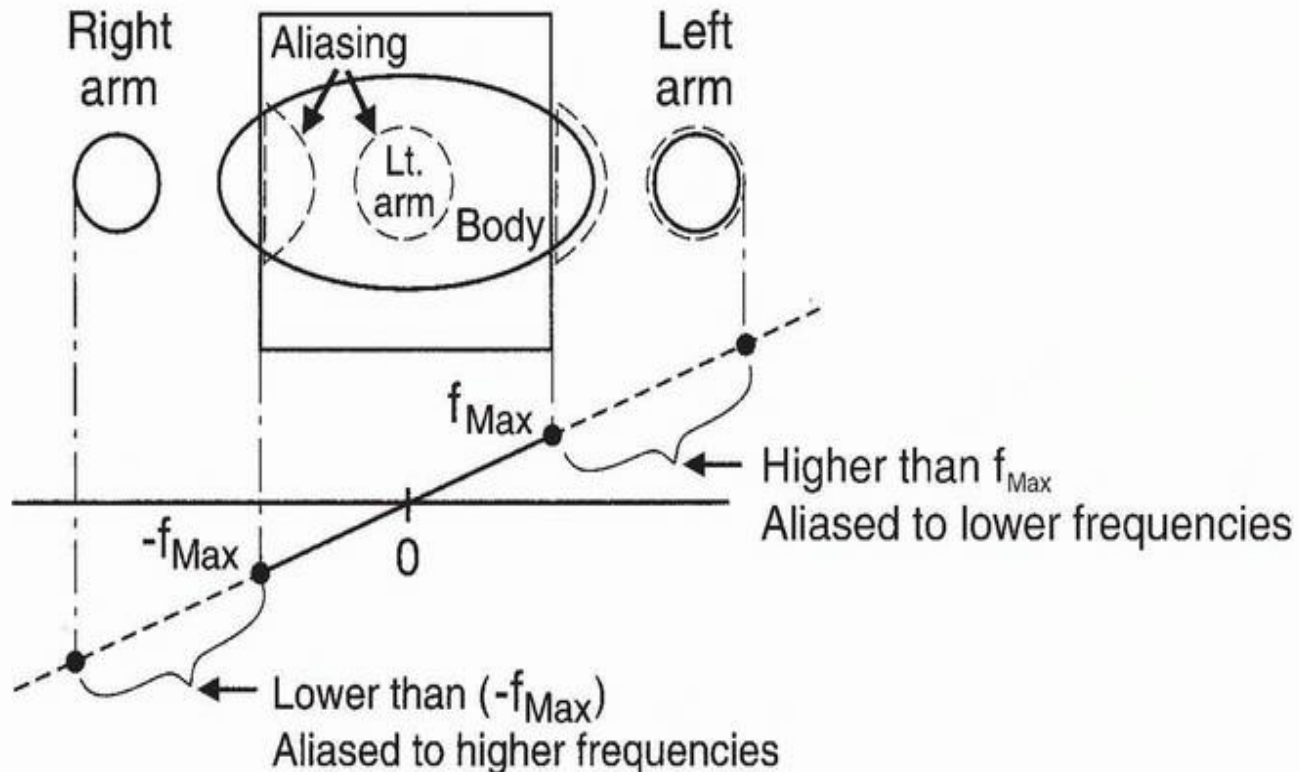
The nose was not included in the FOV
end slices

3D imaging –

Aliasing artifact

Frequencies higher than Nyquist's: tissues outside the specified FOV.

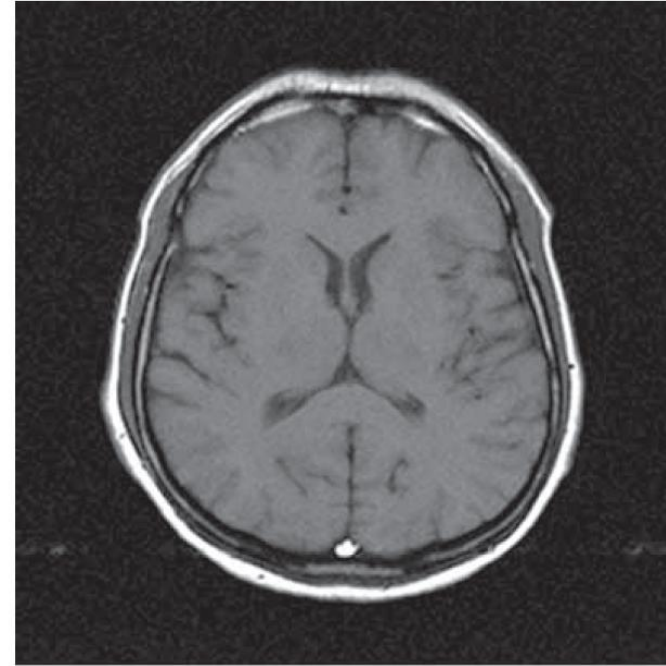
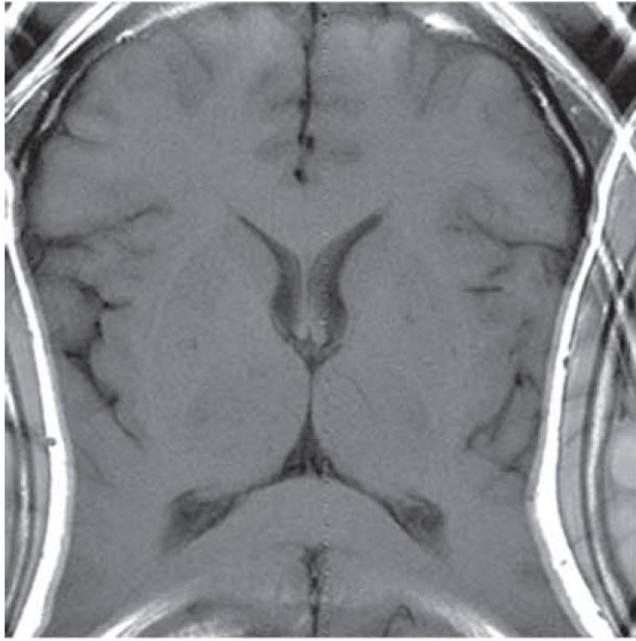
These are (falsely) detected as lower frequencies -> wraparound artifact



Harry
Nyquist

Aliasing artifact

Morelli et al, 2011



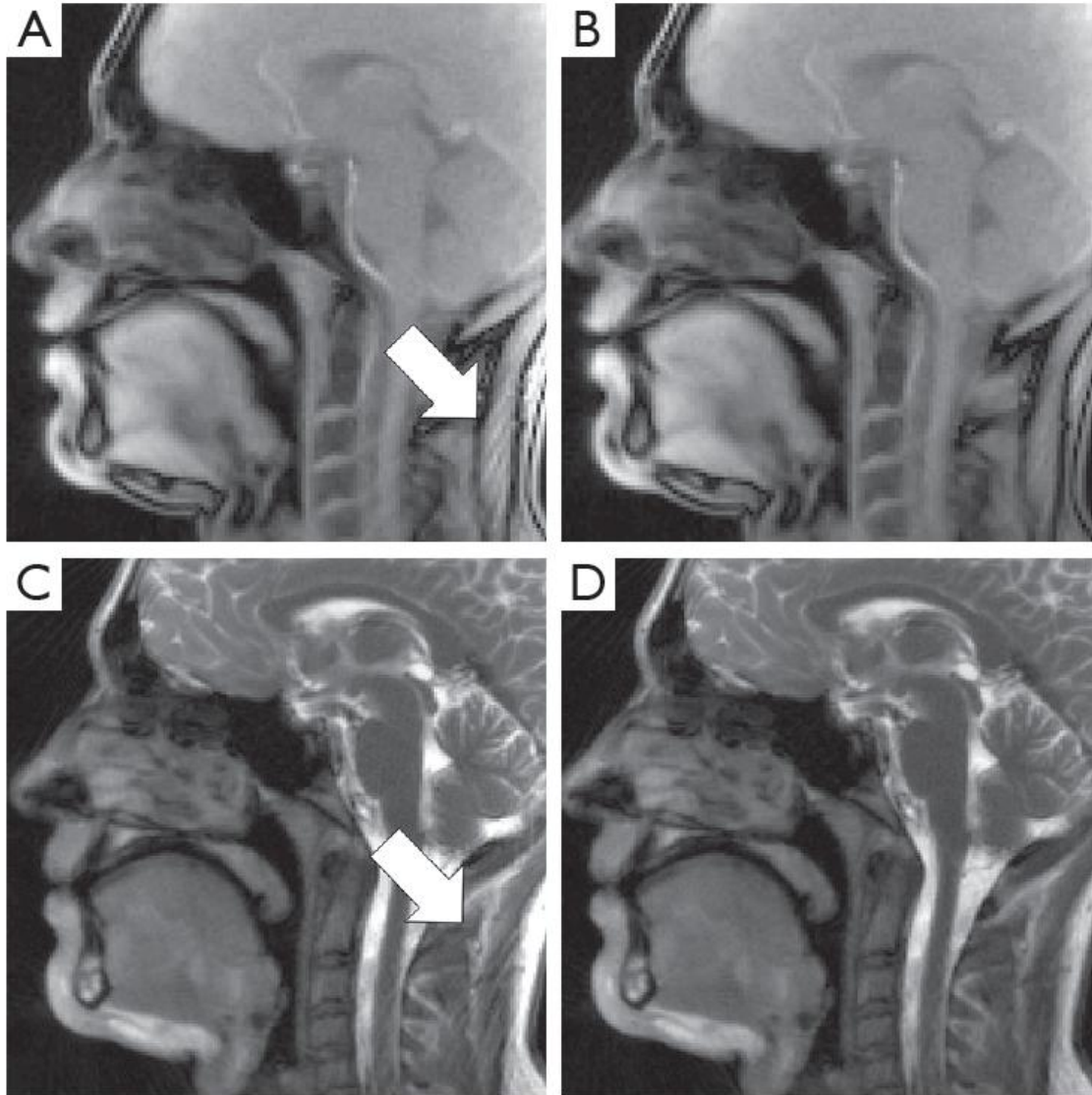
Mitigation strategy: increasing the number of phase encoding steps

Other options:

- Increase FOV
- Utilization of surface coils
- Saturation pulses may also be applied to structures in the nonimaged portion of the FOV

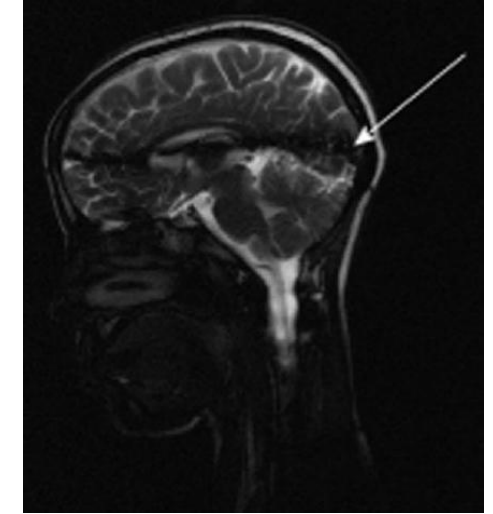
Related issues/final remarks

Radial imaging shows aliasing as streaks



Holme & Franhm, 2016

Sica & Meyer, 2007



Aliasing should not be confused with concomitant gradients causing phase accrual

Undersampling!