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IDENTIFYING IMAGE ARTIFACTS, THEIR CAUSES, AND HOW TO FIX THEM: MR

Outline: Artifact Identification, Cause, How to Fix

- Motion / ghosting
- Flow
- Aliasing / wrap
- Radiofrequency interference
- Metal
- Corduroy
Motion / Ghosting

- Identification:
  - May appear as repetition of “ghosts” across image, may be distinct or blurred depending on type of motion
  - Typically occurs in phase encoding direction
- Causes:
  - Patient motion, physiologic / involuntary, voluntary; equipment vibration / instability

Image space ↔ k-space

FT
K-space trajectory

1
2
3
4
5
6
7
8
9

Ky

Kx
Propeller / Blade

- Reduce sensitivity to motion
- May be used for uncooperative patients

K-space

Propeller / Blade

Image from Siemens Applications guide
Motion / ghosting

- How to fix:
  - Remind patient to hold still, make patient more comfortable, decrease scan time, consider sedation
  - Use respiratory triggering / navigator pulses, motion correction, breath-hold options when available
  - Implement Propeller / Blade sequence options
  - Address equipment problems, test with phantom, test with cold-head off
  - Swap phase and frequency if artifact obscures pathology
Flow

- Identification:
  - Ghosting, appears as repetition (phase encoding direction) of blood

- Causes:
  - Velocity induced phase effects

![Image of brain flow](image-url)
Flow

- How to fix:
  - Gradient moment nulling / flow compensation
  - Spatial saturation bands
  - Swap phase and frequency if artifact mimics pathology

Aliasing / wrap

- Identification:
  - Patient anatomy appears in incorrect locations

- Causes:
  - Insufficient sampling
  - Small FOV with anatomy (signal) outside FOV
Aliasing / wrap

- How to fix:
  - Increase FOV
  - Increase over-sampling in phase encoding and / or slice directions (for 3D)
  - Use saturation bands for anatomy outside FOV
  - Turn off coils outside imaging volume
RF Interference / Zippers

- **Identification:**
  - Typically appears as single or multiple lines ("zipper") in the phase encoding direction

- **Causes:**
  - Unexpected radiofrequency signal from equipment inside room, or outside room with poor RF shielding
RF Interference / Zippers

- How to fix:
  - Identify source, replace electronic components generating unwanted RF signal
  - Check integrity of RF shielding, clean RF door threshold and RF fingers / plates

Metal

- Identification:
  - Signal void, often with adjacent very bright signal
  - Geometric distortion

- Causes:
  - Magnetic susceptibility, induced eddy currents, spin dephasing
Metal

How to fix / reduce:
- Properly screen patient, remove any metal that can be removed
- Turbo spin echo and spin echo sequences reduce artifact compared to gradient echo
- Decrease TE and echo spacing; increase bandwidth and resolution in frequency encoding direction
- Swap phase and frequency to modify shape

Corduroy

Identification:
- Pattern of regularly spaced lines extending across image
- Can occur at different spatial frequencies and different angles
- Multiple sets can combine to appear as a cross-hatch pattern

Causes:
- Spike(s) in k-space
Image space ↔ k-space

FT
Corduroy

How to fix:
- Confirm room humidity in specification
- Perform scanner spike check
- Attempt to localize source if in room

Suggested Reading

- Dietrich, “Artifacts in 3-Tesla MRI: Physical background and reduction strategies” EJR 2008 65(1) 29-35
Thank You
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