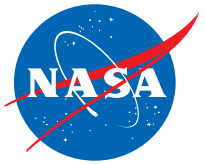


Ocular Related Imaging De-identification Evaluation

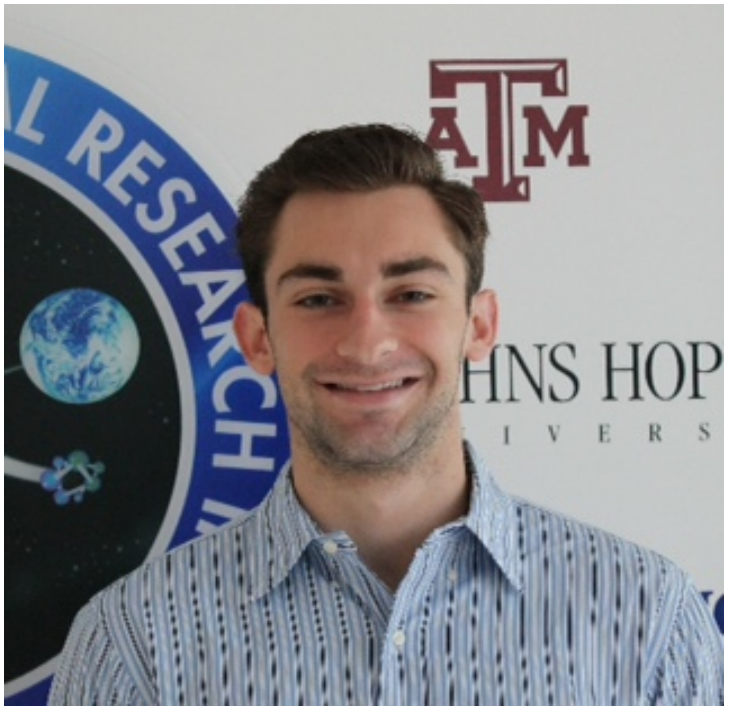
Michael LaPelusa

University of Illinois at Urbana-Champaign

Dr. Mary Van Baalen, Lifetime Surveillance of Astronaut Health

Introduction: About Me

- Hometown
  - Park Ridge, IL
- Studies/Career Interests
  - Molecular and Cellular Biology
    - Chemistry, Italian
  - Pre-Medical
    - Surgical sub-specialty (Trauma, Transplant, Neuro, Ortho)
    - Space Medicine?



Introduction: Research Background

- Beckman Institute for Advanced Science & Technology
  - Lifelong Brain and Cognition Laboratory
  - Targeted Imaging Laboratory

beckman.Illinois.edu/about

Overview of Magnetic Resonance Imaging

- Our tissues are composed primarily of water
  - Two hydrogen nuclei/molecule
- Creating an electromagnetic field within the machine at a certain frequency alters these protons' magnetic alignment
- Turning off the electromagnetic field allows the protons to return to their original magnetic alignment
- The difference in rate at which excited atoms return to their equilibrium state gives the characteristic differences between tissues (light/dark) seen in the final MRI image

bic.Beckman.Illinois.edu

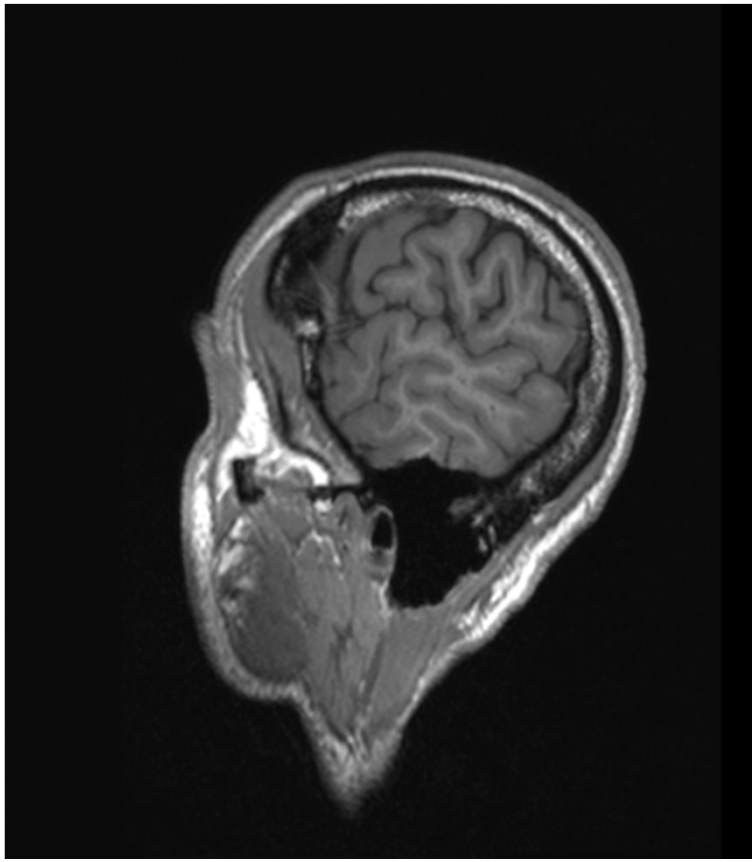
NASA's Interest in Neuro-Imaging

- Visual Impairment from Intracranial Pressure (VIIP)
  - External, collaborative research partners interested in visual impairment and its cause
    - Example: ONS diameter
- Short-term and long-term structural changes of key areas within the brains of astronauts
  - Example: Differences between pre-flight vs post-flight cerebellar volume

Astronaut Privacy Issues

- MRI brain images are attributable
  - Encoded meta-data
    - Name, Date of Birth, Date of Exam, etc.
  - Facial features
    - If not obvious, can be 3-dimensionally rendered using widely available software
- Astronauts are public figures
- MRI brain images inherently provide a significant amount of medical data
- How can we protect the identity of the astronauts AND give researchers useful data/images?
  - Current “skull-stripping” software inadequate
    - Removes crucial pieces of the MRI brain image that makes VIIP analysis impossible

Sagittal 3T Brain/Orbits Slices



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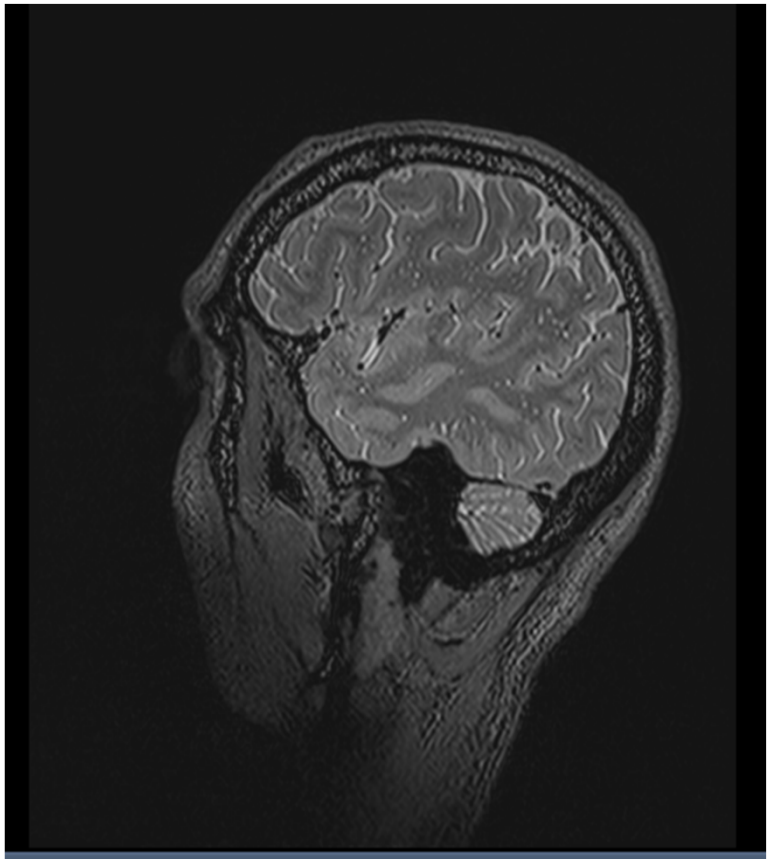

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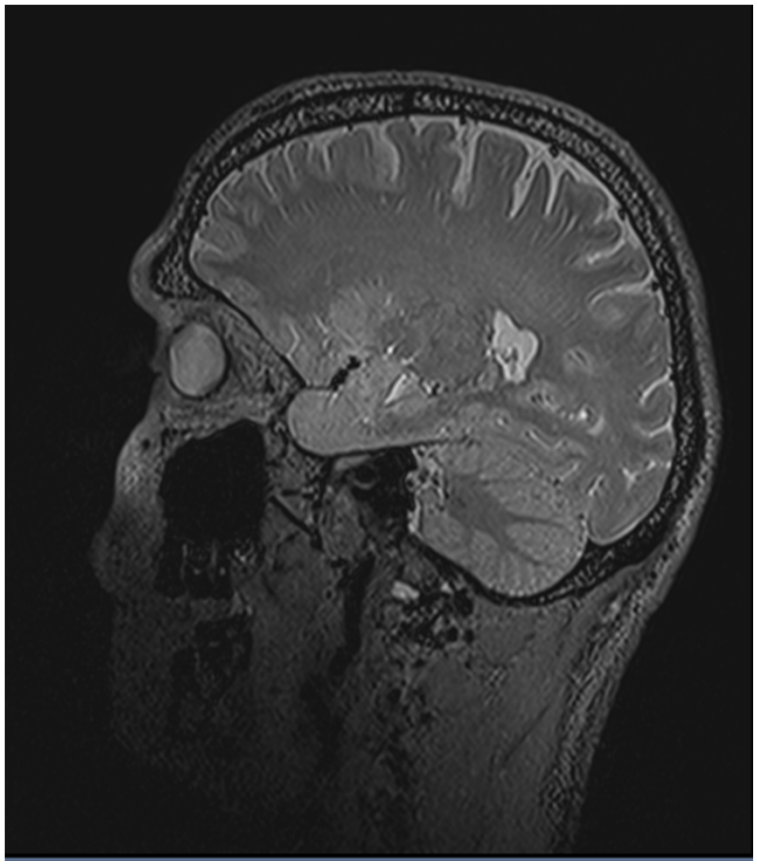
Sagittal 3T Brain/Orbits Slices



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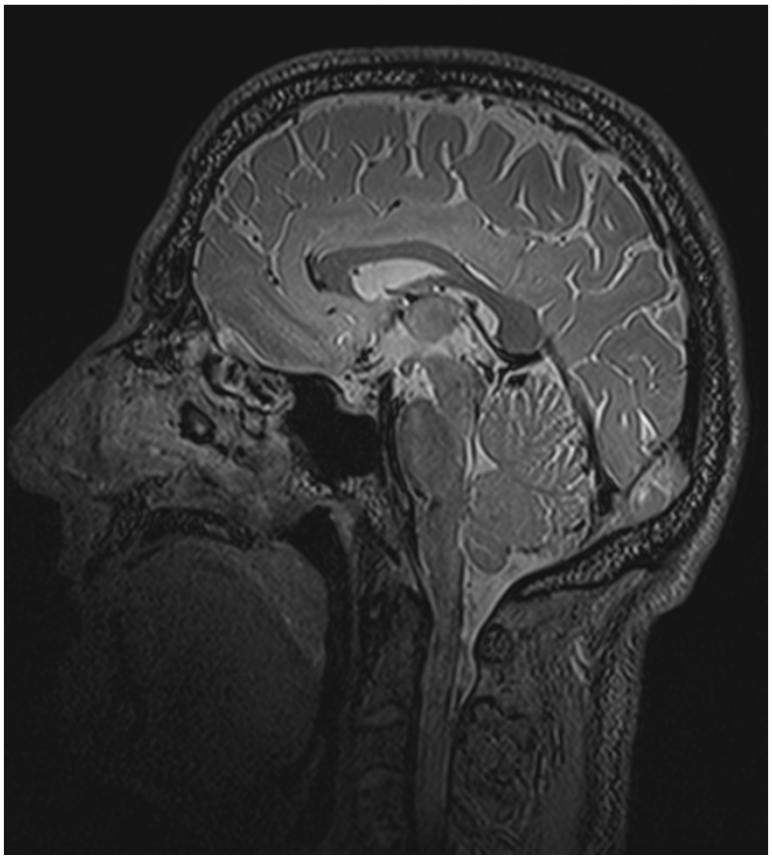

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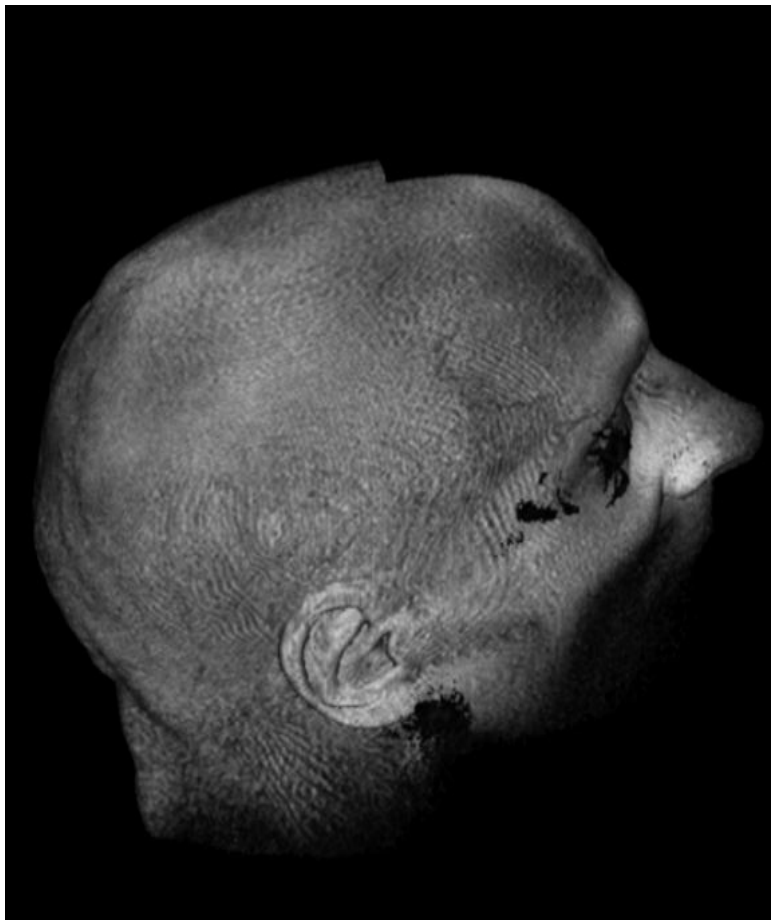
3-D Rendering Software Capabilities

- From the 176 slices of a sagittal MRI brain scan, a representation of what the person (probably) looks like can be rendered by specific software
  - MRICRON

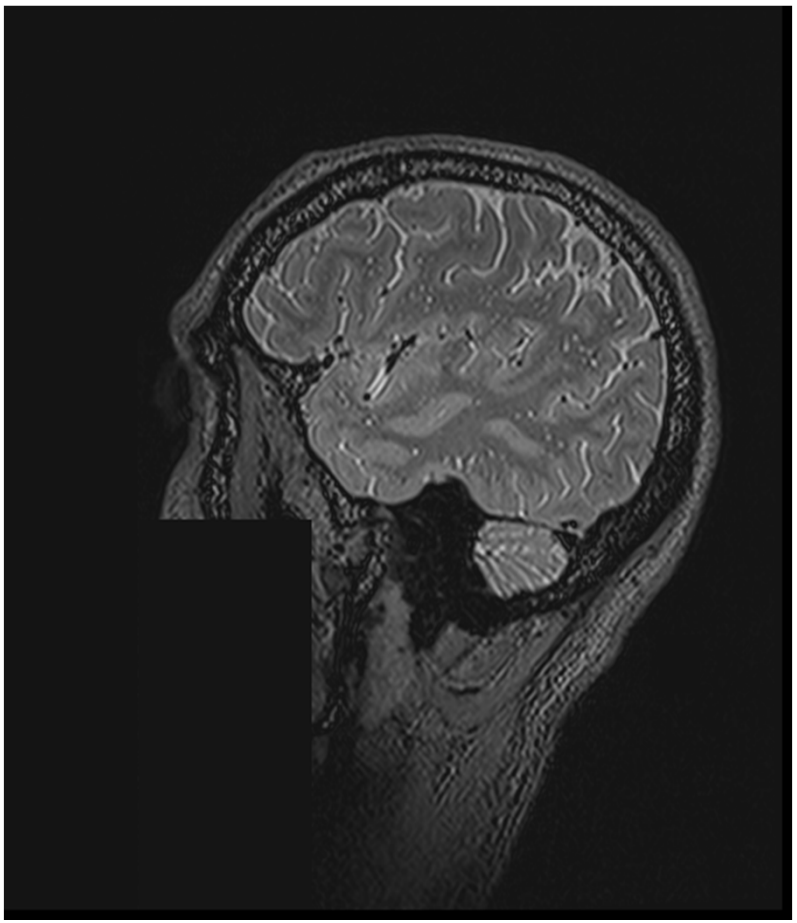


Defacing Technique

- "Showcase" allows us to modify the MRI image without modifying the file format
  - Important to maximize efficiency
- Hypothesis
  - These 3 rectangles will sufficiently prevent patient/astronaut identification and provide uncompromised MRI data to external collaborators

Defaced Sagittal 3T Brain/Orbits Slices

22



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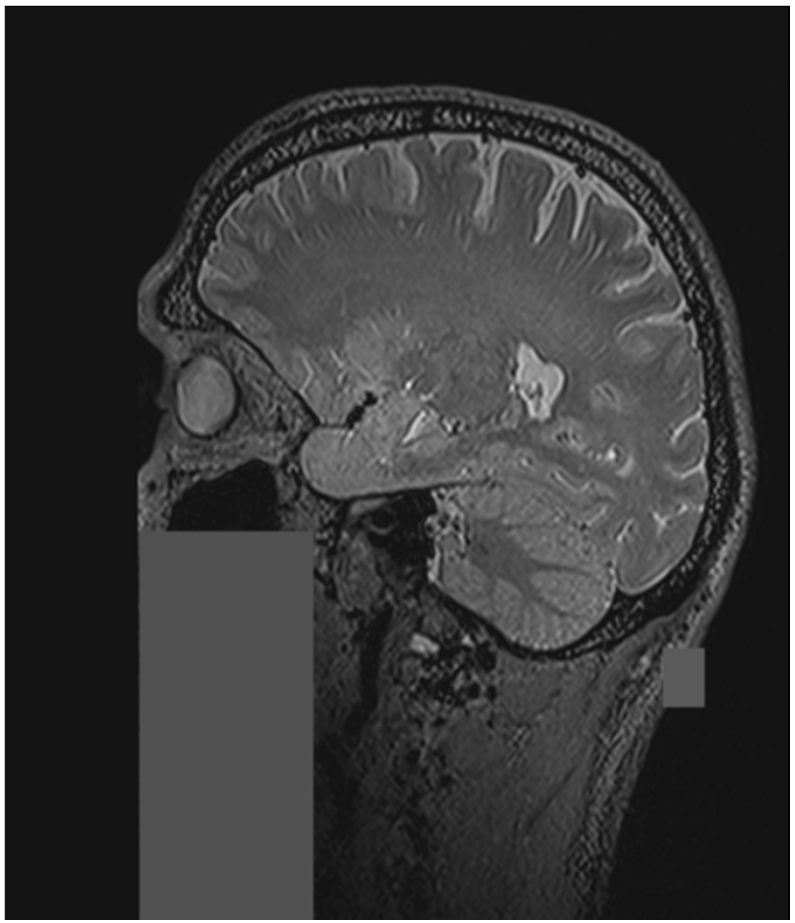
Defaced Sagittal 3T Brain/Orbits Slices



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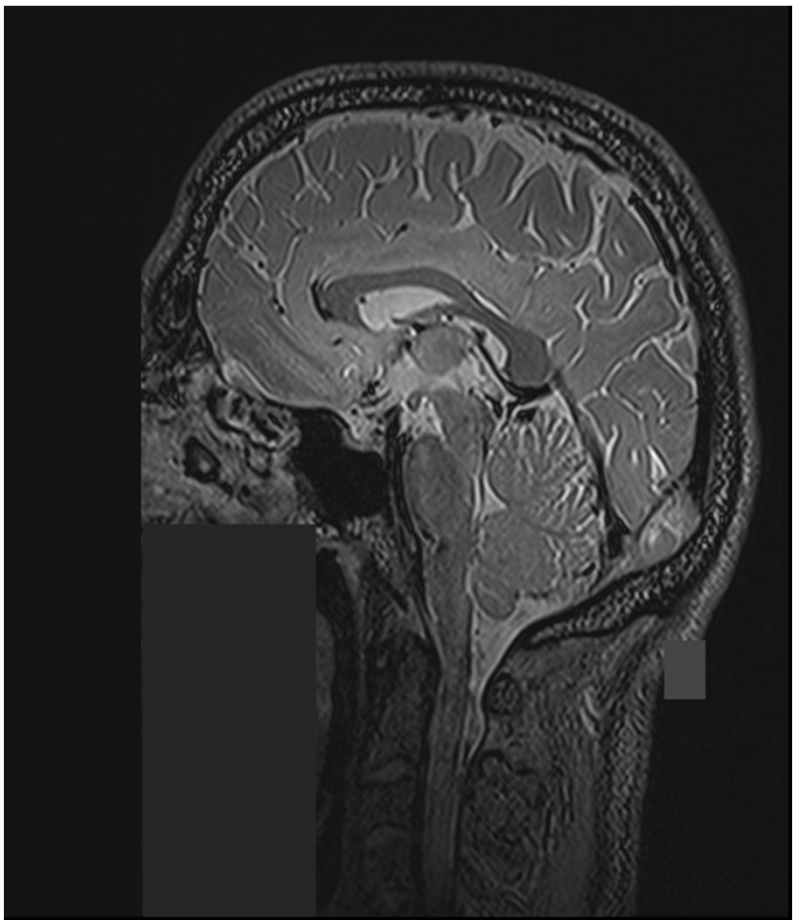

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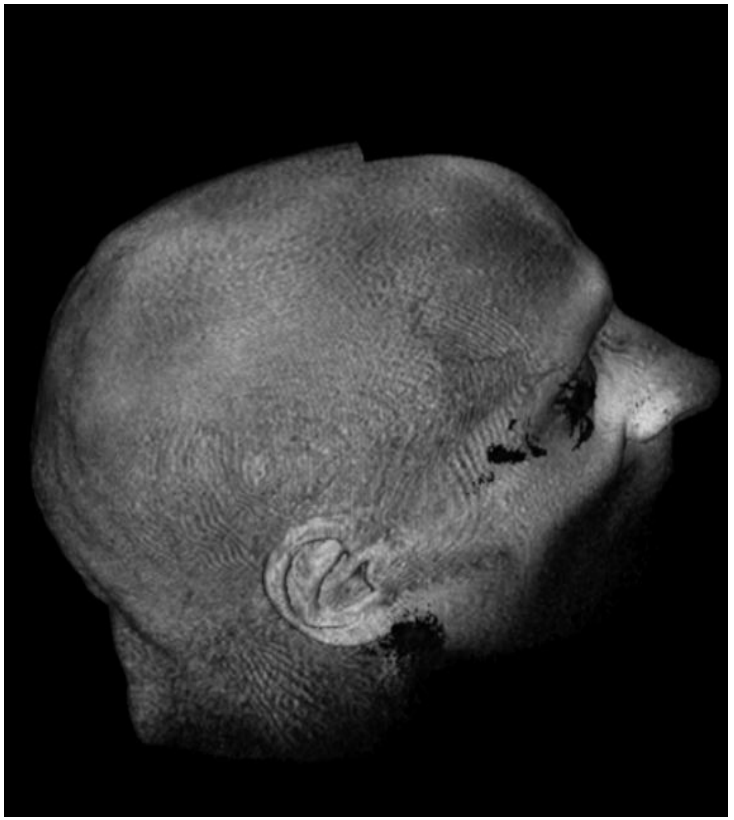
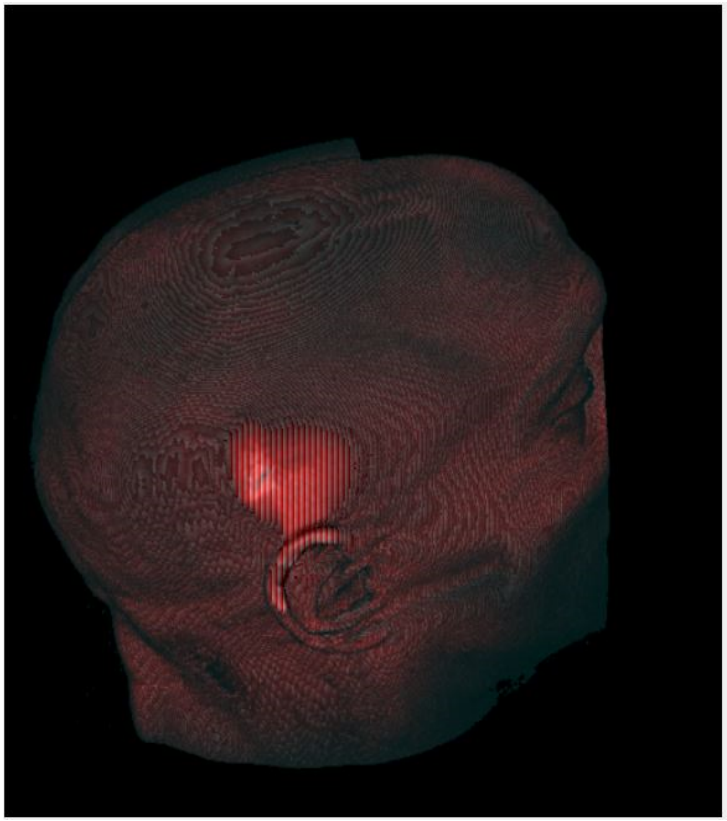
3-D Rendering of Defaced Astronaut

- Before



- After



Next Steps, Future Implications

- Take 10 astronauts who underwent MRI exams at…
  - UT Victory Lakes/Galveston (5)
  - UT Houston/Downtown (5)
- Compare/contrast methodology of MRI de-identification based on location of exam and establish a universal protocol for future use
- 3-tiered approach to determine if any data points of interest are compromised AND if images are truly de-identified
  - Internal Subject Matter Experts (SMEs) and facial recognition software
  - NASA-funded MRI researchers at various institutions
  - Crowdsourcing via “hack-a-thon”
- External researchers will have access to MRI brain images of astronauts for the first time!

Thank You!

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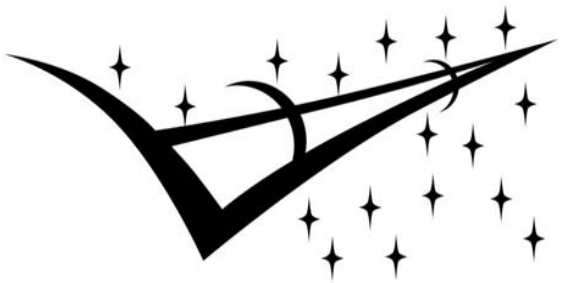

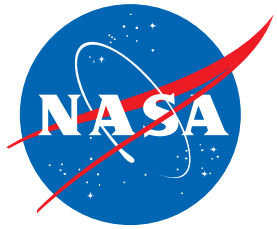
NASA