Machine Learning Methods for Magnetic Resonance Imaging Analysis

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MRI scan

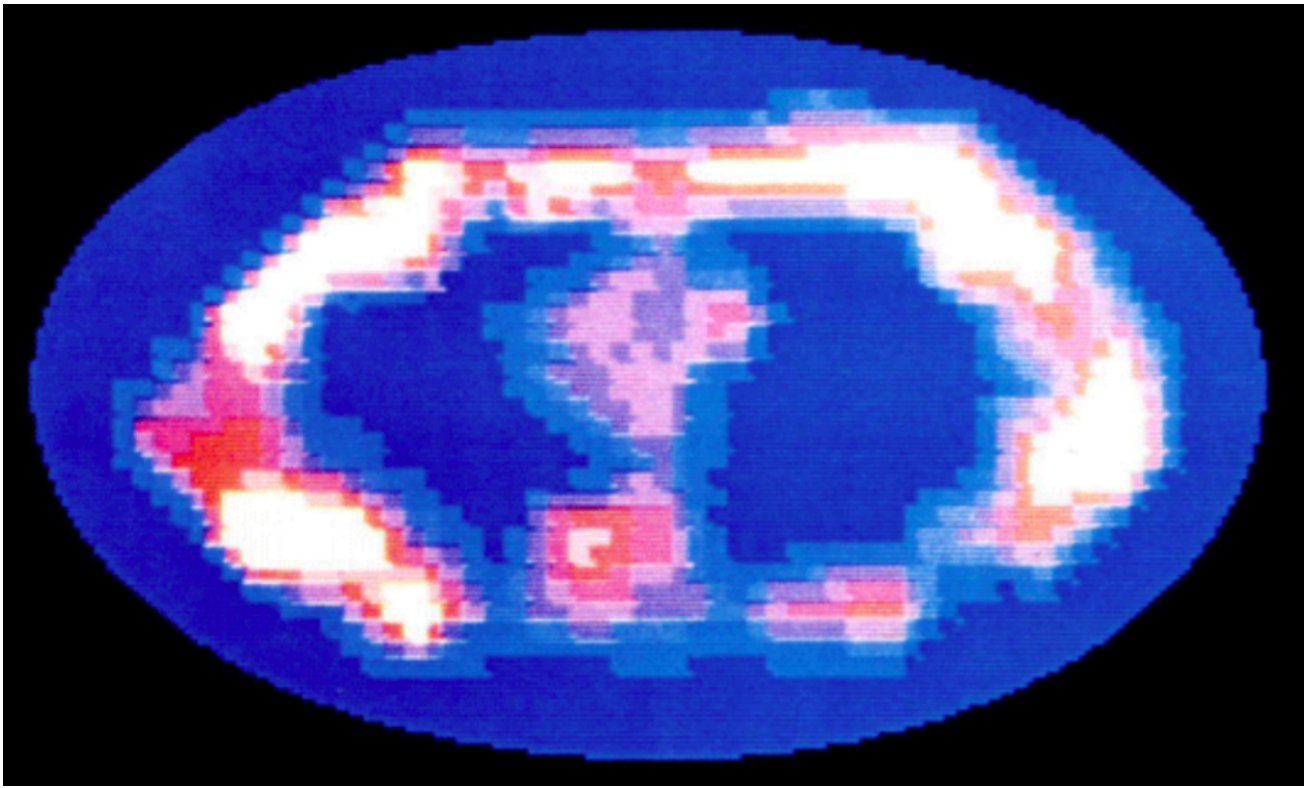

A
R
ST: 6
SL: -7,98
512x512
W: 1019 L: 510
TE: 100
TR: 5832
T2 AX 6mm
138
S
A
ST: 6
SL: -6,77
512x512
W: 1497 L: 748
TE: 100
TR: 5832
T2 SAG 6mm
134

History of Magnetic Resonance Imaging

- MRI — medical imaging technique used in radiology to form pictures of the anatomy and the physiological processes of the body.
- Originally called NMRI (nuclear magnetic resonance imaging).
- Paul C. Lauterbur — first true MR image (Nature, 1973).
- Peter Mansfield — first image of a human body part, a finger (1977), developed technique that led to scans taking seconds rather than hours and produce clearer images.
- Raymond V. Damadian — first whole-body MR image (1977).
- Vladislav Ivanov — unacknowledged inventor.
- Nobel prize in 2003 — Peter Mansfield and Paul Lauterbur for their discoveries concerning magnetic resonance imaging.

First MR image of human finger (1977)

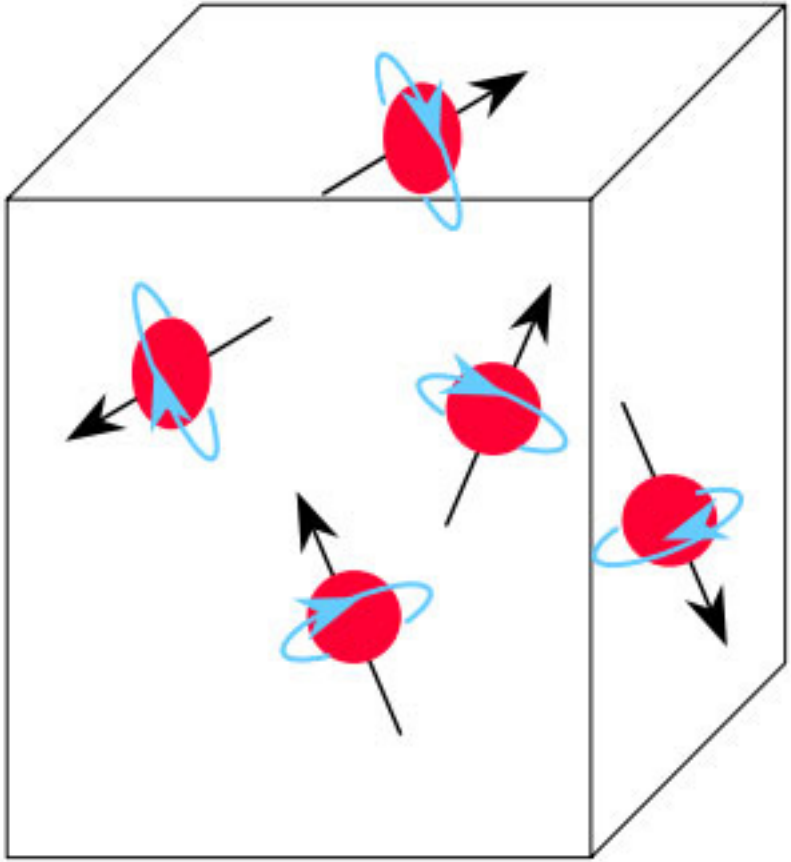
First MR image scan of human body (1977)



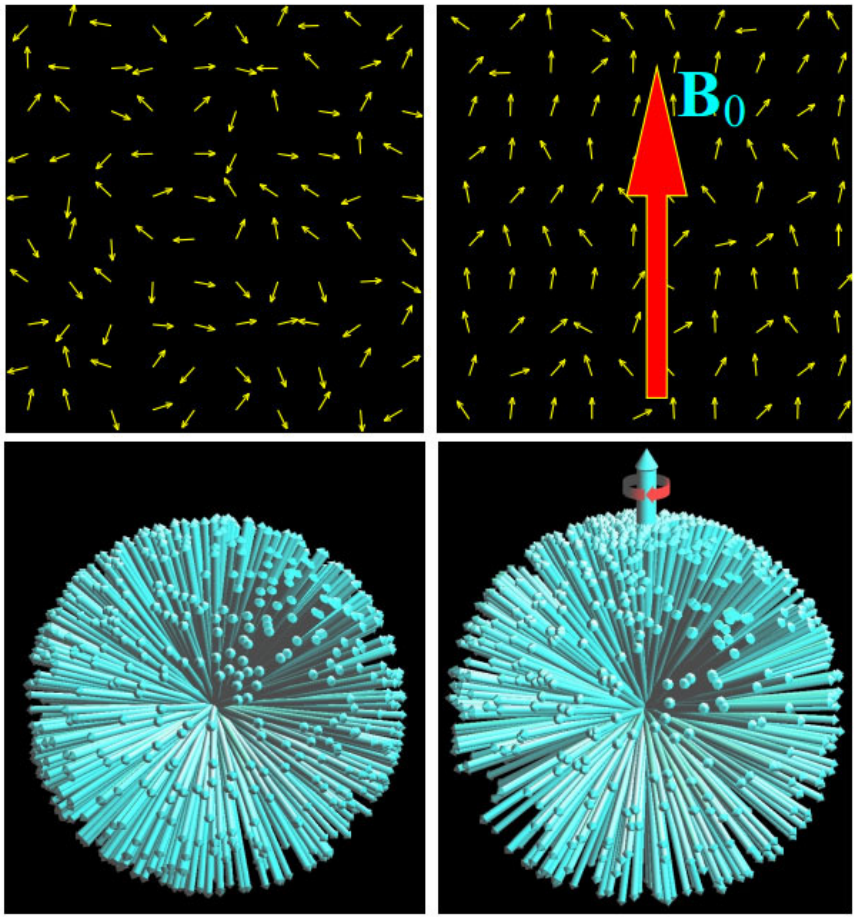
Magnetic Resonance Imaging Usage

- Material science,
- Archaeology,
- Engineering,
- Medicine:
  - Decease detection throughout the body (neurological deceases, musculoskeletal system deceases ...)
  - Tumors, cysts and other abnormalities,
  - Injuries and abnormalities of the joints (back, knee ...)
  - Diseases of the liver and other abdominal organs.
  - Certain types of heart problems.
  - Anomalies of the brain and spinal cord.
  - Measurement of blood or cerebrospinal fluid flow velocity.

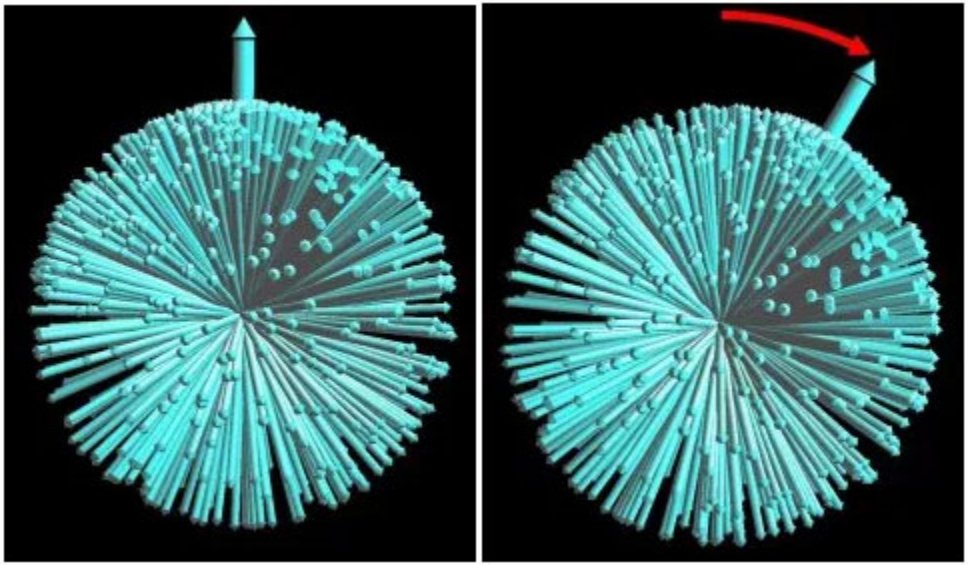
Principles of Magnetic Resonance Imaging



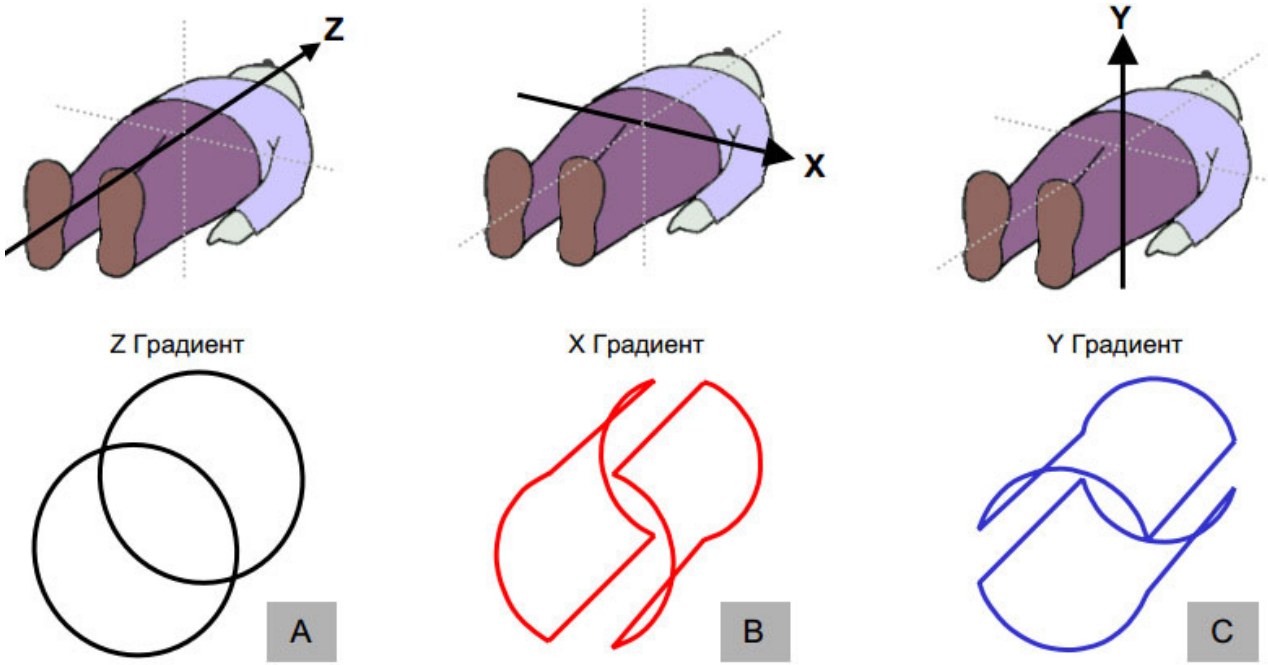
Principles of Magnetic Resonance Imaging



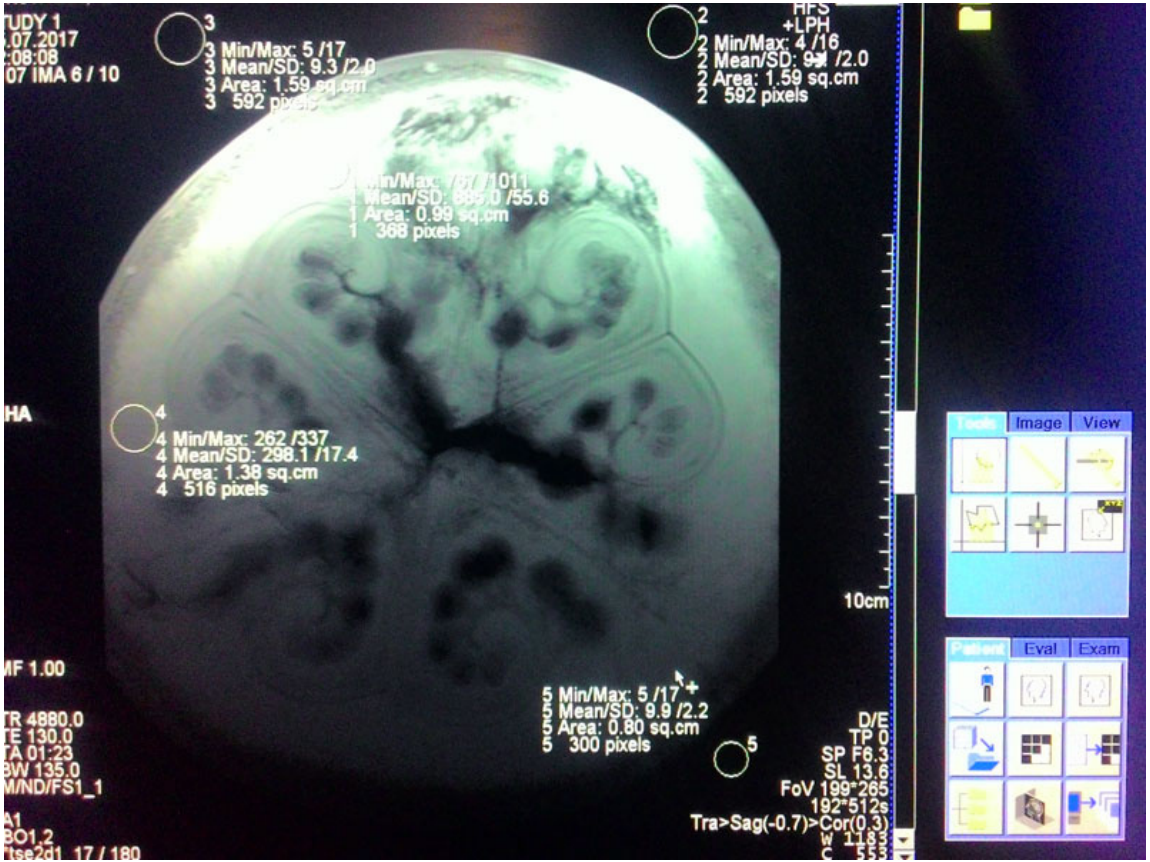
Principles of Magnetic Resonance Imaging



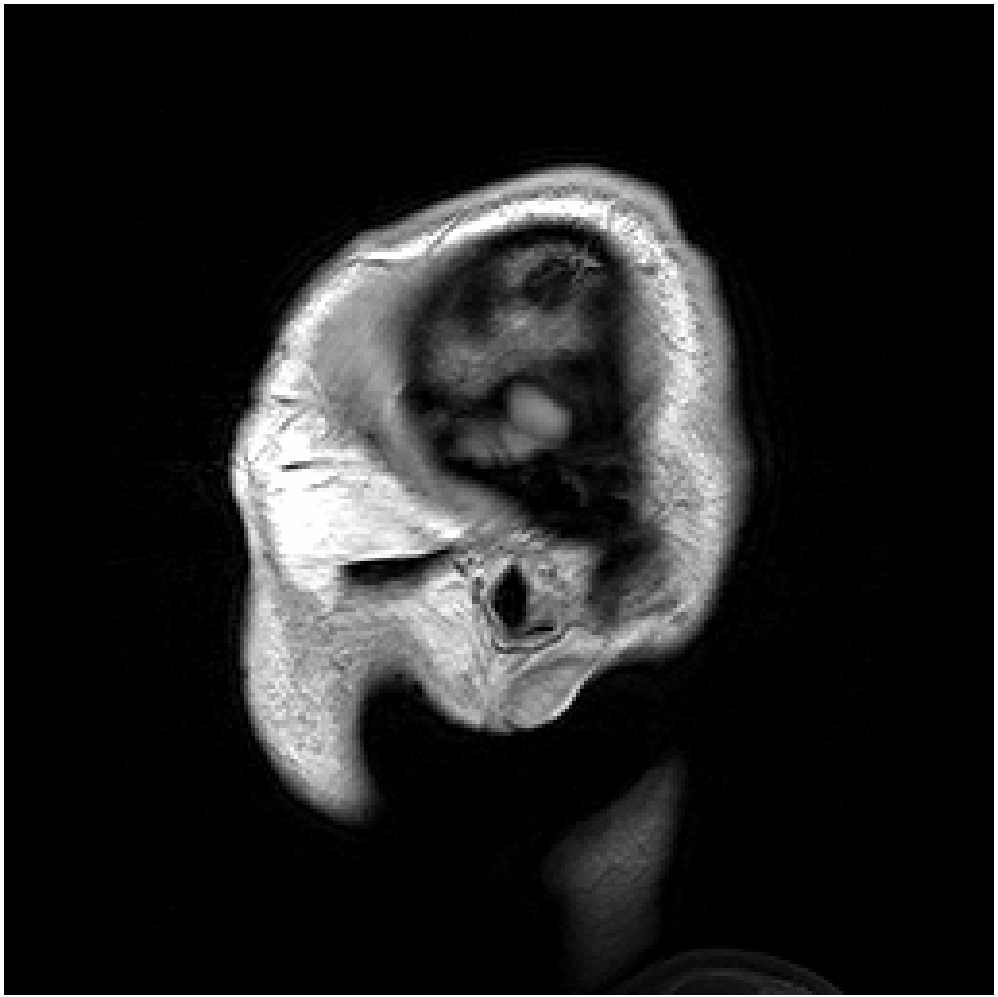
Principles of Magnetic Resonance Imaging



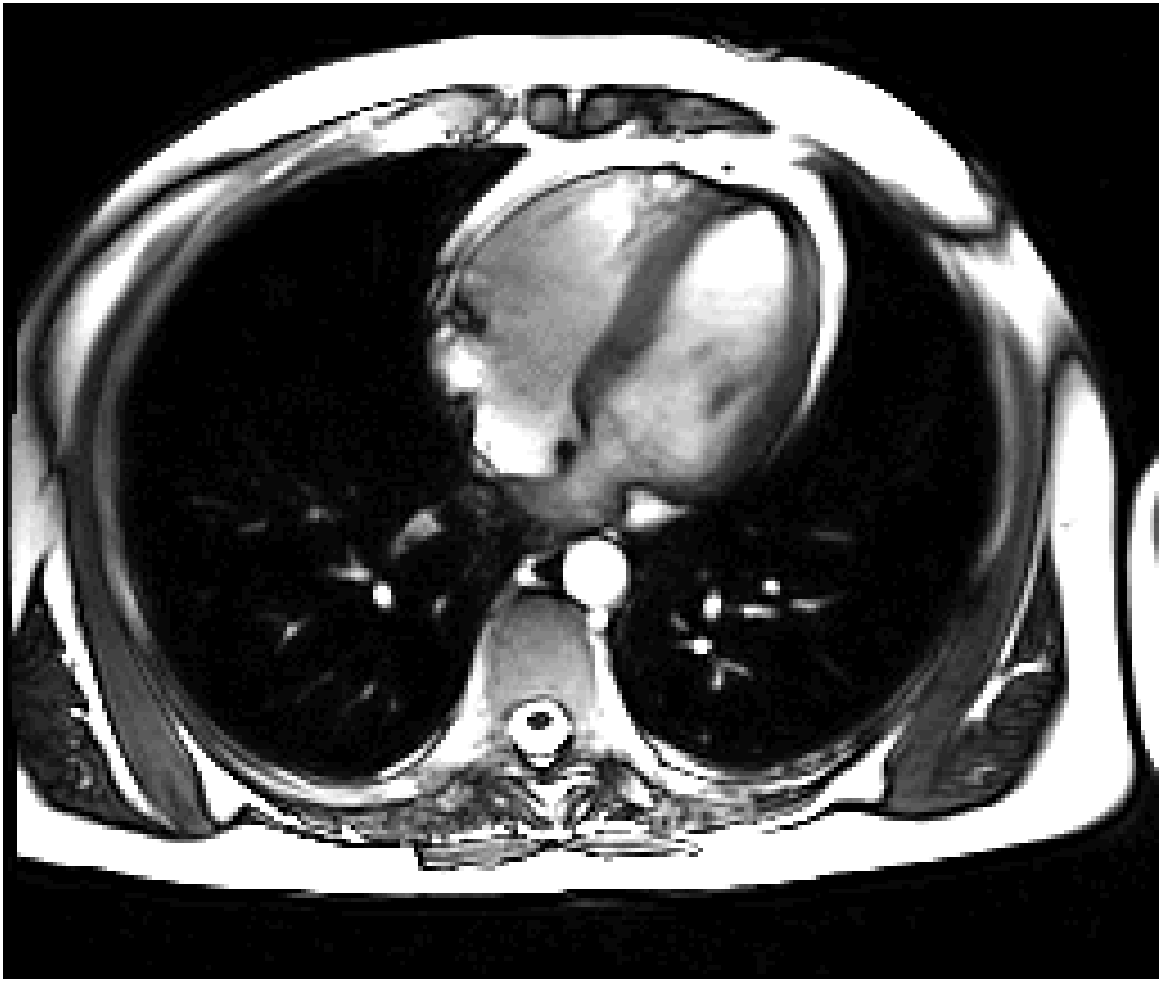
MRI scan of watermelon



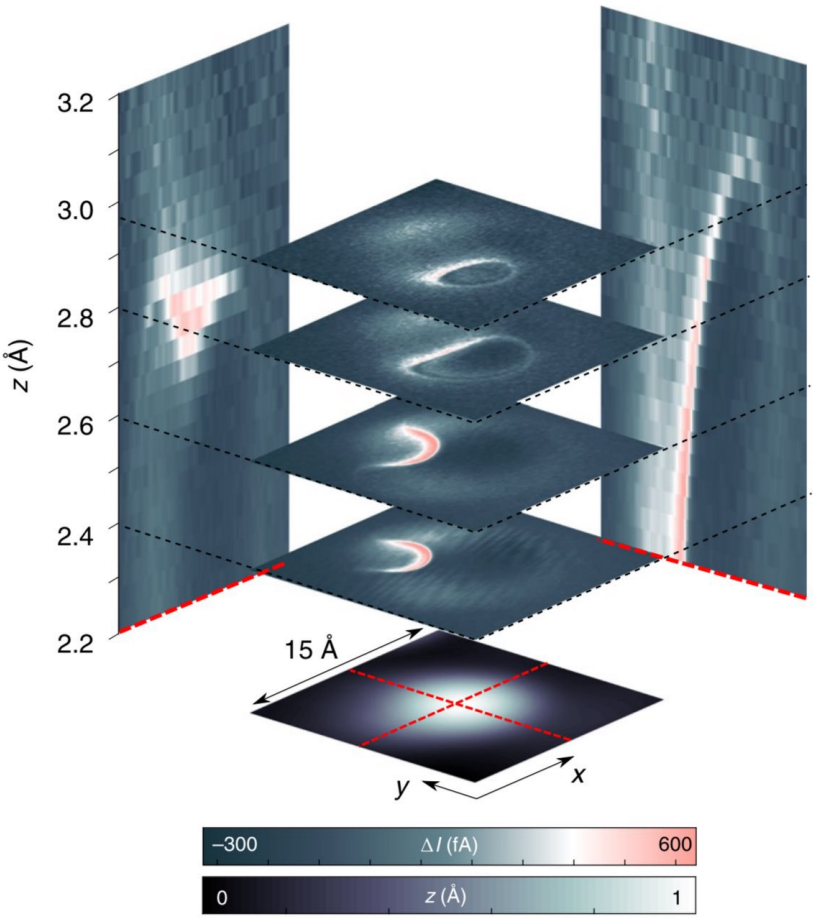
Parasagittal MRI of head



MRI of beating heart

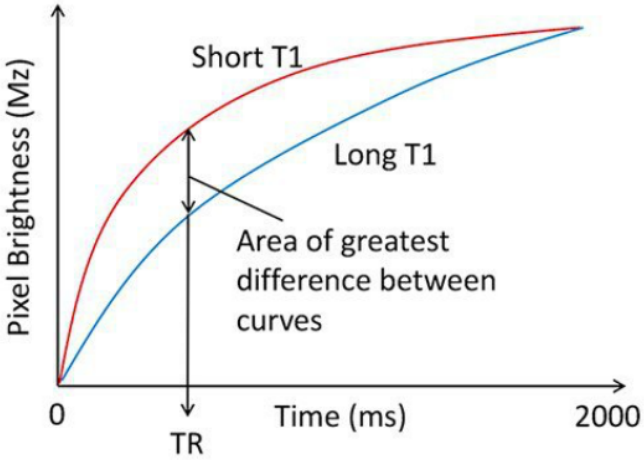


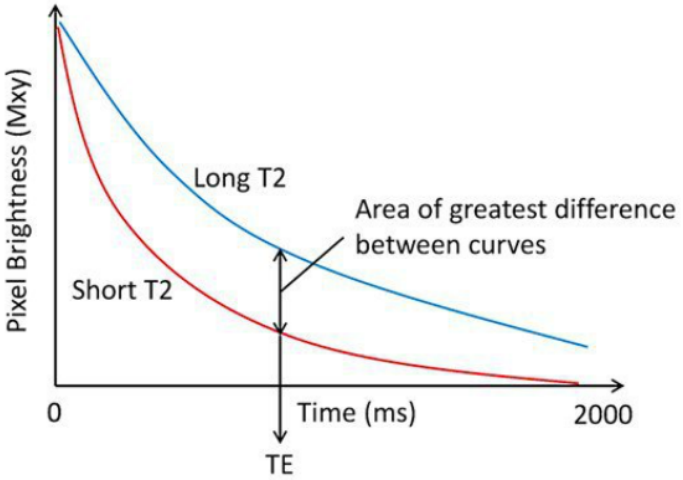
MRI of single atoms on a surface



T1 and T2

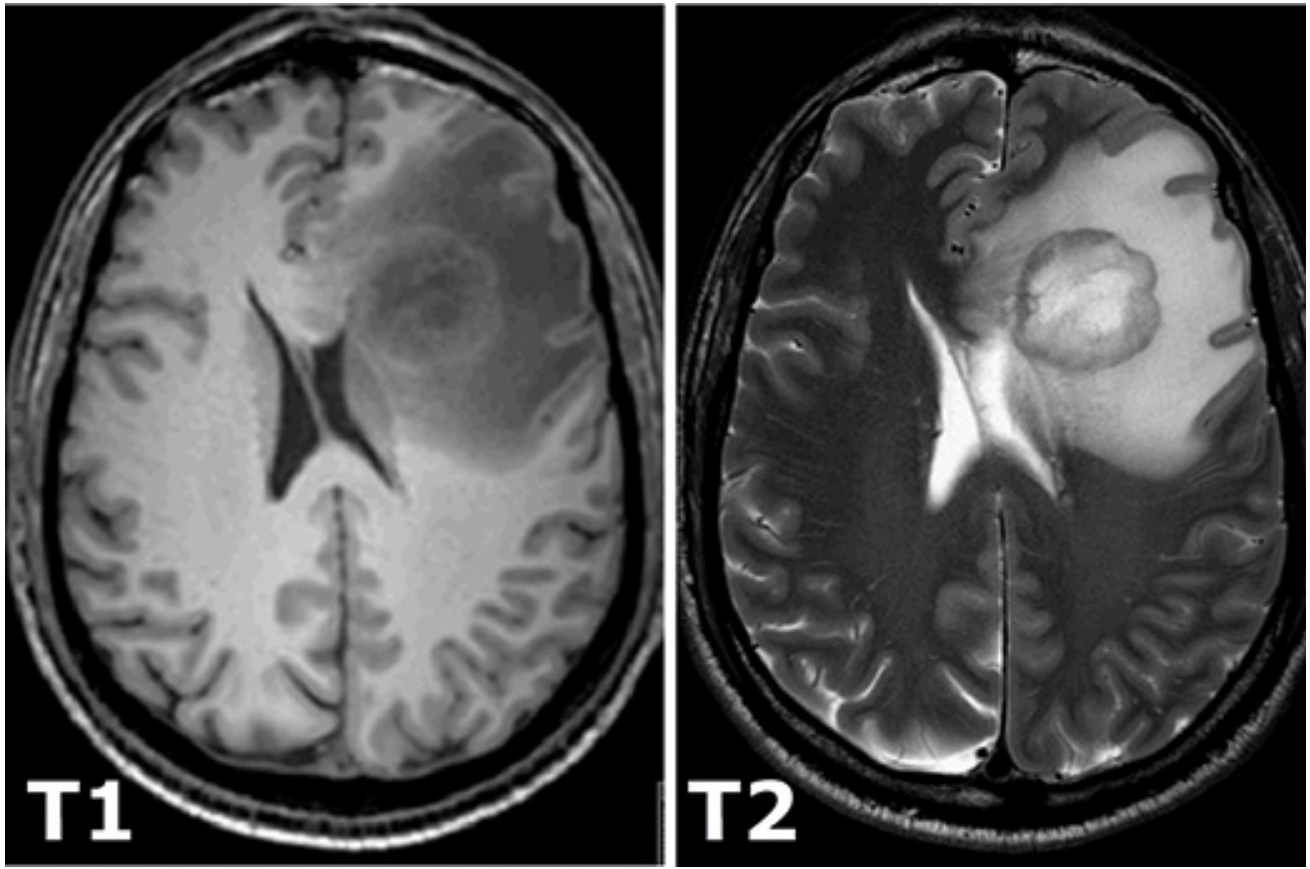
T1 — longitudinal relaxation time,
T2 — transverse relaxation time.





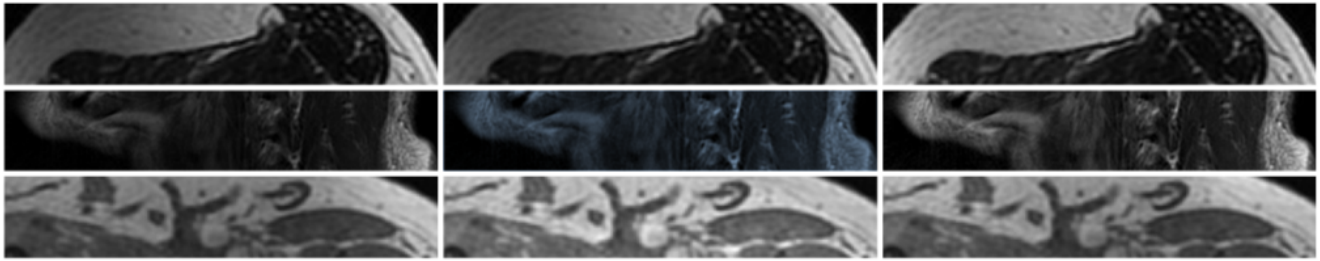
TR — repetition time,
TE — time of echo.

T1 and T2



Denoising and other improvements

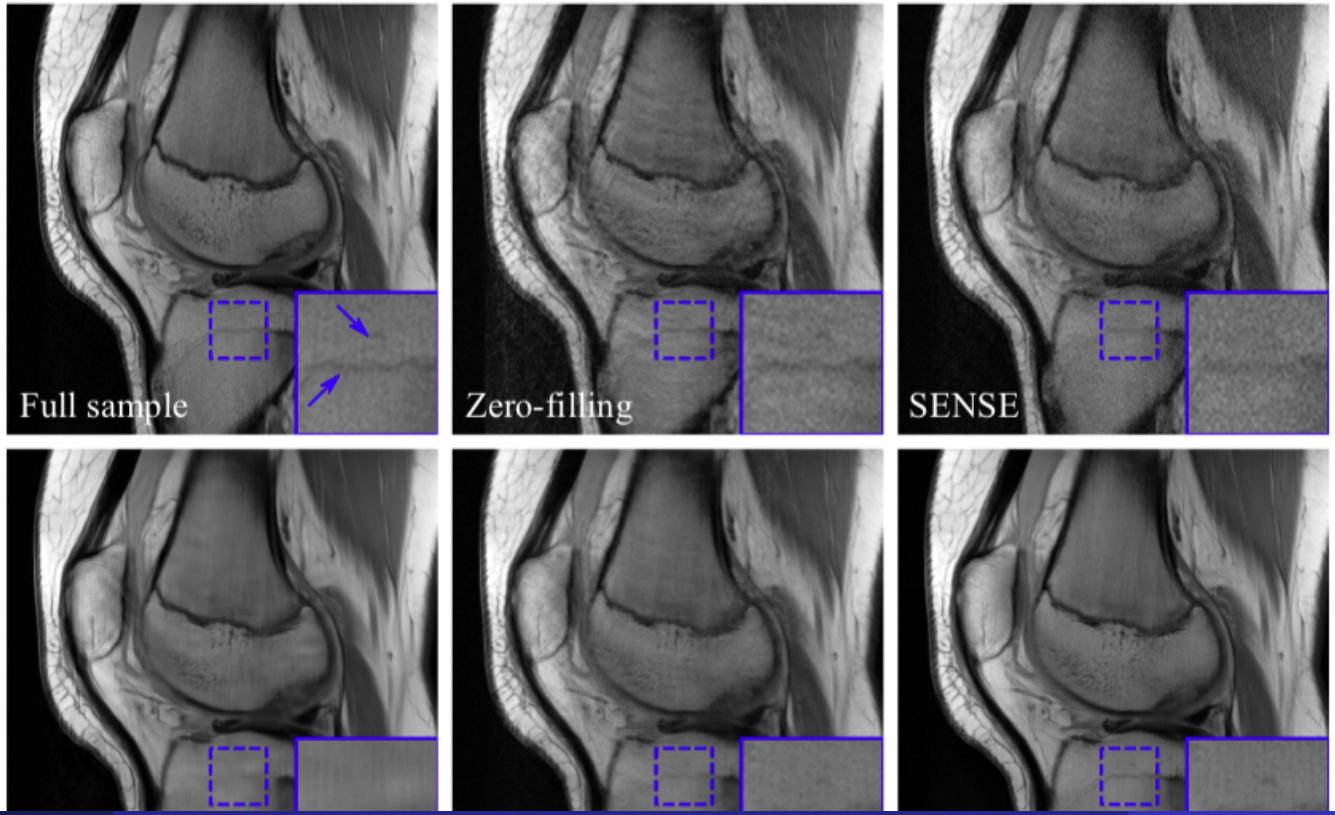
- A Generalized Network for MRI Intensity Normalization.



- Attention Guided Metal Artifact Correction in MRI using Deep Neural Networks

Denoising and other improvements

- Consensus Neural Network for Medical Imaging Denoising with Only Noisy Training Samples



Segmentation

- Dilated deeply supervised networks for hippocampus segmentation in MRI.

(a) Ground truth (b) V-Net (c) Proposed method

- Automatic Liver and Tumor Segmentation of CT and MRI Volumes Using Cascaded Fully Convolutional Neural Networks

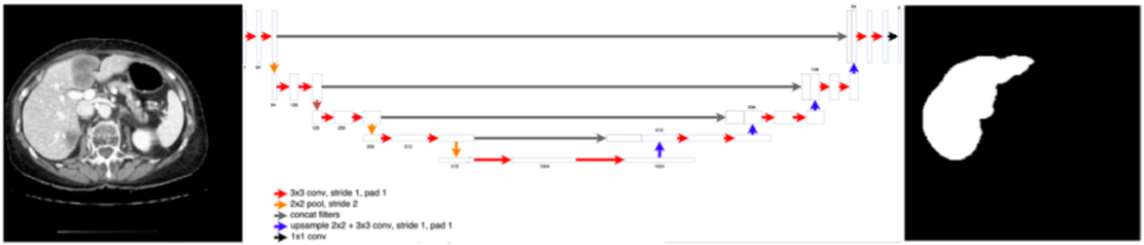
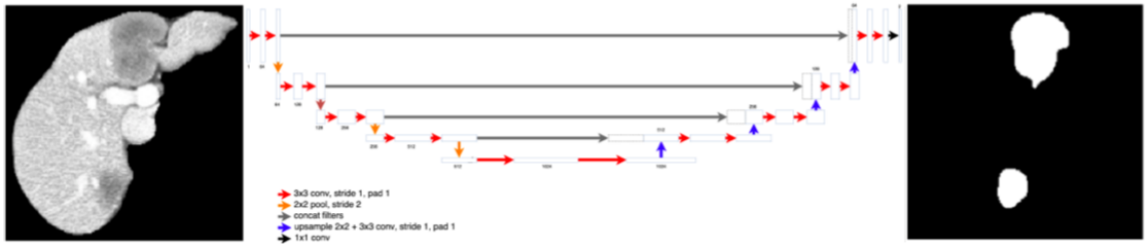
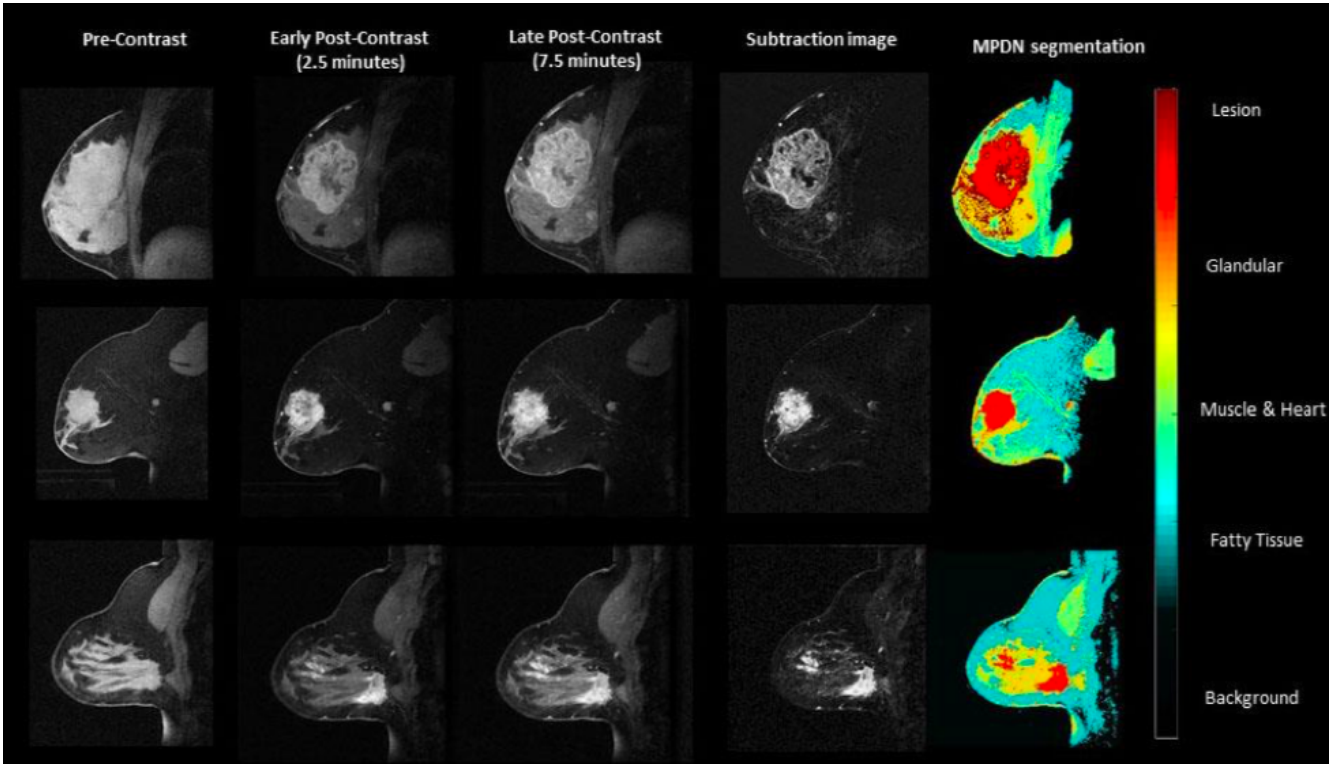


Figure 5: Step 1 of Cascaded FCN: The first U-Net learns to segment livers from a CT slice.



Tumor detection

- Multiparametric Deep Learning Tissue Signatures for a Radiological Biomarker of Breast Cancer.



Generating of new scans

- Medical Image Synthesis for Data Augmentation and Anonymization using Generative Adversarial Networks.