

A 3D CAD Tool for Body Fat Identification

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Examine the technical issues relating to the feasibility of using Computer Assisted Diagnosis (CAD) techniques to automatically identify, localise, and accurately measure body fat tissue from a rapid whole body MRI exam

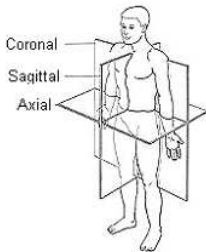


Motivation

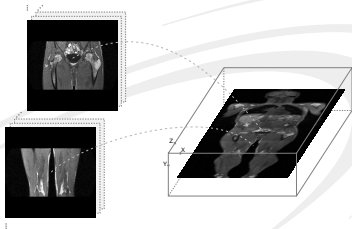
1. MRI vs Body Mass Index (BMI, kg/m^2) !
2. BMI Limitations:
 - may overestimate body fat in athletes and others who have a muscular build
 - underestimate body fat in older persons and others who have lost muscle mass
3. Previous CT, MRI
4. Athletes interest in fat distribution

Full Body MR Acquisition

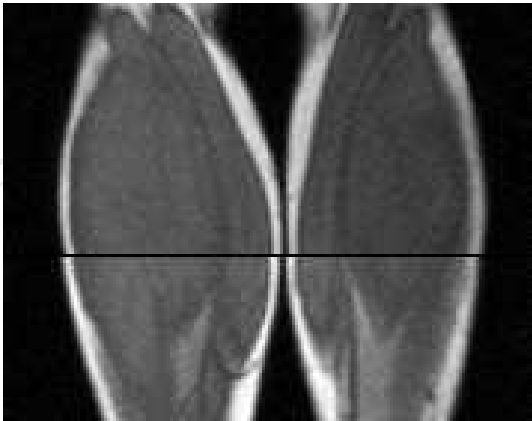
1. Head-to-toe coverage of 200 cm.
2. Images are acquired in 6-7 fully integrated stacks.
3. Imaging time of approx 140 secs.
4. 32 coronal slices of 8 mm thickness are acquired for each of 6-7 stacks.
5. Voxels dimension of $2 \times 2 \times 8 \text{ mm}^3$.
6. DICOM image format.



Full Body MR Acquisition

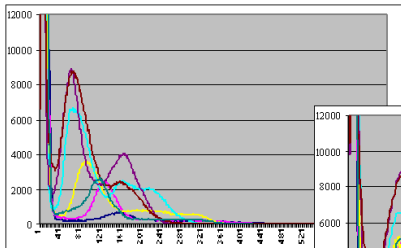


1. Simplistic reconstruction can result in poorly registered data.
2. Mismatches in localisation and image intensities.

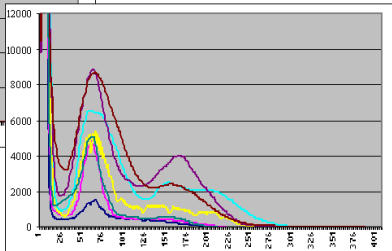


Grey Scale Correction

Scale the data to align the histograms to the minimum intensity value of the second peaks



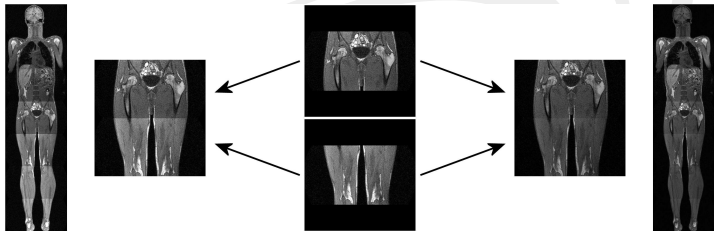
Histogram Matching

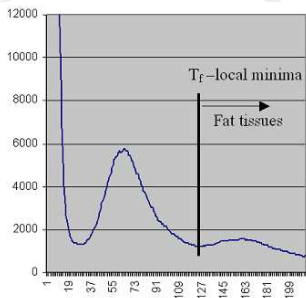
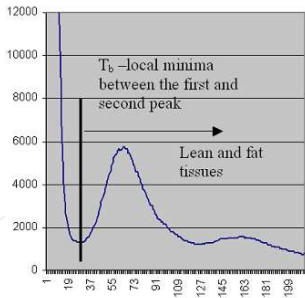


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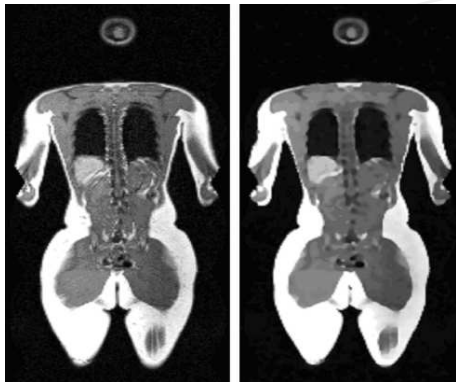


Matching and Merging





Adaptive Smoothing



1. Smoothing operation improves greyscale homogeneity.
2. Did not affect the edge localisation.
3. Potential fat voxels used to seed a 3D dilation based (6-connected) region growing procedure.

Total Body Fat Calculation (TBF)

$$TBF = (N_{FatVoxels})(Voxel_Dim)(Fat_Density)$$

normalised to yield the total body fat in kilograms

$$TotalBodyMass = TBF + (N_{FullBody} - N_{FatVoxels})(Voxel_Dim)(Lean_Tissue_Density)$$

NeatMRI - Graphical Interface

Body Fat Analyser

File Segmentation Tools

Study: Series Information: Volume:

Study #1 Series #1: 250 x 32 x 937, 2.822059mm x 8.0mm x 2.022059mm Study #11
Study #2 Name: Study #12
Study #3 Weight: 90.0kg Study #13
Study #4 Sex: M Study #14
Study #5 Date of birth: Study #15
Study #6 Estimated full body volume = 98,422.84cc Study #16
Study #7 Estimated full body height = 1.89m Study #17
Study #8 Study #18
Study #9 Study #19

Calculated Body Fat Table:

	Method 1	Method 2
Body weight DCOM	90kg	90kg
Body weight calculated	103.14kg	102.91kg
Estimated BMI	28.73	28.67
Fat by volume	31,803.81cc	33,016.37cc
Fat by weight	29.2kg	30.31kg
% by volume	32.31%	33.55%
% by DCOM weight	32.44%	33.68%
% by calculated weight	28.31%	29.45%

Ready

Volume Viewer

HOME

Rotation
Scale
Translation

Render type: Render quality
MR: Sub Visual

Threshold: 0

LUT Editor Save LUT

Modality box

Clipping Planes

LUT
LUT
LUT
MR
MR
MR

Ready

Slice 1 of 806

File Zoom Image View 1 View 2 Markup

Ready

Volume Viewer

HOME

Rotation
Scale
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MR: Sub Visual

Threshold: 0

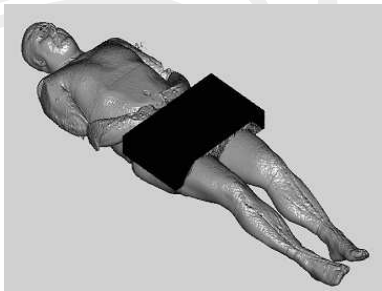
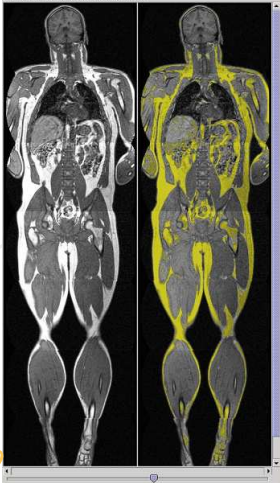
LUT Editor Save LUT

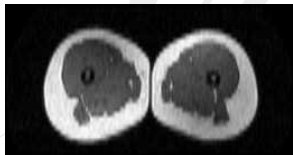
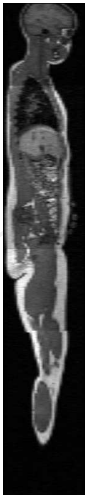
Modality box

Clipping Planes

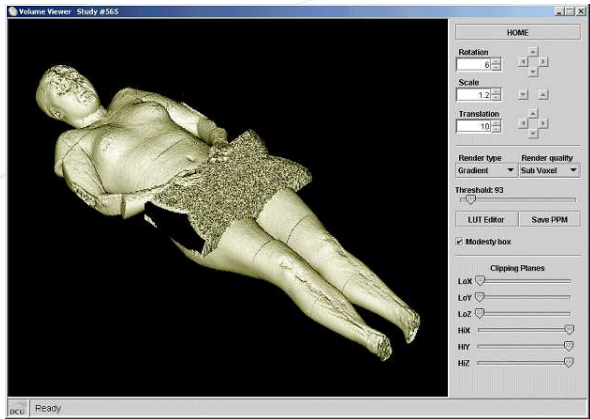
LUT
LUT
LUT
MR
MR
MR

Ready

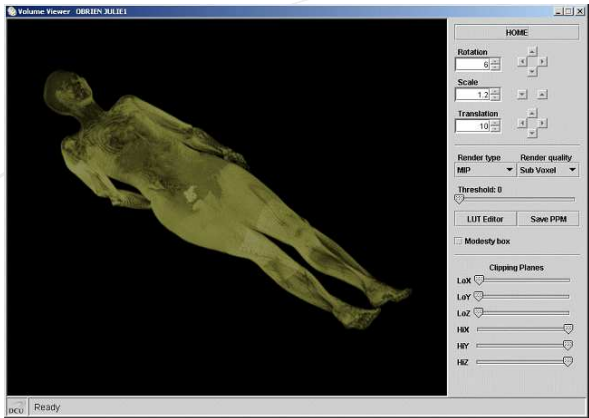


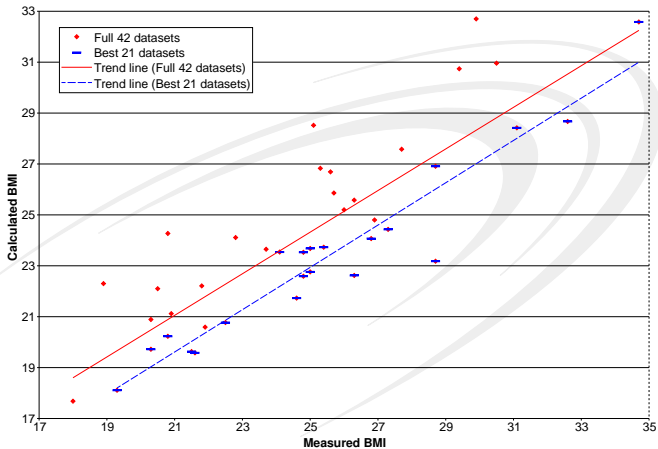


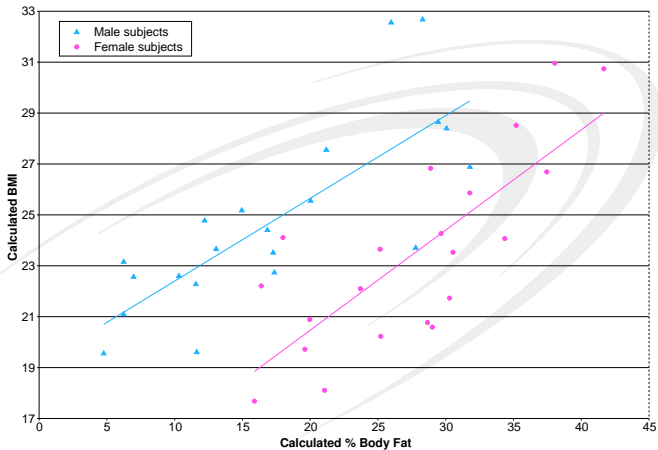
Surface Rendering of Volume



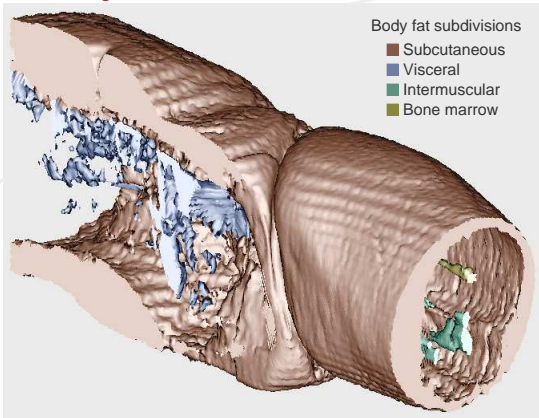
MIP







Body Fat Sub-Classification



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