

Measurement of Fat Lab

Jan 10, 2019, 1-3pm

Overview

Please download the starter .m files and data files from the CLE.

Follow the steps below. It is fine to do steps in a different order or with different methods, as long as the final objective is the same and any major changes are explained.

Include images of figures and results and discussion as requested in the step-by-step guide into a document and submit along with your .m files. You can publish your code as a .pdf in matlab.

Please see the Flowchart on the last page.

Parts:

- I. Create Fat Fraction Maps (FFmap, masked FFmap (with regions w/ low snr masked out))
- II. Manually segment visceral fat
- III. Semi-automatically segment visceral fat
 - a. Use the FF map
 - b. Use the masked FF map
- IV. Determine Accuracy / Differences in ROIs
 - a. Compare the semi-automatic VAT ROI (masked) to the manual VAT ROI.
 - b. Compare the semi-automatic VAT ROIs (masked) to the VAT ROI. (made using the masked FFmap vs. the FFmap).
- V. Assess the Effect of Diet on VAT – Post VAT vs. Pre VAT (just use 1 method)

Inputs:

Image files are in format of volumes:

<fileroot>.int2 = binary data, stored as short integers (2 bytes), top left of image, across, to bottom left of image, as a stack of images. Here inferior is listed first.

<fileroot>.idf is an image descriptor file = a text file w/ information such as the type of file and the # of pixels and FOV of the image volume

You can load these directly into matlab, or can use the read_idf_image_pc functions provided

Type help <command> to learn more

For this exercise, we will focus just on the umbilicus slice.

Pre = suc047_4_S10 files, use slice 15 if counting from the first slice, 30 if counting from the superior end (if using readidf functions)

Post = suc047_2_S21 files, use slice 18 if counting from the first slice (from feet); 27 if counting from superior end (if using readidf functions)

STEP-BY-STEP GUIDE TO THE LAB

Fat Fraction Measurements

Part I - Create Fat Fraction Maps (FFmap, masked FFmap)

<u>Output?</u>	<u>Steps</u>
	1. Load images.
	2. Calculate a Fat Fraction (FF) Map. → FF map
	3. (Create a Body/SNR Mask) Threshold (pick which data) to only include values in the body w/ good SNR (by eye ok).
	4. (Create a Body/SNR Mask) Apply a 2D median filter to this thresholded mask. Select a size that eliminates most or all of the background noise without altering the body shape/size. → Body /SNR Mask
	5. Apply this mask to the fat fraction map. → masked FF map
Y	6. Make a figure of: the FF map, the Body/SNR Mask, and the masked FF map
Y	7. Discuss the differences between these two maps. What was the impact of doing steps 3 and 4? What are the implications of changing the threshold in step 3 or the filter size in step 4? When might you not want to do these steps?

Part II – Manually Segment Visceral Fat (manVAT)

(on one slice)

<u>Output?</u>	<u>Steps</u>
Y	1. Time yourself and manually draw an ROI around the visceral fat on whichever image type you prefer. (i.e. fat, water, FF map, in-phase, out-of-phase, etc) → manual VAT
Y	2. Make a figure with the manual VAT ROI marked on your image

Part III – Semi-automatically Segment Visceral Fat

1-Manually segment the Viscera

<u>Output?</u>	<u>Steps</u>
Y-2x	1. Time the time it takes to create the ROI.
	On one slice – the same slice as above:

Y-2x	2. Draw a rough ROI around the viscera (exclude subcutaneous fat, vertebrae), but include fat posterior to the kidneys).
	3. Create a mask from the viscera ROI.

2-Automatically generate VAT mask and VAT-FF

Do the following steps twice (with the following maps) and generate VAT ROIs:

- A. Use the FF map → VAT ROI (FF)
- B. Use the masked FF map → VAT ROI (mFF)

Output?	Steps
Y-2x	4. Time the time it takes to create the ROI.
	On one slice – the same slice as above:
Y-2x	5. Draw a rough ROI around the viscera (exclude subcutaneous fat, vertebrae), but include fat posterior to the kidneys).
	6. Create a mask from the viscera ROI.
	7. Create a histogram of the FF in the viscera ROI.
	8. Threshold the FF map to include only FF > 50% → FF-mask50
	9. Multiply the FF map by the viscera mask and by the FF-mask50, element by element. → VAT ROI
Y-2x	10. Create a histogram of the VAT ROI FF values
Y-2x	11. Make a figure of the VAT ROI FF image
	12. Describe the histograms of the visceral ROI FF and the VAT ROI FF and any differences. What shape do they have and why?

Part IV - Determine Accuracy / Differences

Do these steps twice (for comparisons A and B):

- A. Compare the semi-automatic VAT ROI (masked) to the manual VAT ROI.
- B. Compare the semi-automatic VAT ROIs (masked) to the VAT ROI. (made using the masked FFmap vs. the FFmap).

Output?	Steps
Y-2x	1. Calculate the volume, median, mean, and std dev of the VAT ROI Fat Fraction
Y-2x	2. Calculate the Dice coefficient (See lecture slides) and the %Difference in size vs. the manual VAT ROI(A) or vs. the VAT ROI (B)
Y-2x	3. Make a figure with the fat fraction image, the mask of the two VAT ROIs and the overlap of the two masks.
Y-2x	4. Discuss the differences between the two approaches to measuring the visceral fat.

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Part V - Assess Effect of Diet on VAT – Post VAT vs. Pre VAT

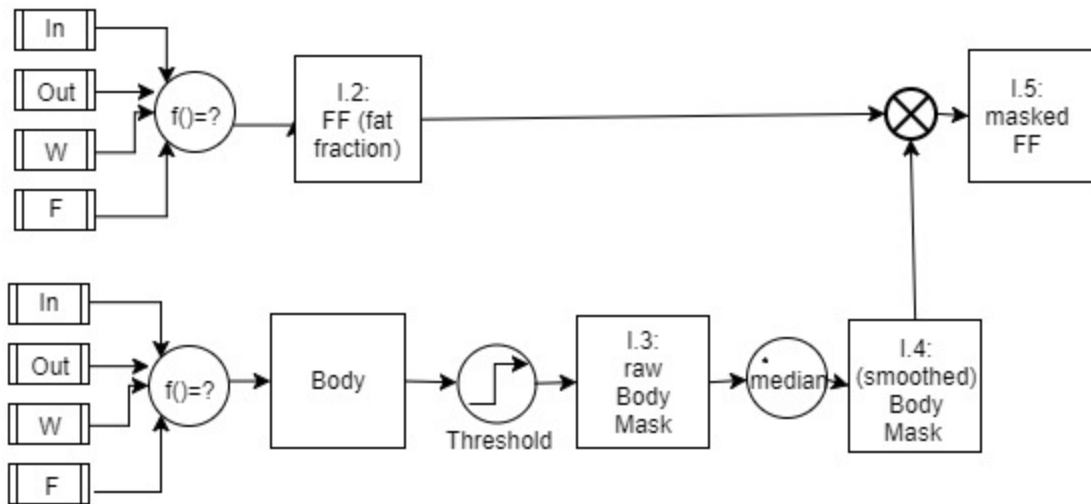
<u>Output?</u>	<u>Steps</u>
Y	1. Load the images for Pre and for Day10 and calculate the masked VAT ROIs (on the masked FFmap)
Y	2. Calculate the volumes of each ROI.
Y	3. Calculate the %change in volume for (Day10-Day0)/Day0
Y	4. Make a figure of the VAT ROI image from Day0 and from Day10
Y-2x	5. Determine the volume, median, mean, and std dev of the VAT ROI Fat Fraction
Y-2x	6. Display the histogram of the VAT ROI fat fraction
Y	7. Discuss the findings.

Part VI – SAT Measurement

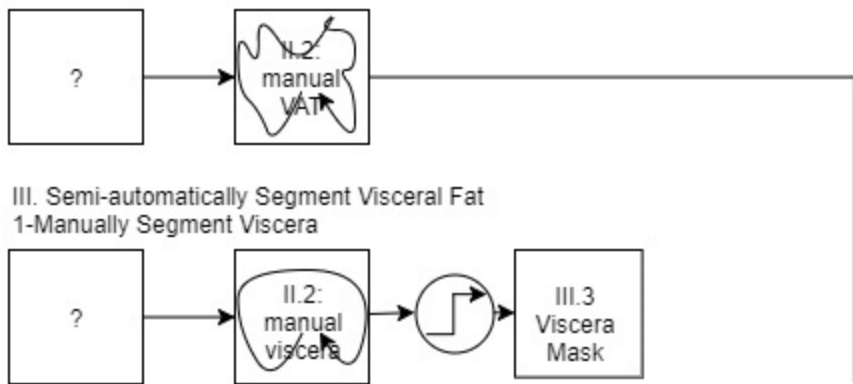
Y	1. List the steps you'd need to follow to also segment the SAT on the same slice as above.

See Flowchart on the next page.

I. Create Fat Fraction Maps (FFmap, masked FFmap)

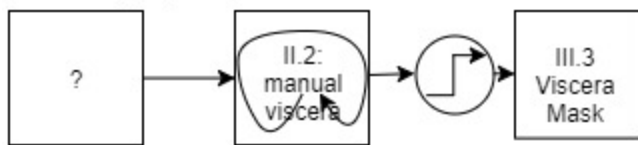


II. Manually Segment Visceral Fat (manVAT)



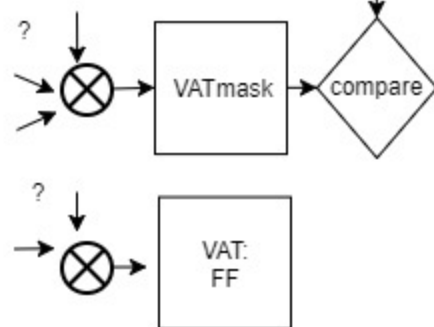
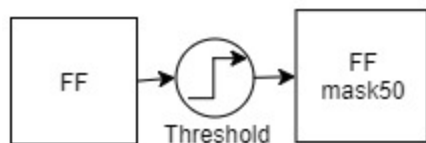
III. Semi-automatically Segment Visceral Fat

1-Manually Segment Viscera



2-Automatically generate a VAT mask and a VAT: FF for:

(A) FFmap and (B) masked FF map



IV. Compare ROIs