Computer Technology for the quantification of pericardial fat assessed through cardiac CT
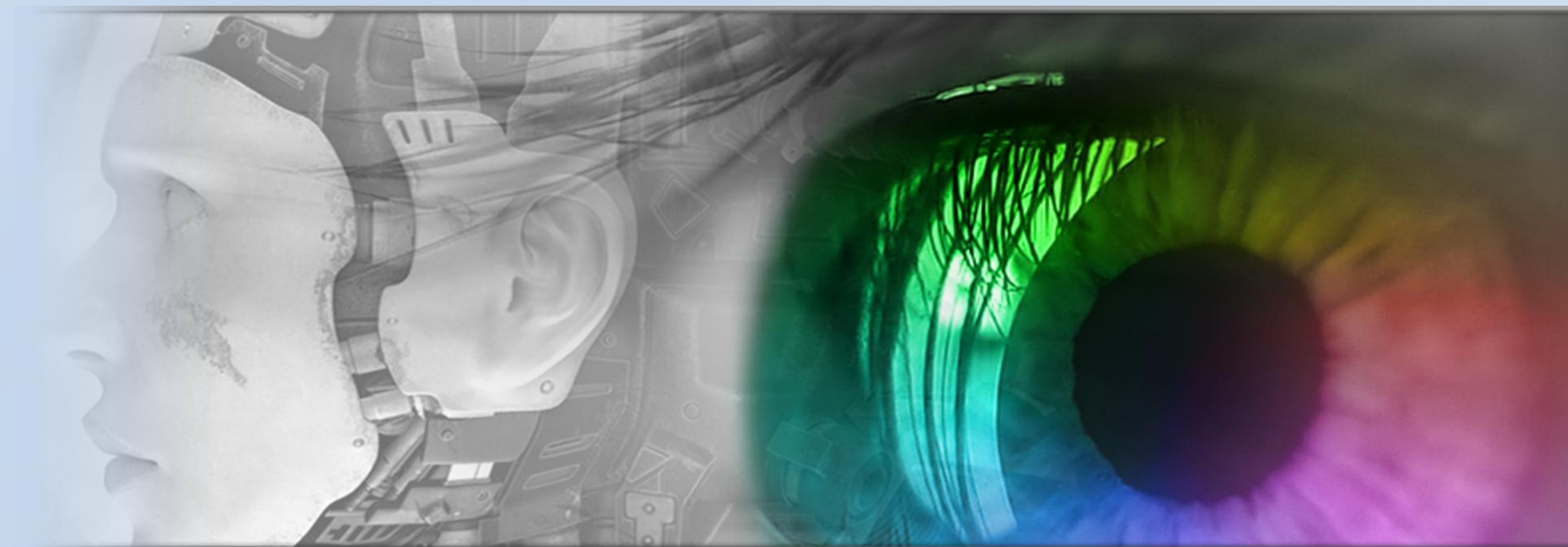
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ABSTRACT

Pericardial fat is associated with the extent of coronary artery disease (CAD) and with cardiovascular mortality. The aim of the study was to develop a computer software for the detection and measurement of pericardial fat in patients with suspected CAD. Main design requirement were: simplicity of use, short execution time and measurement accuracy.

METHODS

- A dedicated software was developed to quantify pericardial fat from cardiac Multi Slice CT

- In this work we used standard Calcium Score Scans

- Each scan was preliminarily reformatted according to long-axis
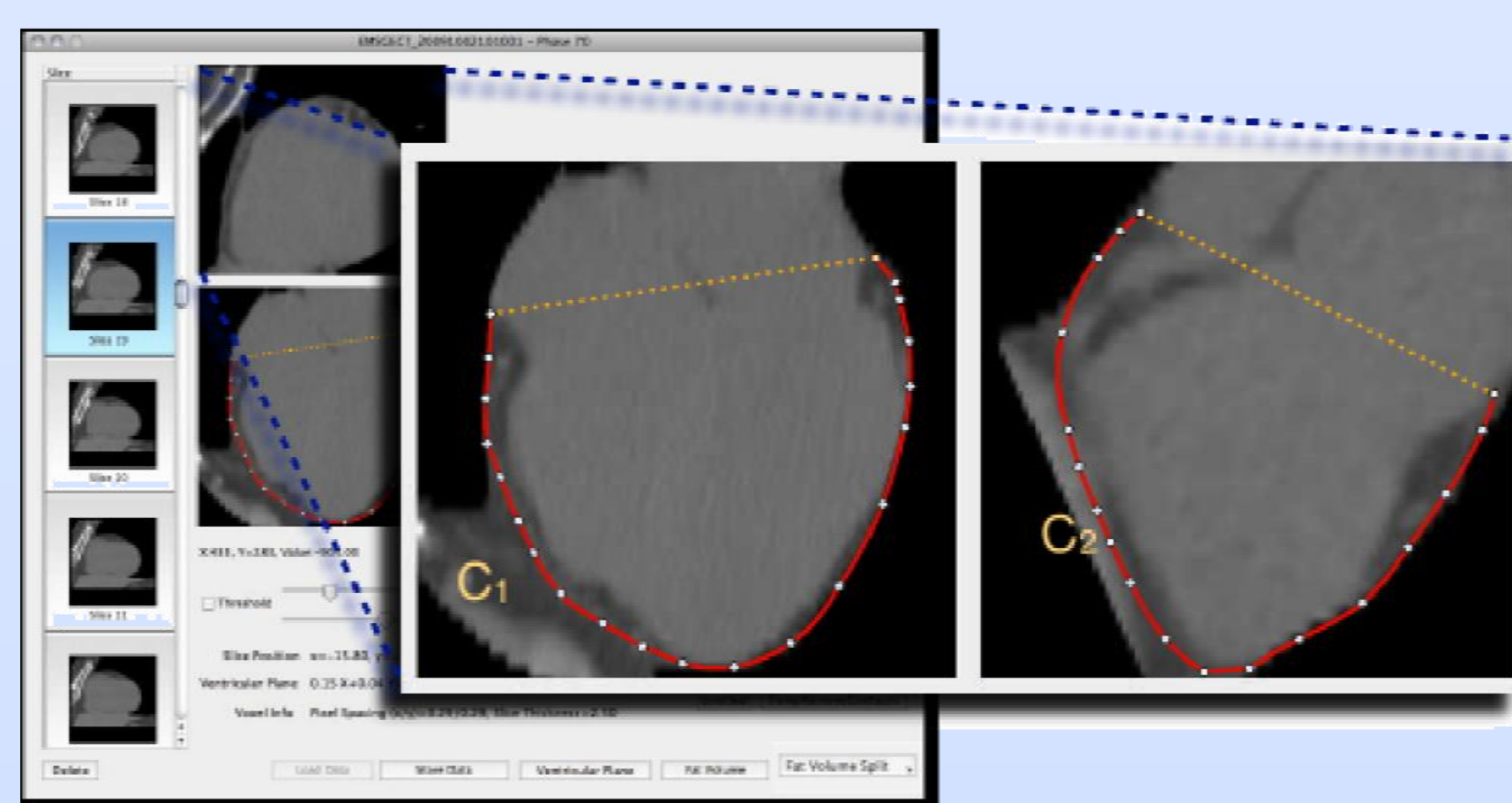
1. The boundaries of pericardium (C1 and C2) are interactively traced in two (orthogonal) long-axis slices of the heart


2. The ventricular region is automatically segmented:
- Pericardial surface is represented by a series of spherical harmonics
- The series coefficients are estimated by minimizing the elastic energy of the surface under the action of the data points modelled as springs
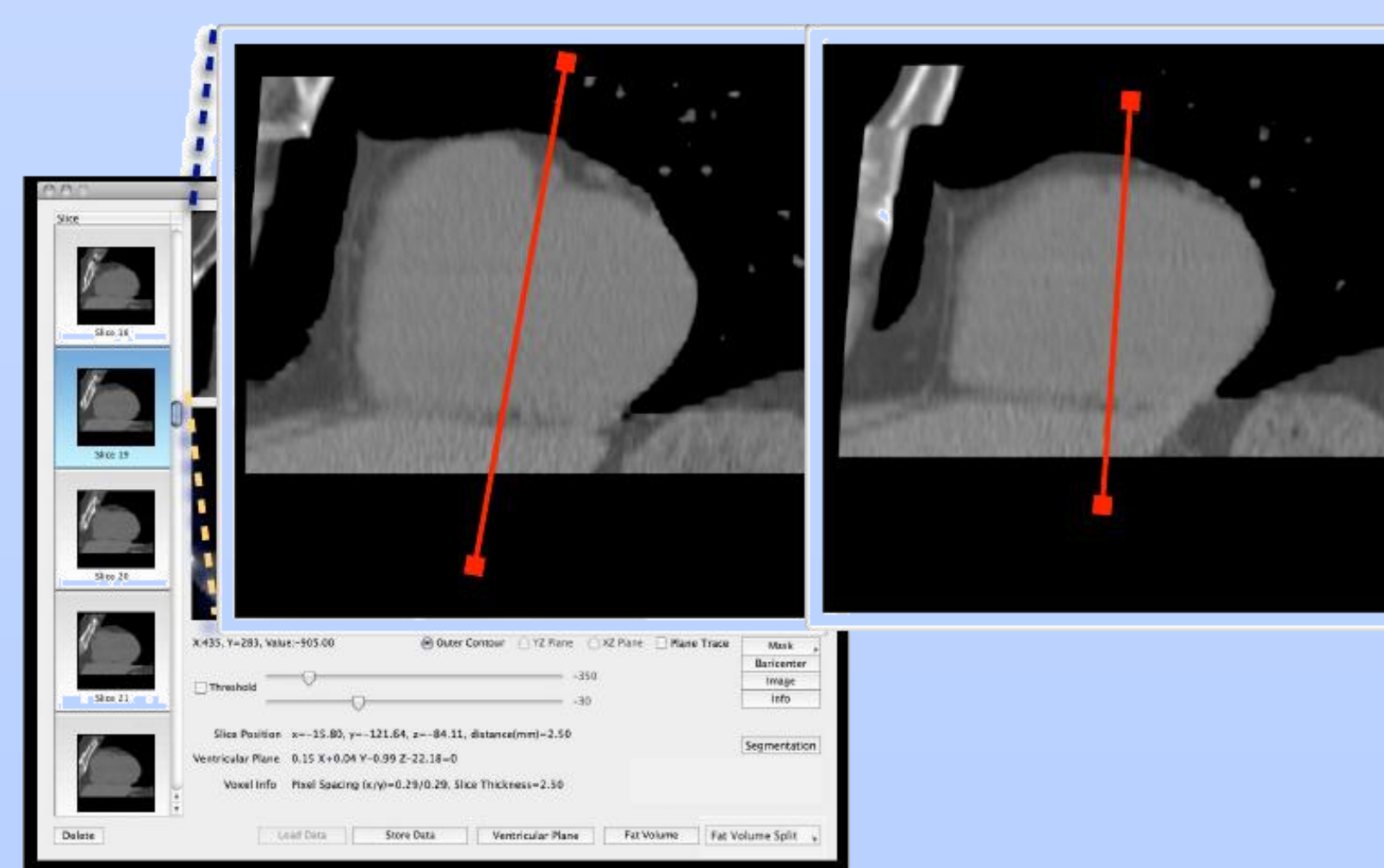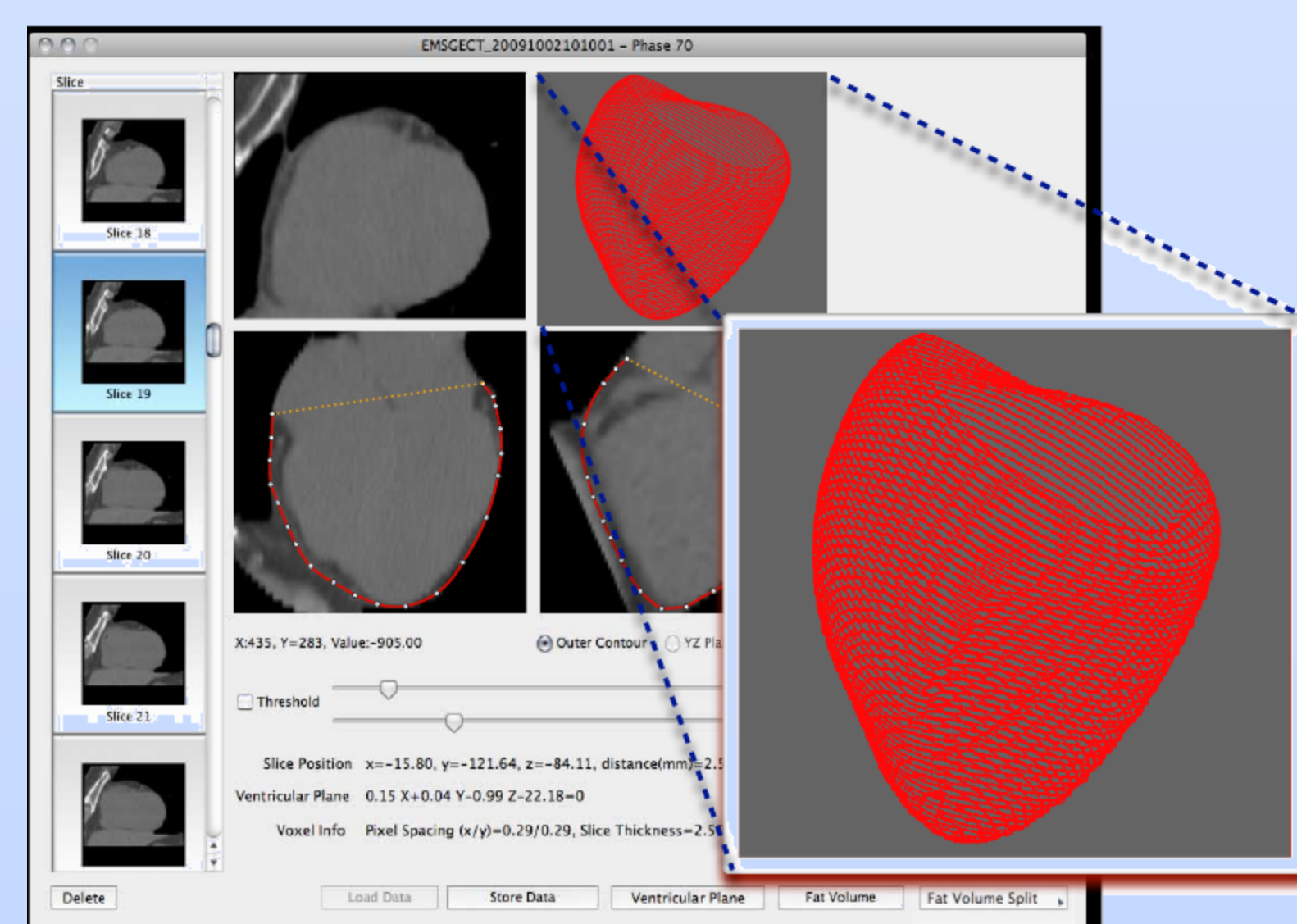
3. The operator defines the trace of the inter-ventricular plane in two slices

4. Fat volume is reconstructed:
- Applying a gray window (default values: -25 ÷ -350 HU)
- Fat volume as well as the fat volume of left and right ventricle regions are finally computed by voxel-counting
- The segmented regions may be extracted to allow 3D visualization and further processing
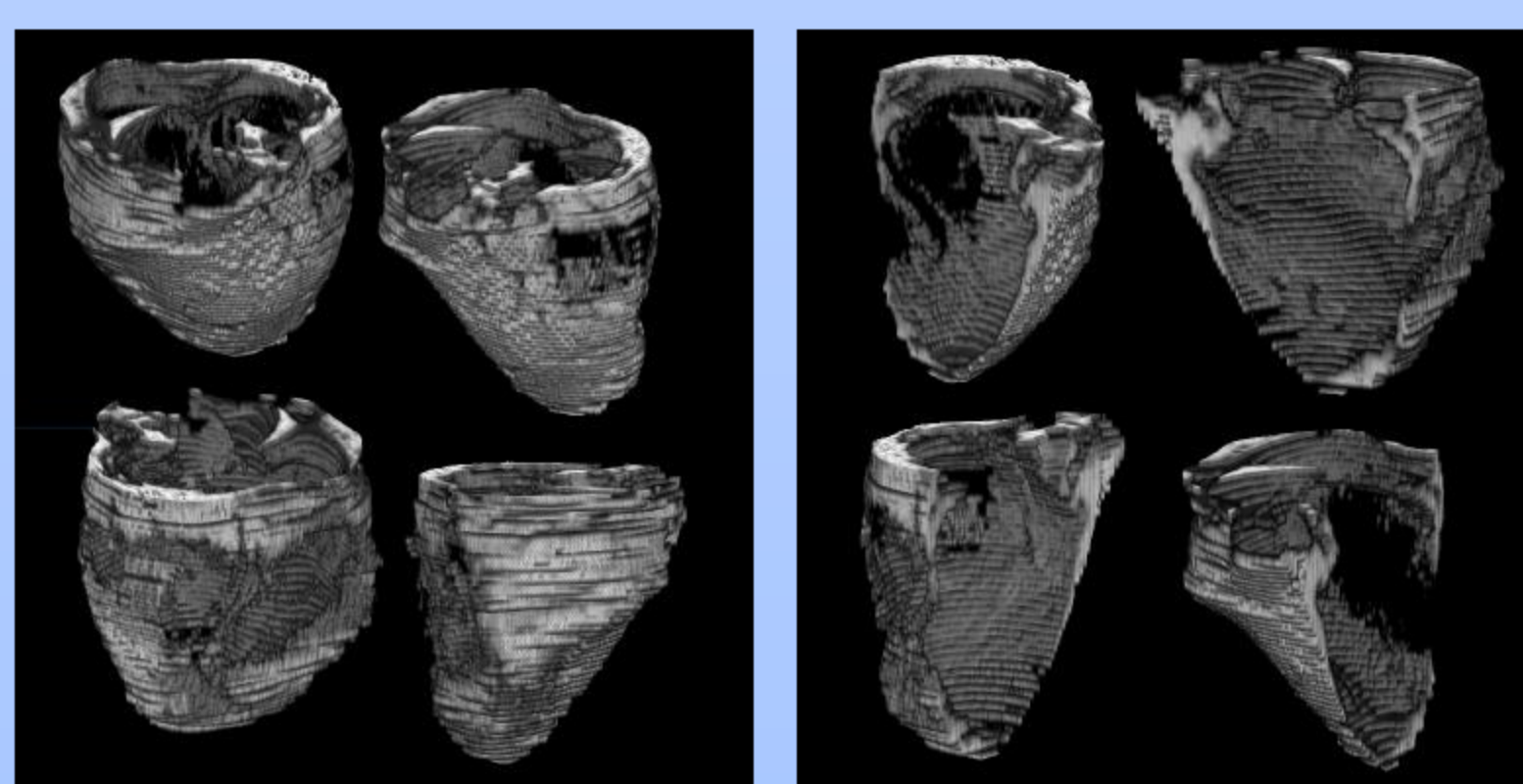
SEGMENTED FAT   **LEFT/RIGHT SPLITTING**

RESULTS

- To test the performance of the software, we used the scans from a set of 22 patients (63±8 years, 64% male, body mass index [BMI] 27.4±5.2 kg/m2) referred to our Institution for suspected CAD and undergoing cardiac CT

- In this patient sample, we observed that the total pericardial volume (108.92 ± 32.31 cm^3) was divided unevenly between the right (71.79 ± 28.3 cm^3) and left (37.52 ± 15.59 cm^3) ventricles.

- To evaluate the accuracy of our procedure, we compared the volume V_M provided by the program with the volume V_R obtained by manually segmenting the pericardium on a slice by slice basis

$$V_M = 0.967\, V_R + 3.075$$
$$R^2 = 0.9861$$
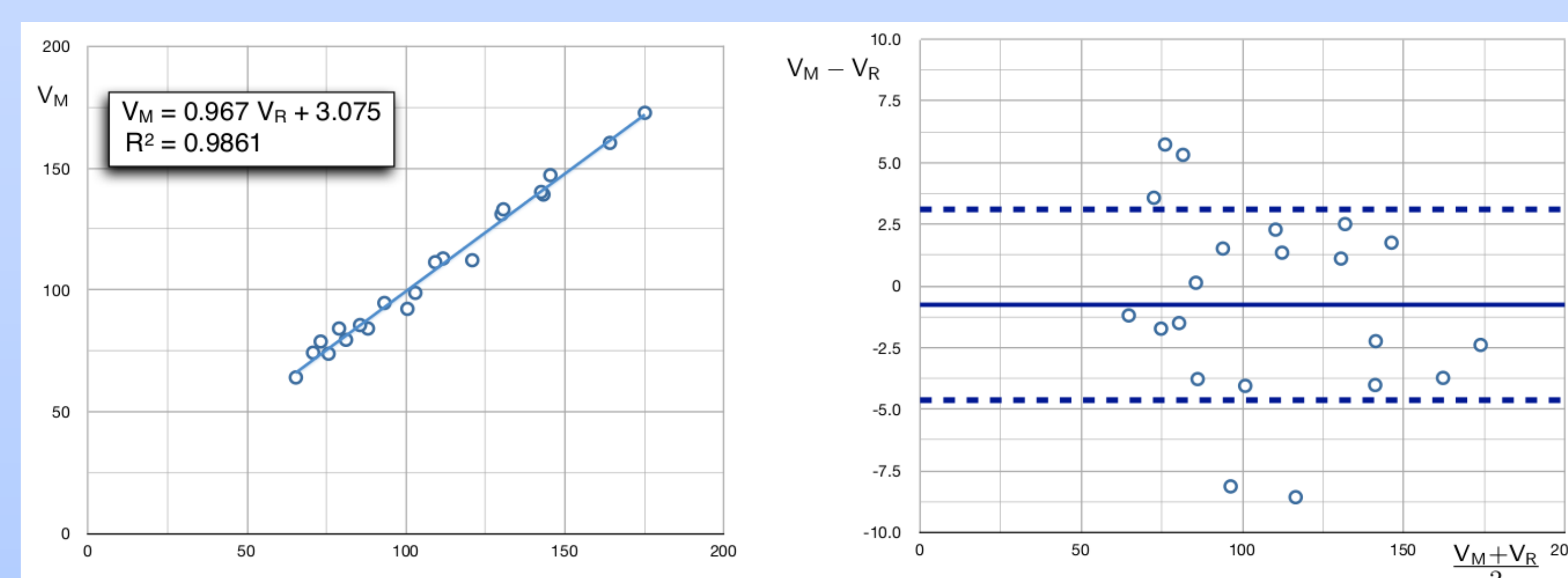
- We obtained: V_M = 108.92 ± 32.31 cm^3, V_R = 108.16 ± 31.39 cm^3

- A very good linear correlation was observed among V_M and V_R with R^2 = 0.98

CONCLUSIONS

- Pericardial fat volume may be assessed non-invasively through cardiac CT

- The average computation time is about 20s on a normal PC; the overall time needed to complete the measurement is less than 2 minutes

- The use of a computer software, such as the one tested in the present study, permits a systematic evaluation of epicardial fat that may prove useful for the risk stratification of patients undergoing cardiac CT