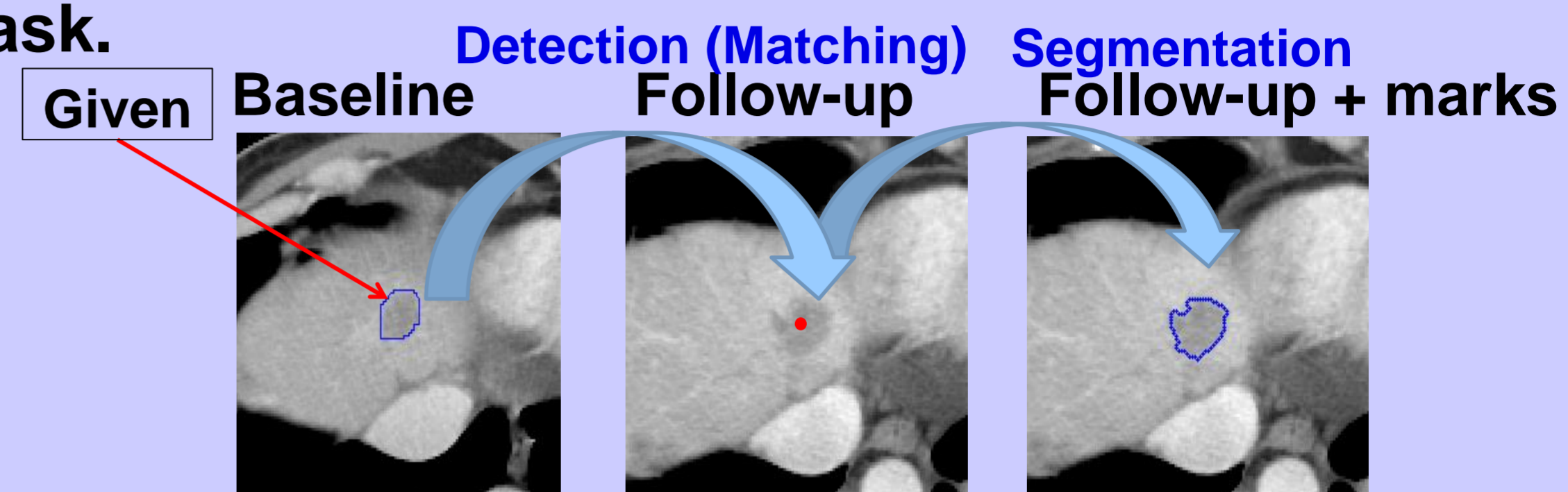


## Abstract

A novel automated method for detection and segmentation of various liver metastases classes on serial CT examinations is shown. Our method uses the given 2D baseline segmentation mask for identifying the lesion location in the follow-up CT and locating surrounding tissues in order to reduce the search area for segmentation. Adaptive region-growing and mean-shift clustering are used to obtain the final lesion segmentation. Results show average Dice index of  $0.84 \pm 0.07$  and matching rate of 93.2%.

## Goal

Automated algorithm for tracking and segmentation of metastatic liver lesions, given a baseline segmentation mask.



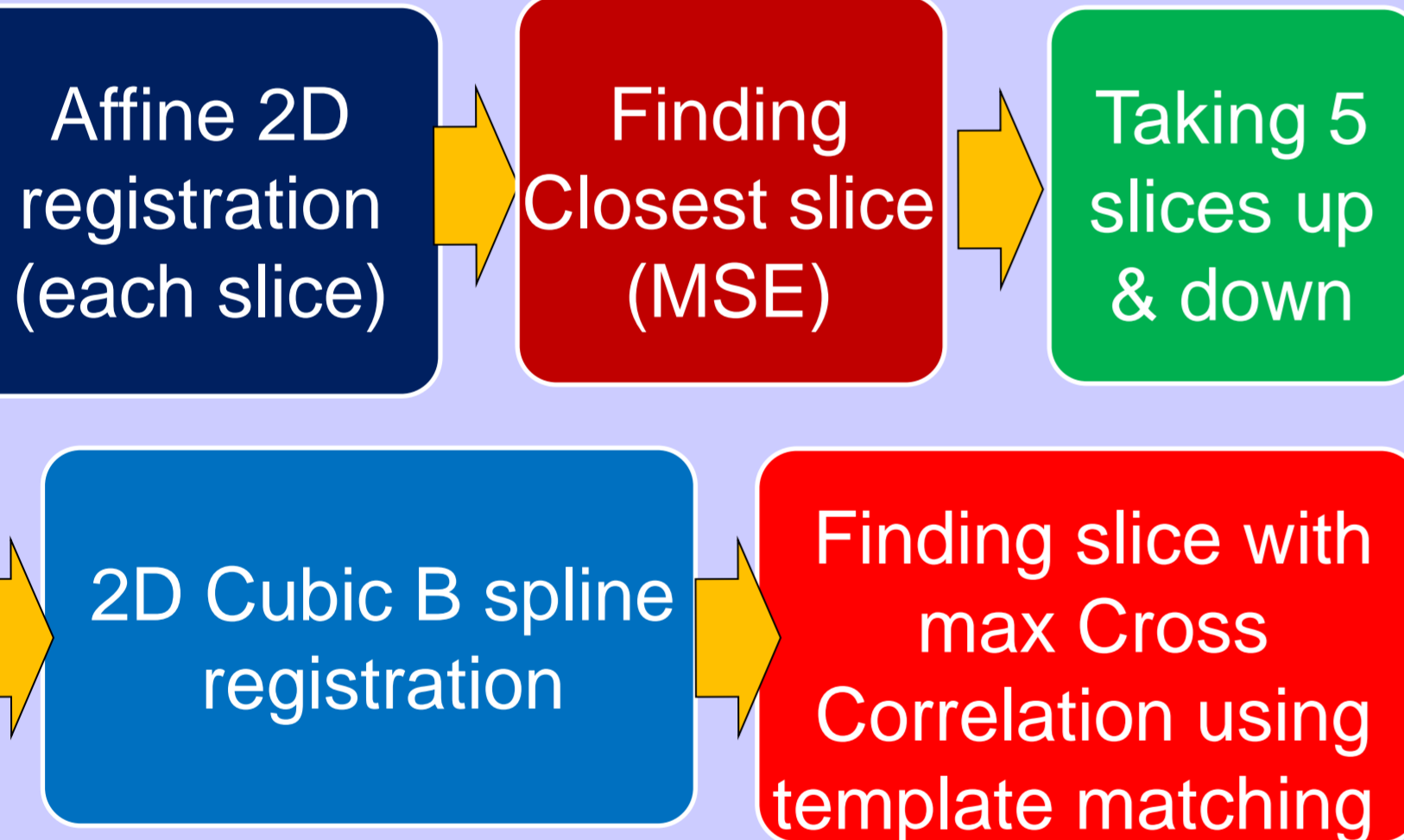
Motivation: The main criterion for evaluation of a therapy is change in tumor size. Tracking lesions over time and measuring diameter length is a time consuming task with the radiologist comparing two 3D CT scans which may include multiple metastases.

## Methods

### Step 1

Finding the most similar slice in the 3D Follow-up scan given the baseline CT slice.

- Reducing search area using anatomical knowledge and Mean-Shift clustering.

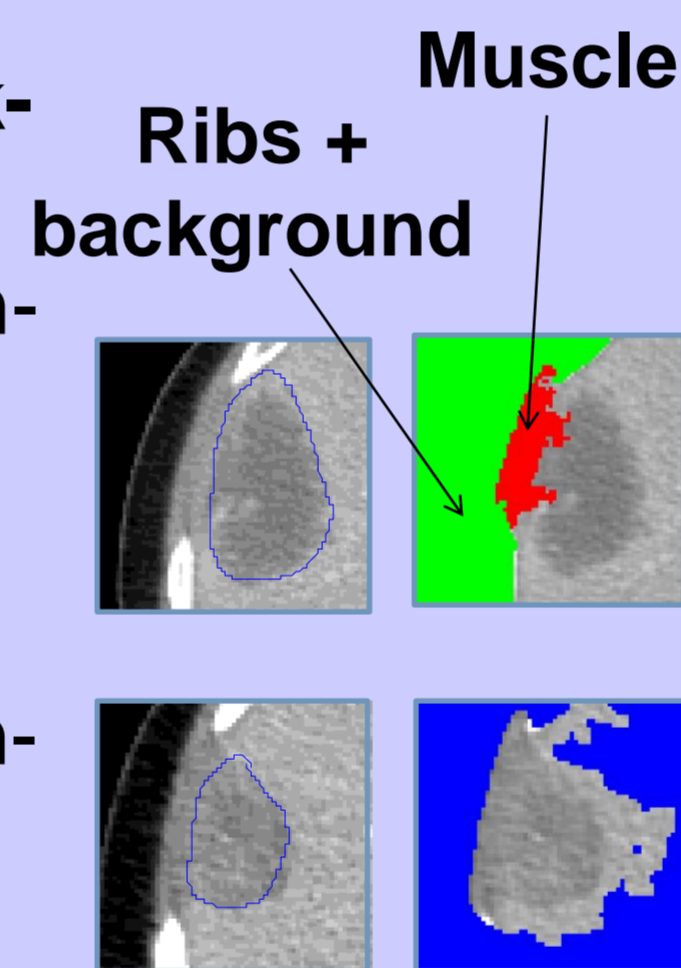


### Step 2

Constraining the search region in a novel way using the context from the baseline slice:

**Baseline intensity mask-**

Taking out regions containing pixels with non-similar or very similar intensity to the lesion.



**FU intensity mask –**  
Taking out pixels with non-similar intensity to the lesion.

**Muscle removal mask-** leaving only parenchyma + lesion.

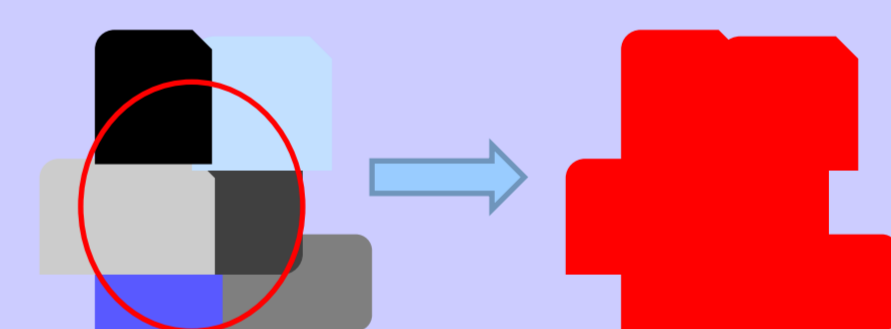


### Step 3

**Segmentation :**

**Adaptive region growing** optimizing compactness with limitations on mean and STD of the intensity levels.

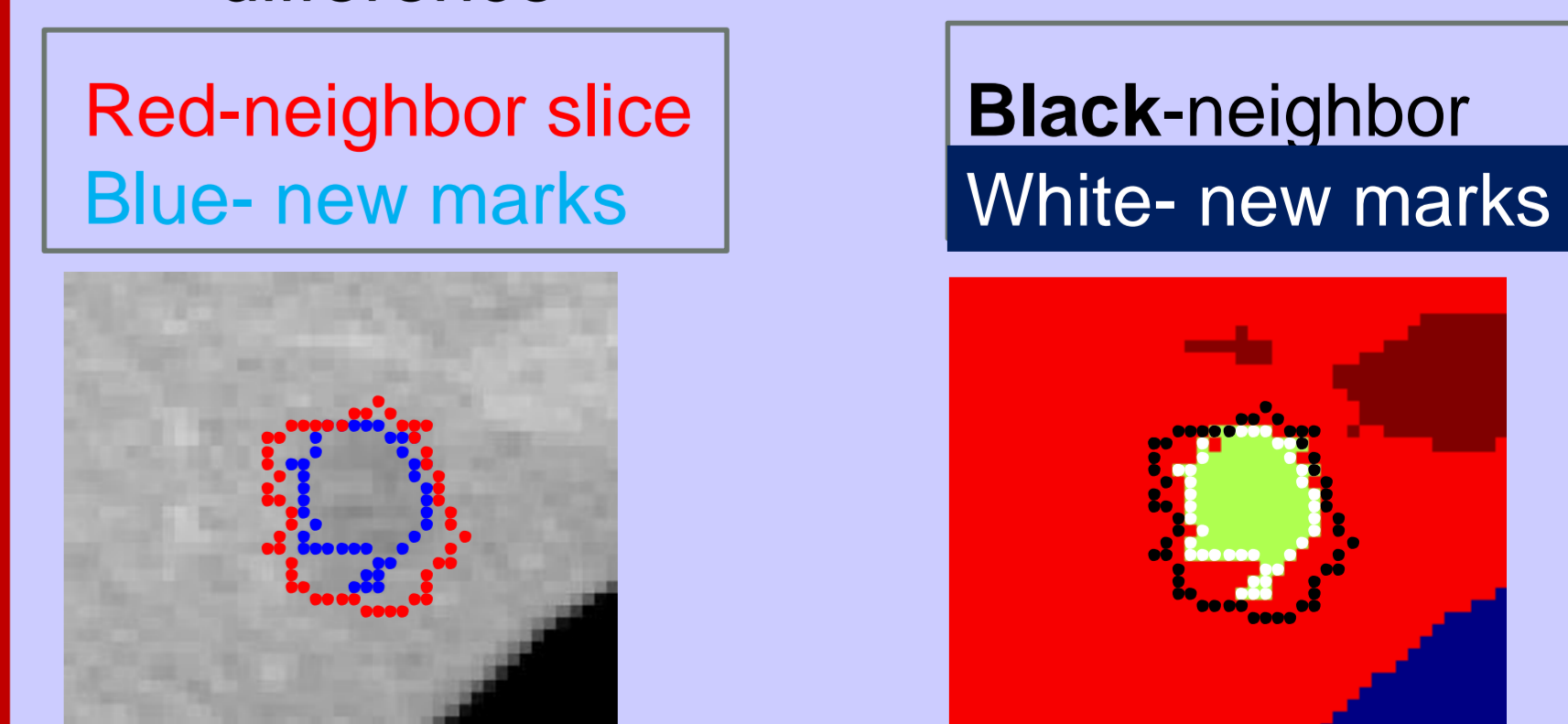
- Case of no optimization => **refining the seed points** using thresholding and template matching
- Refining the boundary** using mean shift segmentation for lesions with high variability.



### Step 4

**3D Propagation using mean shift clustering:**

- Removing regions with low ranking :
  - Overlap ratio and relative area (compared to neighbor)
  - Compactness
  - Intensity levels mean and STD difference



## Results & Discussion

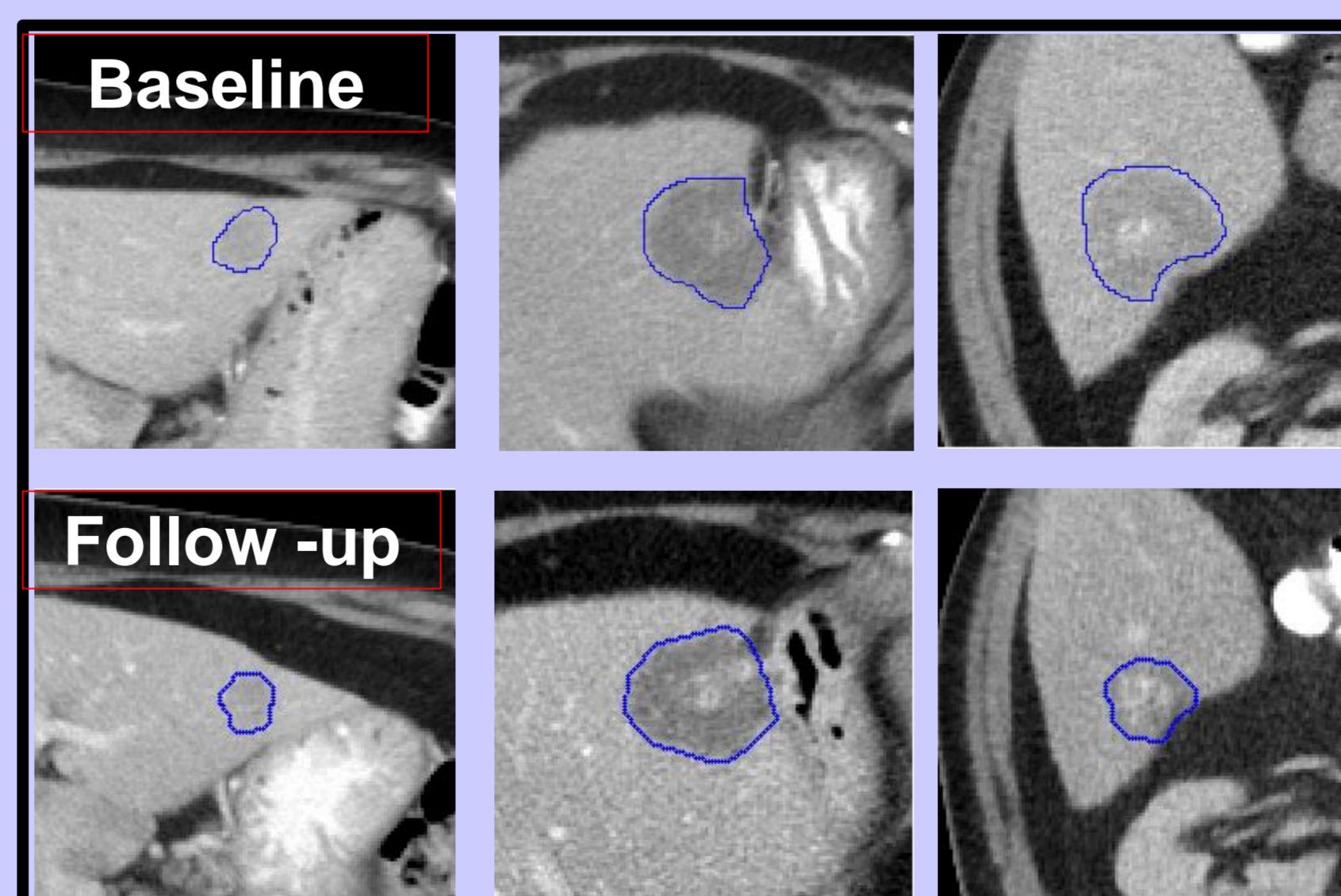
Data: 35 patients containing 59 metastatic lesions:

Small lesions (14) – Longest diameter < 2[cm]  
Large lesions (7) – Longest diameter > 5[cm]

	--	-	0	+	++
Ratings	2	2	8	20	23
[%]	3.6	3.6	14.6	36.8	41.8

++ = Very good + = Good  
0 = Acceptable - = Bad  
-- = Very bad

	Dice	Sensitivity	PPV
Mean	0.84	0.83	0.87
SD	0.07	0.11	0.11



We reach high sensitivity , PPV and Dice segmentation results

Our method detected and segmented 55 out of 59 lesions – 93%

In 92.8% of the cases the results were classified as acceptable or better (0, +, ++) by consensus among 2 readers

• Ben Cohen, Avi, et al. "Automatic detection and segmentation of liver metastatic lesions on serial CT examinations." Oral presentation at CAD session, SPIE Medical Imaging 2014.