An Entropy Based Multi-Thresholding Method for Semi-Automatic Segmentation of Liver Tumors

ALTAIR Team

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Summary

- Introduction
- Material and Methods
  - Liver Segmentation
  - Tumor Segmentation
- MICCAI Competition Results
- Future Work

Introduction - Liver Cancer

- Liver cancer is the 5th most commonly diagnosed cancer and the 3rd most common cause of death from cancer worldwide[1]
- The liver is the 2nd most commonly involved organ by metastatic disease[2]

[1] *American Cancer Society, 2008. Cancer facts & figures 2008. Technical report, Atlanta: American Cancer Society*

[2] *World Health Organization, 2008. World health statistics 2008. Technical report, WHO Press*

Materials and Methods

Our system workflow is divided into 2 main steps:

- Segmentation* of the liver using the ribs and diaphragm constraints.
- Segmentation* of the tumor from the segmented liver using multi-thresholding approach.

* **Segmentation**: *to partition an image into distinct, semantically meaningful entities by defining boundaries between features and objects in an image, based on some constraint, or homogeneity predicate.*

Segmentation of the Liver

1. Segmentation of the ribs
2. Segmentation of the diaphragm
3. Watershed

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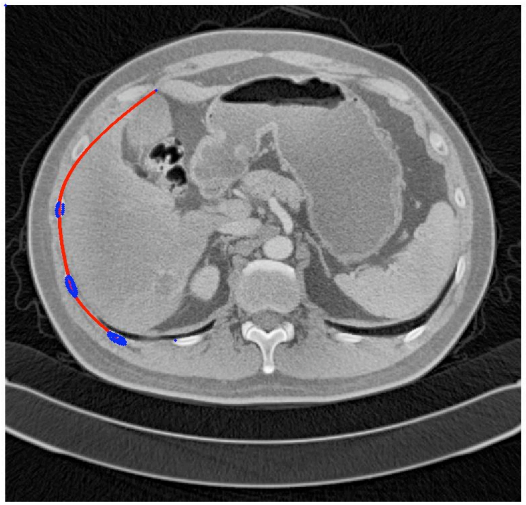

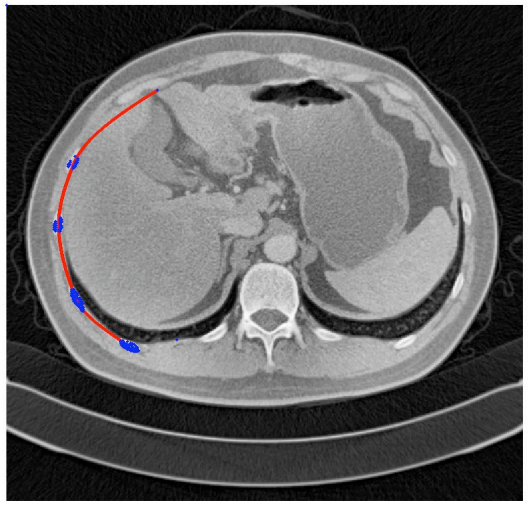

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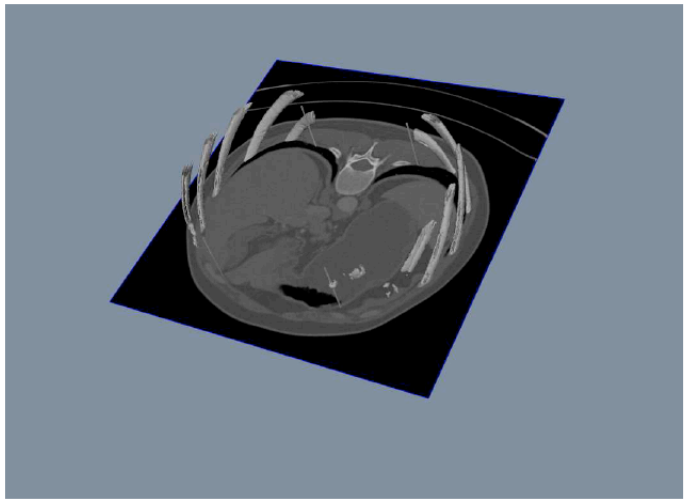

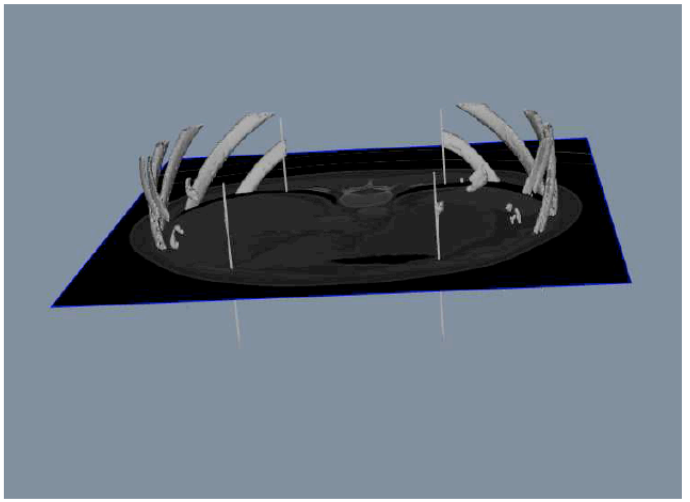

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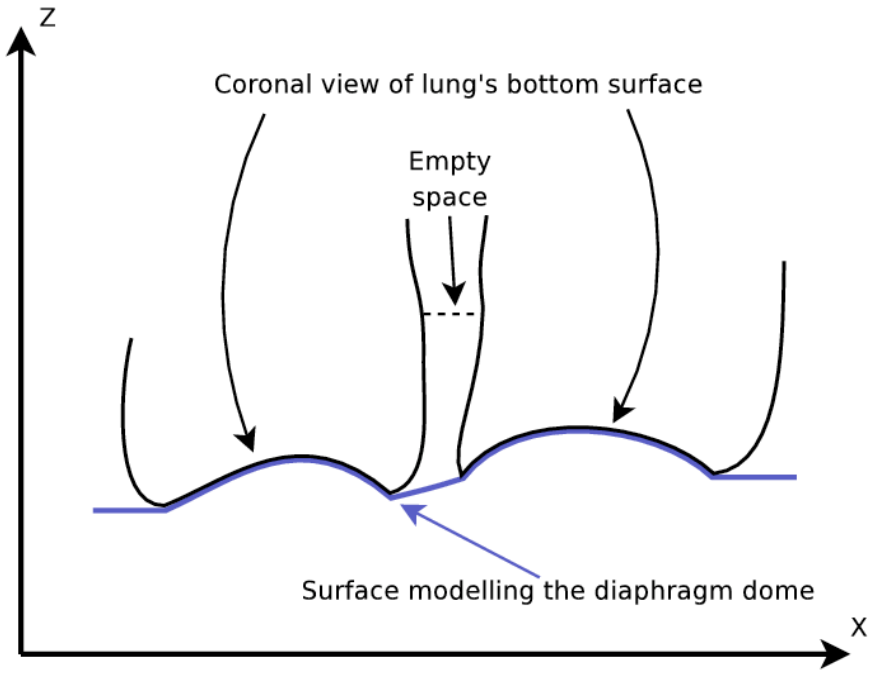

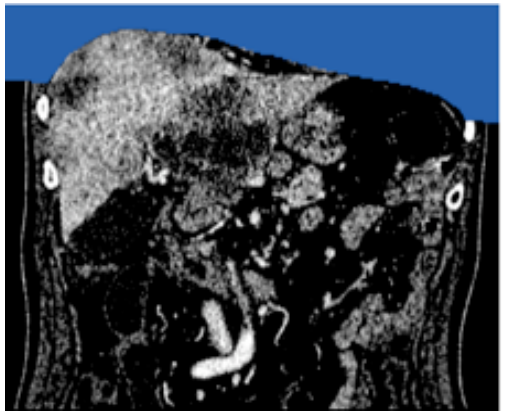

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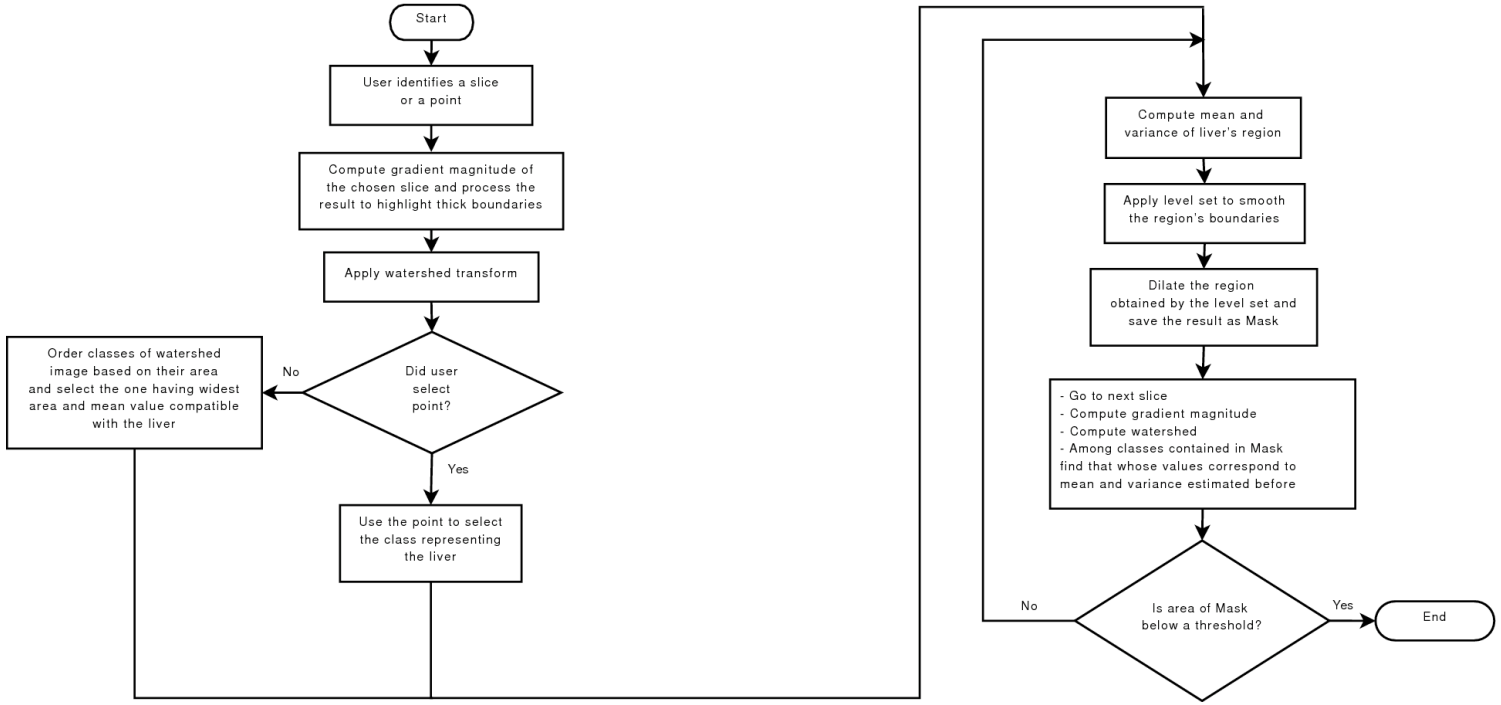

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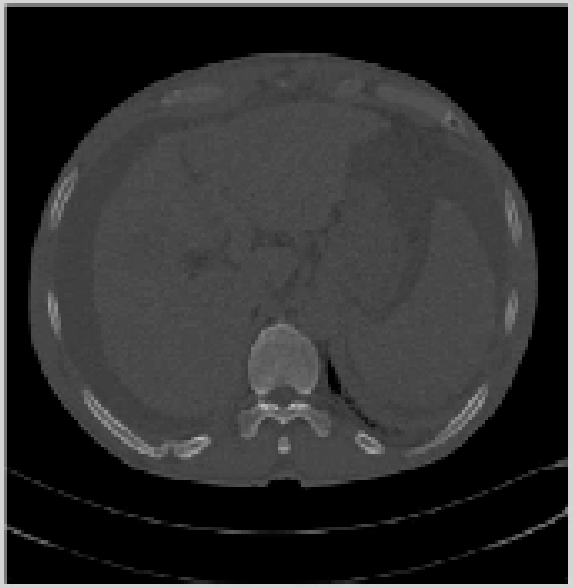

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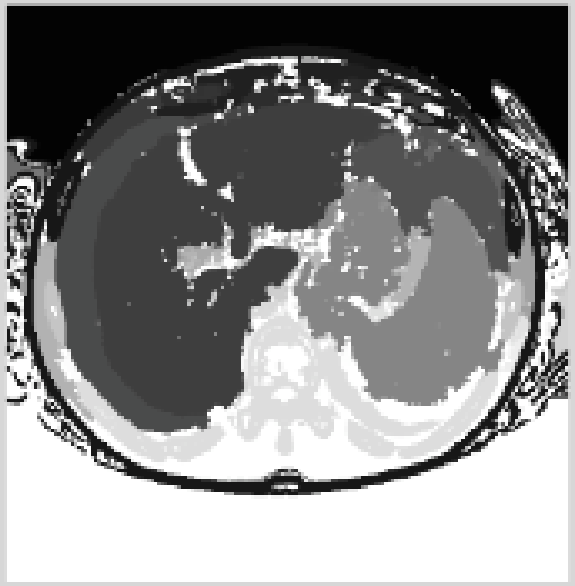

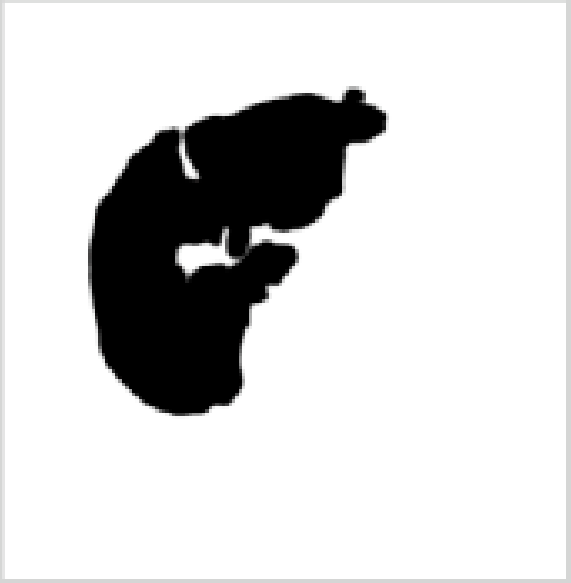

Segmentation of the Tumors

1. Denoising with Haar wavelets
2. Adaptive multi-thresholding
3. Segmentation refinement of the thresholded tumors
   - 3.a 3D Region Growing
   - 3.b Denoising by Slice Connectivity Criteria
   - 3.c 3D Min/Max Flow

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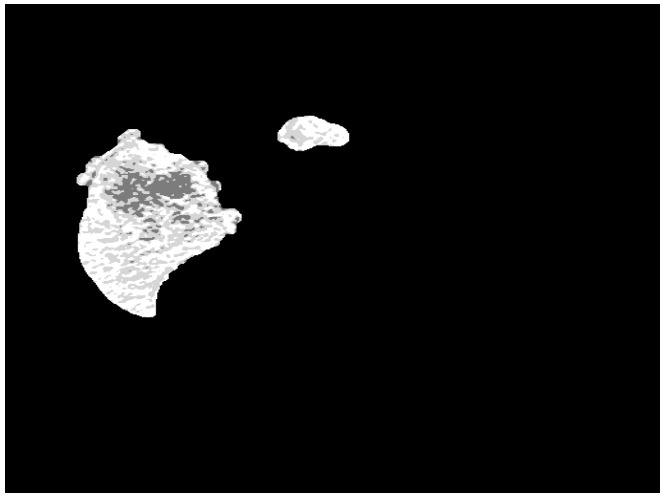
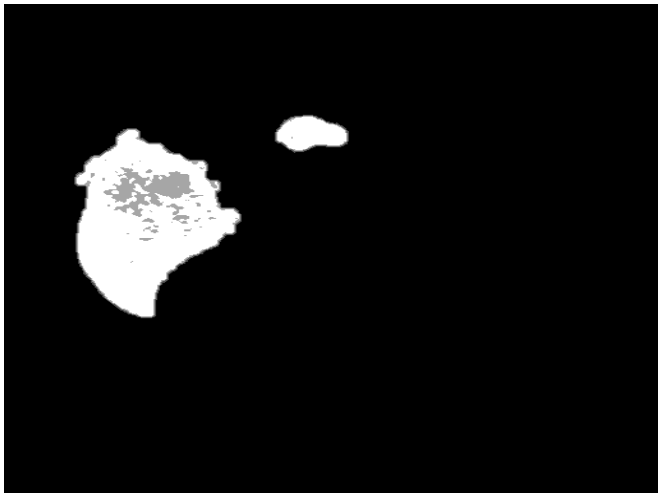


Denoised Image(90)



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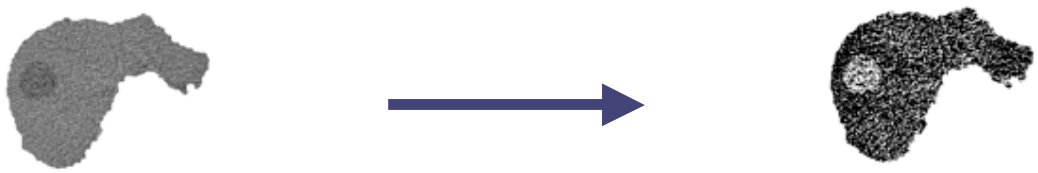

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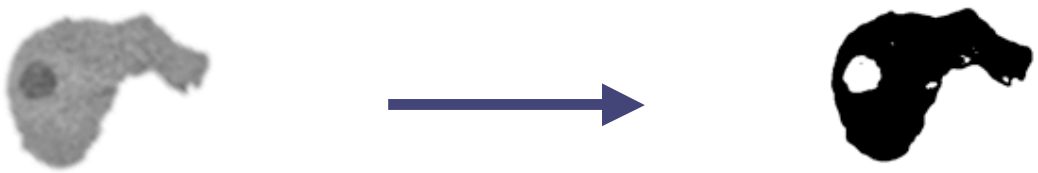

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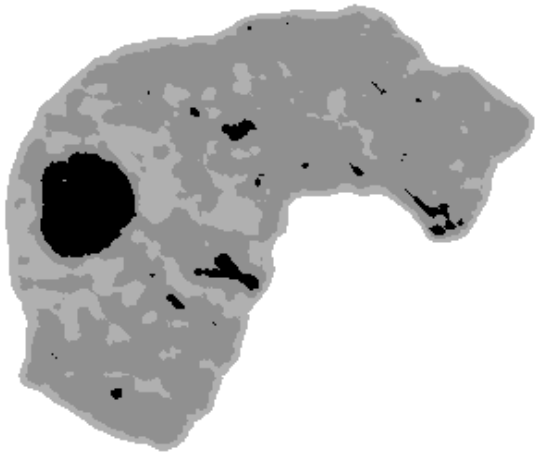

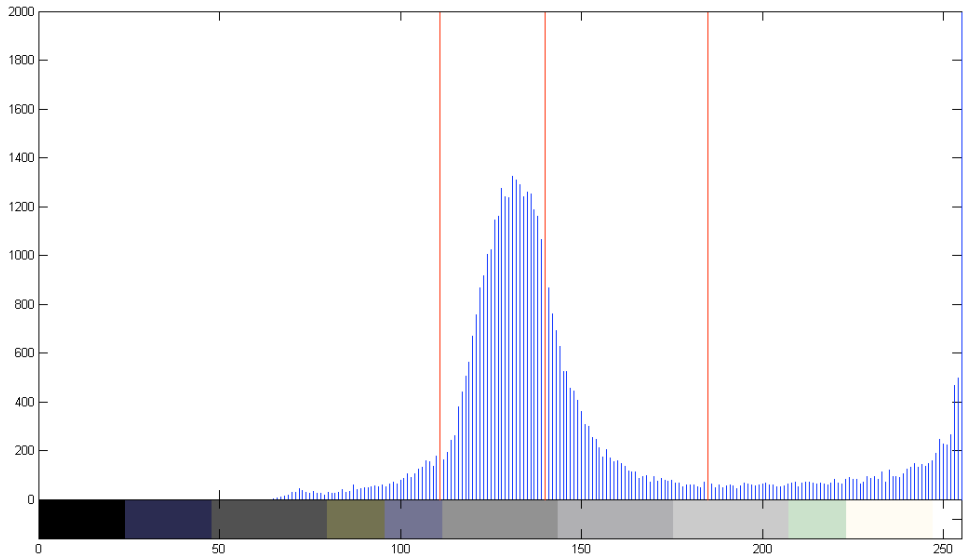

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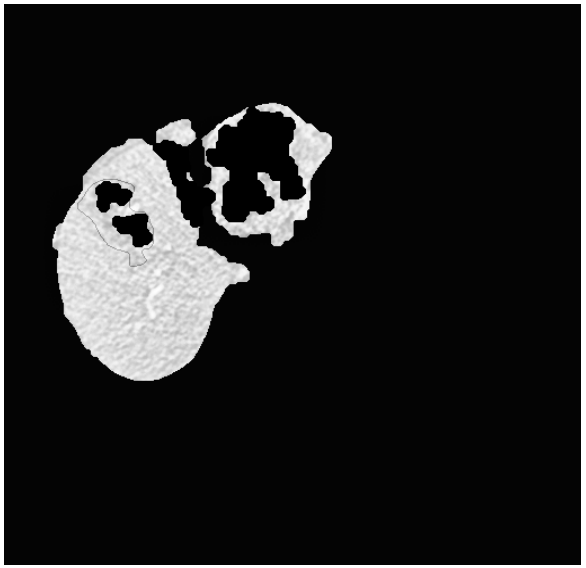

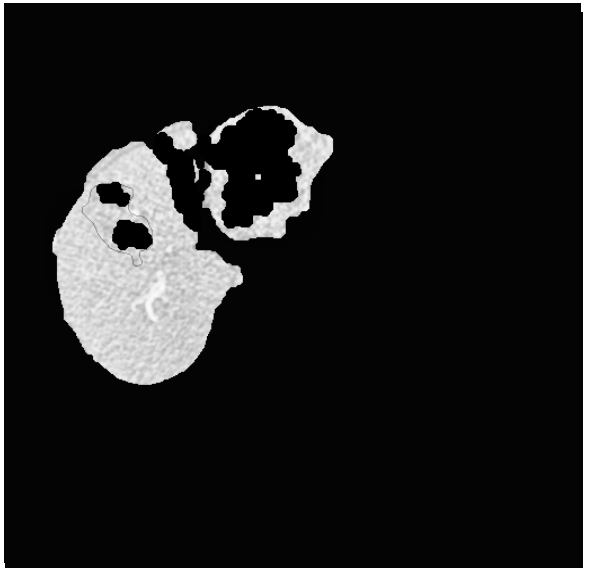

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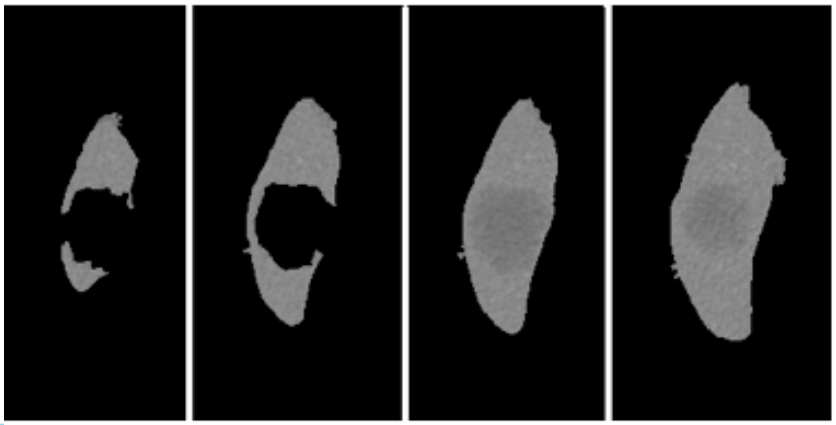

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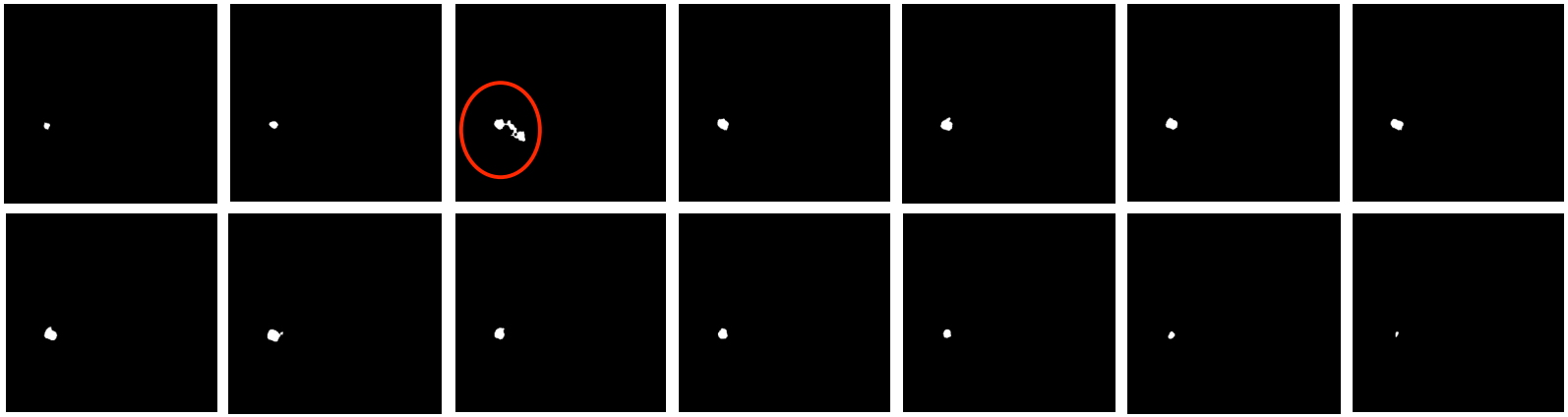

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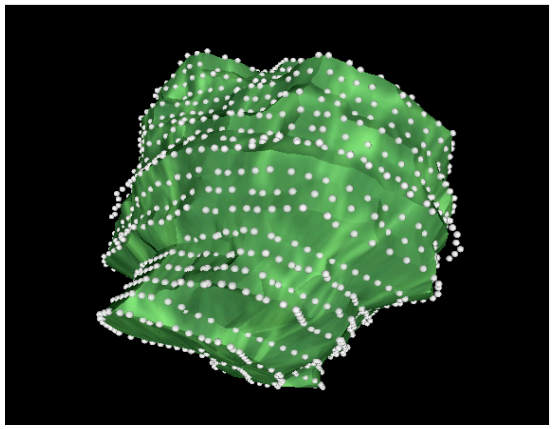
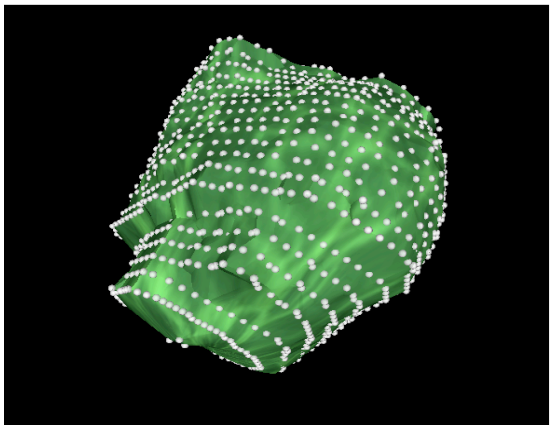
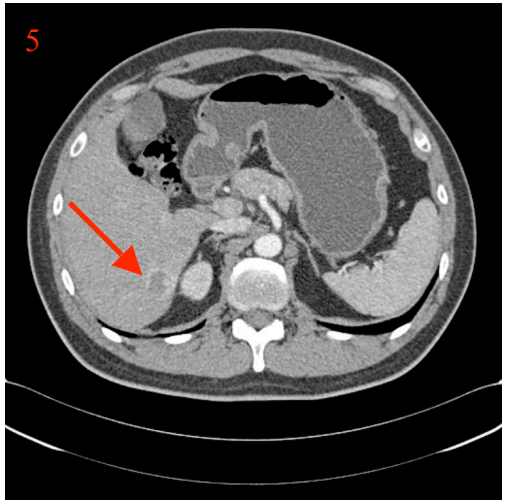
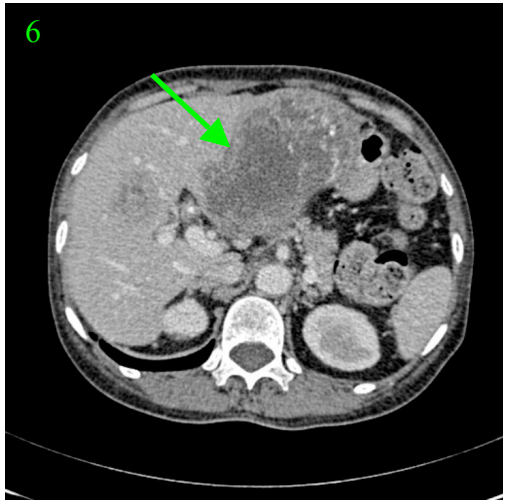




Results

	Overlap Error		Volume Diff.		Avg. Surf. Dist.		RMS Surf. Dist.		Max. Surf. Dist.		
Tumor	**(%)**	**Score**	**(%)**	**Score**	**(mm)**	**Score**	**(mm)**	**Score**	**(mm)**	**Score**	**Tot.**
1	35.10	73	19.69	80	2.74	31	3.79	47	12.87	68	**60**
2	29.68	77	25.65	73	1.00	75	1.41	80	6.03	85	**78**
3	43.66	66	35.66	63	1.86	53	2.63	63	7.68	81	**65**
4	30.34	77	9.52	90	0.77	81	1.03	86	4.23	89	**84**
5	35.27	73	28.10	71	0.77	80	1.09	85	5.21	87	**79**
6	23.88	82	2.87	97	3.07	23	4.27	40	18.69	53	**59**
7	30.47	76	5.88	94	1.56	60	2.10	71	9.10	77	**76**
8	17.85	86	11.61	88	1.99	50	2.76	61	11.72	71	**71**
9	45.65	65	78.18	19	2.11	47	2.60	64	9.74	76	**54**
10	29.53	77	8.61	91	1.78	55	2.27	68	7.64	81	**75**
Average	**32.14**	**75**	**22.58**	**77**	**1.77**	**56**	**2.40**	**67**	**9.29**	**77**	**70**





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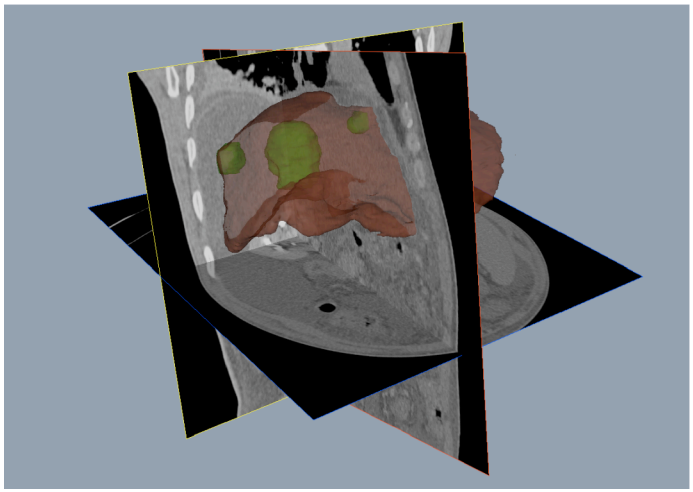

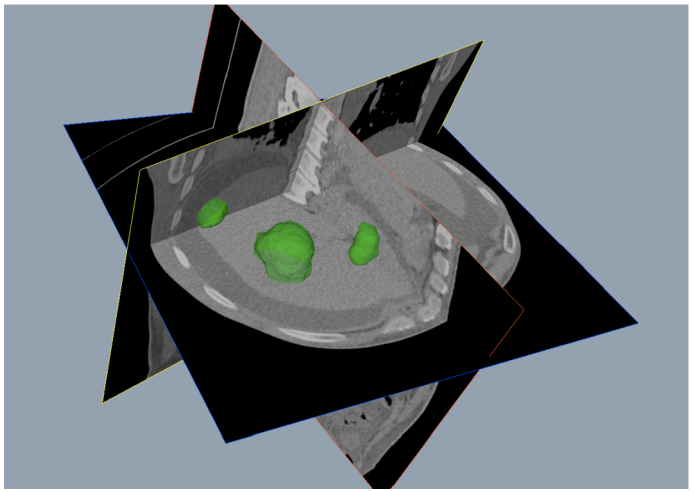

Conclusions and Future Work

- System optimization using genetic algorithms
- Use textures modeling to better discriminate the liver from other organs
- Application of the approach developed to other abdominal structures

Thanks for the attention!

ALTAIR Team

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