Medical Imaging Research Laboratory

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A FULLY AUTOMATIC AND MULTI-STRUCTURAL SEGMENTATION OF THE LEFT VENTRICULE AND MYOCARDIUM ON HIGHLY HETEROGENEOUS 2D ECHOCARDIOGRAPHIC DATA

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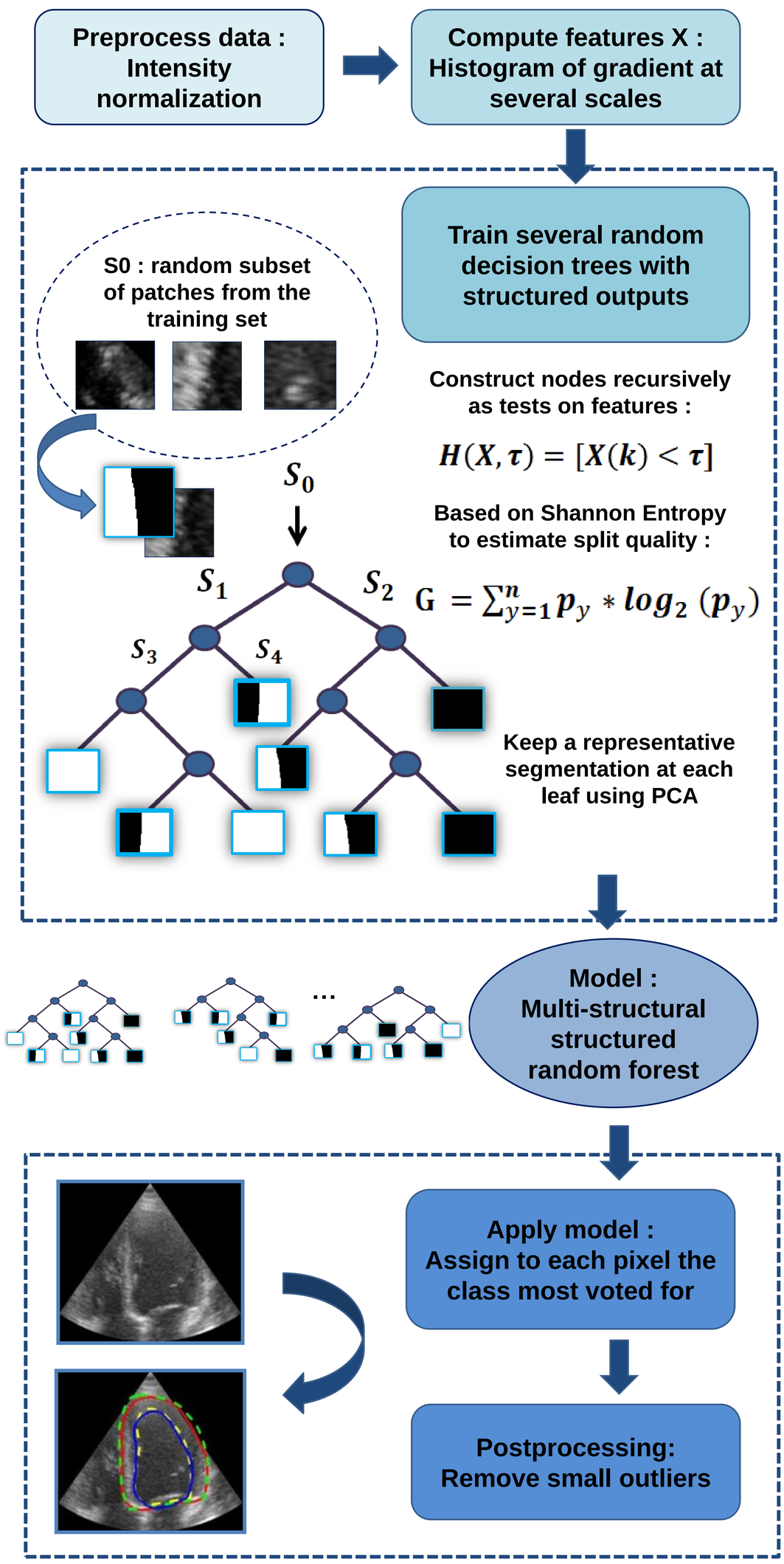
Introduction

- **CONTEXT :** Segmentation of the heart structures in 2D ultrasounds (US) is the first step to assess cardiac functionality
- **LOCK :** It still requires unreproducible manual interactions
- **OBJECTIVE :** Automate multi-structural segmentation in 2D US
- **PROPOSITION :**
  - Emphasize contextual information in US images
  - Adapt Structured Random Forests to multiclass segmentation (MS-SRF)
  - Compare it to semi-automatic Active Appearance Models (AAM)

Methods



Results

EXPERIMENT

- **DATABASE :** 200 train patients and 50 test patients segmented at both End Diastoly (ED) and End Systoly (ES)
- **STRUCTURES :** Left ventricule (LV) and Myocardium (Myo)
- **METRICS :** Dice, Hosdorff distance (HD) and Mean Average Distance (MAD) in mm
- **COMPARISON :** To the AAM algorithm, which requires 5 initialization points to perform the segmentation
- **MS-SRF-r :** Statistical results without the 6 worst cases, indicator of the potential of our method

OUTCOME

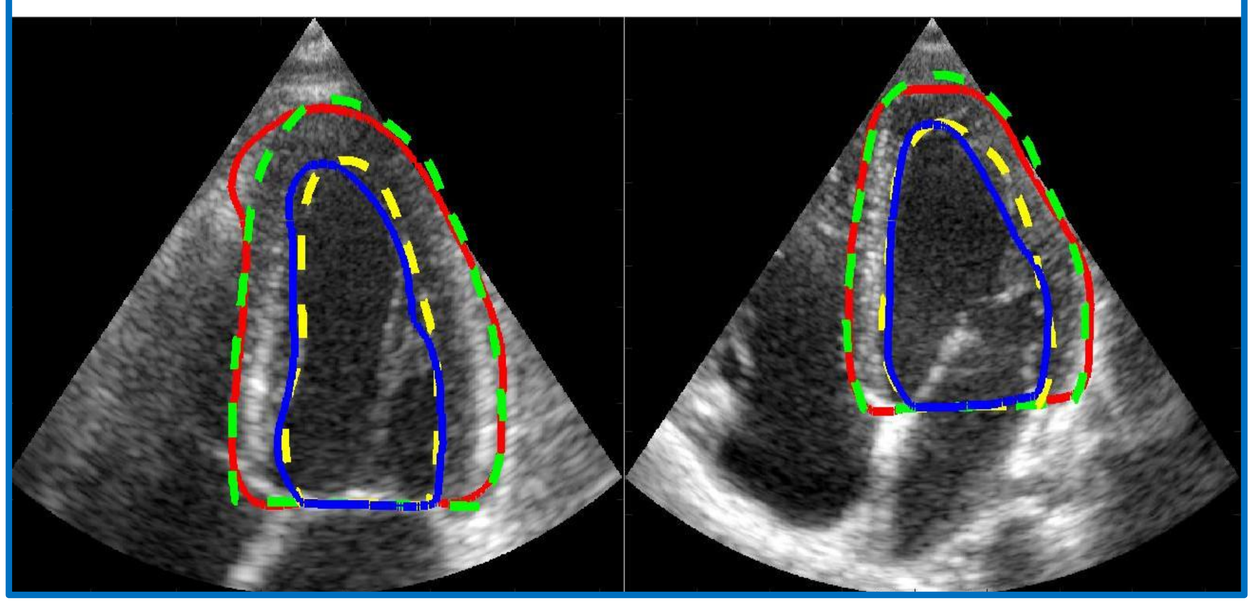
ED

Struct	Algorithm	Dice	HD	MAD
LV	AAM	0.90±0.04	**7.24±2.77**	2.84±1.20
	MS-SRF	**0.92±0.03**	8.20±4.77	**2.13±0.91**
	MS-SRF-r	0.92±0.03	7.41±3.91	2.04±0.86
Myo	AAM	**0.92±0.03**	**7.51±2.37**	2.91±1.10
	MS-SRF	0.88±0.08	8.51±6.9	**2.42±1.95**
	MS-SRF-r	0.90±0.05	6.73±3.89	2.01±0.85

ES

Struct	Algorithm	Dice	HD	MAD
LV	AAM	0.89±0.06	**6.9±3.04**	**2.25±1.29**
	MS-SRF	**0.93±0.04**	10.23±5.44	2.88±1.44
	MS-SRF-r	0.93±0.03	9.04±4.24	2.57±1.17
Myo	AAM	**0.93±0.03**	**6.64±2.16**	**2.43±0.9**
	MS-SRF	0.90±0.08	12.71±13.14	3.33±2.53
	MS-SRF-r	0.92±0.04	8.77±4.50	2.53±1.16

VISUALS (MS-SRF)



Discussion and Conclusion

- Above results show performance on par with a semi-automatic state of the art method
- The MS-SRF showed difficulties on specific patients with especially low contrast or unusual intensity patterns
- Robustness may be further improved by learning more data, adding shape priors and using more discriminative features

References: (1) P. Dollar, and C. L. Zitnick. “Fast edge detection using structured forests”
(2) J. Domingos, R. Stebbing, and J. A. Noble, “Endocardial segmentation using structured random forests in 3D echocardiography”
(3) T. F. Cootes, G. J. Edwards, and C. J. Taylor, “Active Appearance Models”

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