EJECTION FRACTION CLASSIFICATION IN TRANSTHORACIC ECHOCARDIOGRAPHY USING A DEEP LEARNING APPROACH

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Agenda

Introduction

Related Work

Methods

Results

Discussion

Conclusion

INTRODUCTION:

Cardiovascular Diseases (CVDs) are the leading cause of death worldwide

Accounted for approximately 17.7 million deaths in 2015

Highly correlated with left ventricle (LV) function indices:

Ejection Fraction (EF)

Wall thickness

Ventricular mass

^{...}

INTRODUCTION:

Techniques to assess patient condition:

Computed Tomography (CT)

Magnetic Resonance Imaging (MRI)

Transthoracic Echocardiography (TTE)

TTE is widely available, cheaper, and portable

Considered a first line of diagnosis technique



INTRODUCTION:



Related Work:

Automatic left ventricle segmentation:

Active Contours

Supervised Learning Methods

Issue: require prior knowledge on the left ventricle shape

Deep learning methods using 2D echocardiography

Issue: requires prior detection of the systole and diastole frames by the user

Related Work:

3D information has already been used in EF estimation with data from:

Magnetic Resonance Imaging

3D Echocardiography

Issue: both techniques have higher associated costs than 2D Echocardiography

OBJECTIVE: Estimate **ejection fraction** using **TTE** cineloops (2D echo), considering **time** as the **3**rd dimension

METHODS: DATASET

Exams containing TTE cineloops, annotated information and free text report

Manual selection of the Apical 4 Chambers view, EF data extraction from meta-data

Extraction of 30 sequential frames from each cineloop

Automatic extraction of the region of interest to mask burned in PHI

Frame size: 128 x 128 pixels

Categorization of EF values

METHODS: DATASET





METHODS: DATASET



METHODS: 3D-CNN



Results

Accuracy: 78%	EF Class	\mathbf{F}_1 score
	< 45%	71,3%
F ₁ score (one vs all)	45% - $55%$	$63{,}6\%$
	55% - $75%$	$72,\!3\%$
	>75%	$54{,}6\%$

DISCUSSION

Class imbalance is reflected on model performance

Class 2 is a transitional class: contains both healthy and unhealthy exams

Discrepancy between values in meta-data and in clinical text reports

Noise in TTE images: possible incorrect data representation

CONCLUSION

CVDs are the leading cause of death worldwide

First line of diagnosis often based on TTE

Metrics like EF frequently require manual annotations

Novel 3D-CNN proposed to automate the process, obtaining promising results

Possible improvements:

Automatic selection of Apical 4 chambers view in TTE exams to expand dataset

Key-point selection in TTE cineloops

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