

Automatic Heart Segmentation and Murmur Detection in Pediatric Phonocardiograms

João Pedrosa | Ana Castro | Tiago T. V. Vinhoza

Instituto de Telecomunicações | FEUP | FCUP

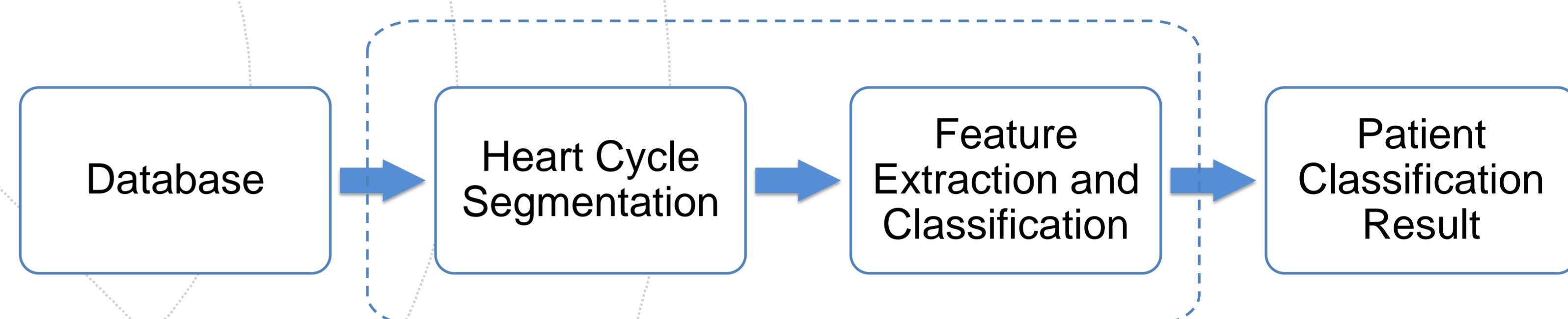
Fundamentals

Heart Murmurs

- Heart murmurs are caused by the turbulent blood flow that results, for example, from the narrowing (stenosis) or leaking (regurgitation) of the heart valves or due to abnormal blood passages in the heart.
- Prevalence: 50-70% in children (most of these are innocent) and 2-5% in adults.
- Physician trainees accuracy in murmur detection [M.Lam et al.]: 79,2% and 67% for pan-systolic and ejection systolic murmurs respectively

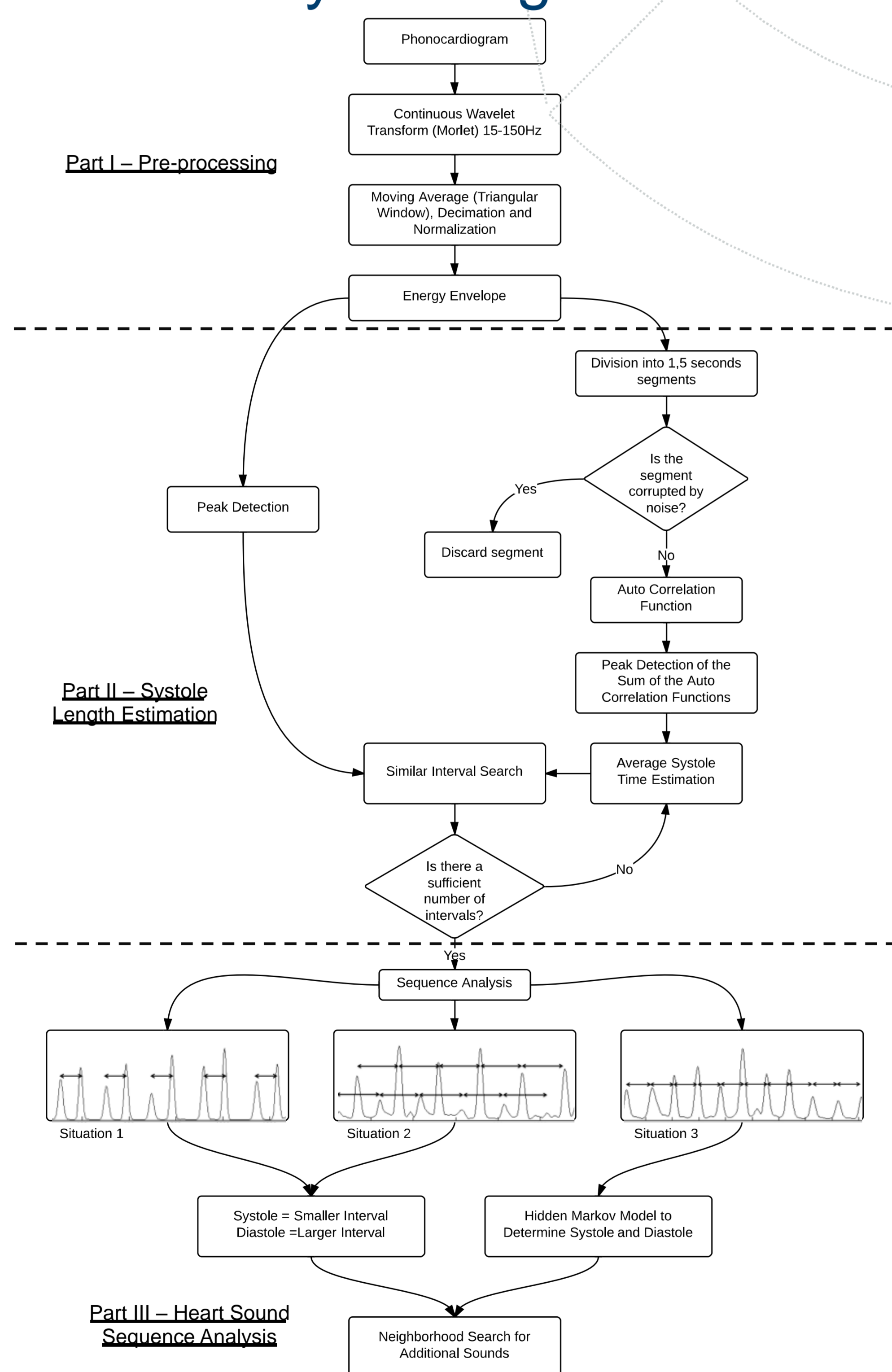
Algorithm Structure

- The approach used is composed of two main phases. First the main heart sounds are identified so that the signal is separated into systolic and diastolic segments. Each of the segments is then subjected to a classifier to determine the presence of a murmur.



Methodology and Results

Heart Cycle Segmentation



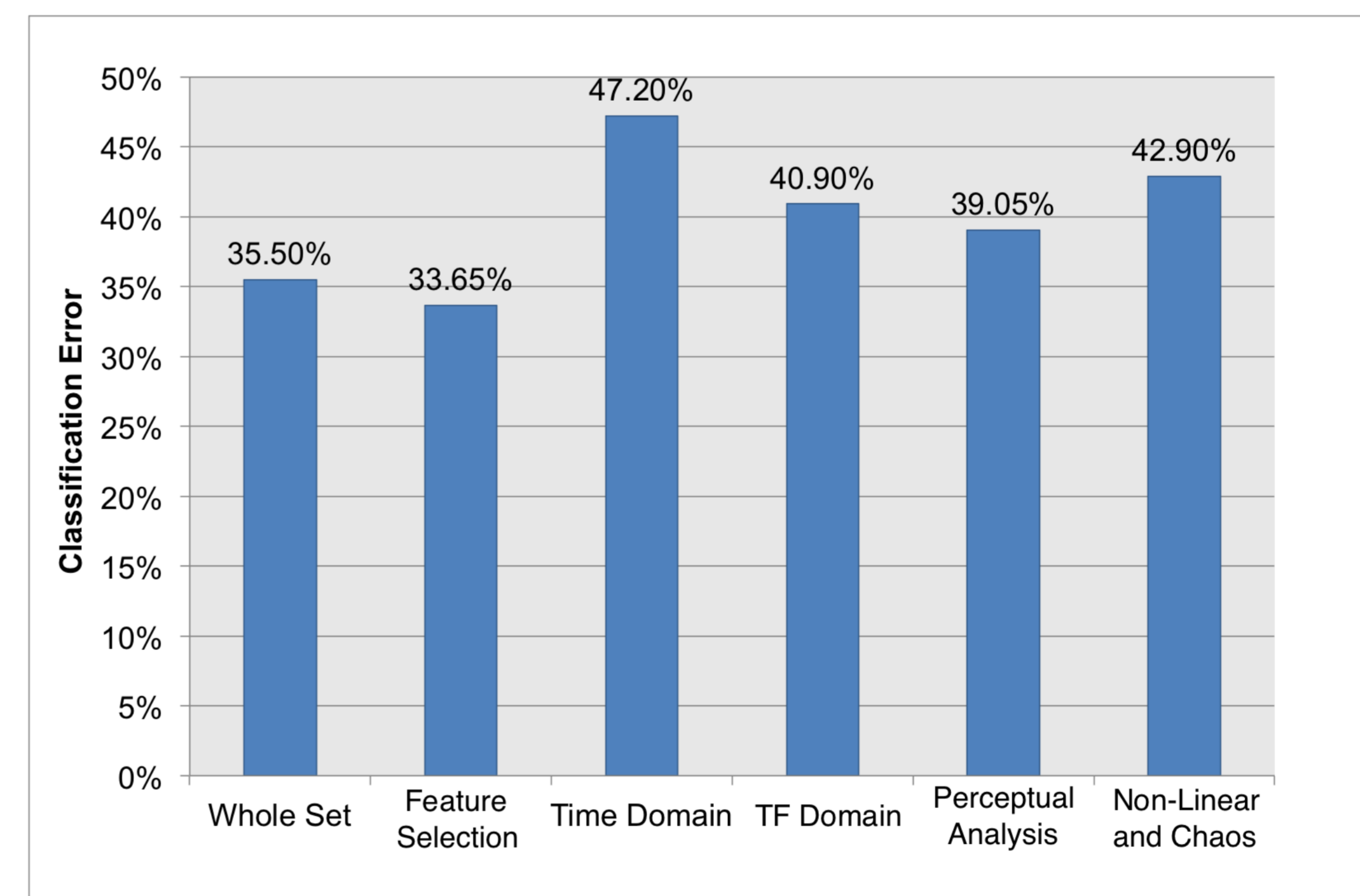
- An effective detection of S_1 and S_2 is necessary for feature extraction and classification.
- Noisy segments are rejected based on a mean amplitude criterion and the autocorrelation function is used to find the periodic elements of the signal.
- Systole and diastole are distinguished by their duration or through non-duration based features extracted from the peaks if necessary.

Feature Extraction and Classification

Analysis Domain	Feature Name	Amount
Time Domain	Shannon Energy	7
Time-Frequency Domain	CWT	13
	DWT	55
Perceptual	Singular Value Decomposition	48
	MFCC	100
Nonlinear and Chaos Based	Bispectrum	16
	VFD	9
	Lyapunov Exponents	2
Total		250

- 250 features of different analysis domains were used to ensure a thorough description of each segment.

Classification Results



- Train and test sets were obtained by separating the patients in a 60-40 percentage to account for interpatient variability.
- Error rate can be justified by the relatively small size of the database and the noise present in the signals used.
- The operating value was set to 69,67% sensitivity and 46,91% specificity to ensure a greater amount of murmur cases detected.