

The 47th International Conference
APPLICATIONS OF MATHEMATICS IN ENGINEERING AND ECONOMICS
(AMEE 2021)

Wavelet Analysis for Biomedical Data

Stella Vetova

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Image Classification Approach

Stage 1: Image Features Extraction

Stage 2:
Similarity Computation

Stage 2: Image Features Extraction

Stage 2:
Artificial Neural Network

Image Classification with Similarity Analysis

Basic tasks

Task 1

Image features extraction and
generating feature vectors on the
base of primitive

Task 2

Similarity computation on the base
of similarity measure:

Euclidean distance;
Manhattan distance;
Mahalanobis distance;
Canberra distance, etc.

Image Classification with NN Learning

Task 1

Image features extraction and generating feature vectors on the base of primitive

Task2

Performing training using the generated feature vectors

Task 3

Query-Image processing on the base of tasks 1 and 2

➤ Low-level features

1. Color
2. Shape
3. Texture
4. Layout

➤ Group classification

1. Spatial
2. Spectral

➤ Spatial group

- Computing statistical values
- Rotation irresistance
- Insufficiency of number of features
- Sensibility of image noise

➤ Spectral group

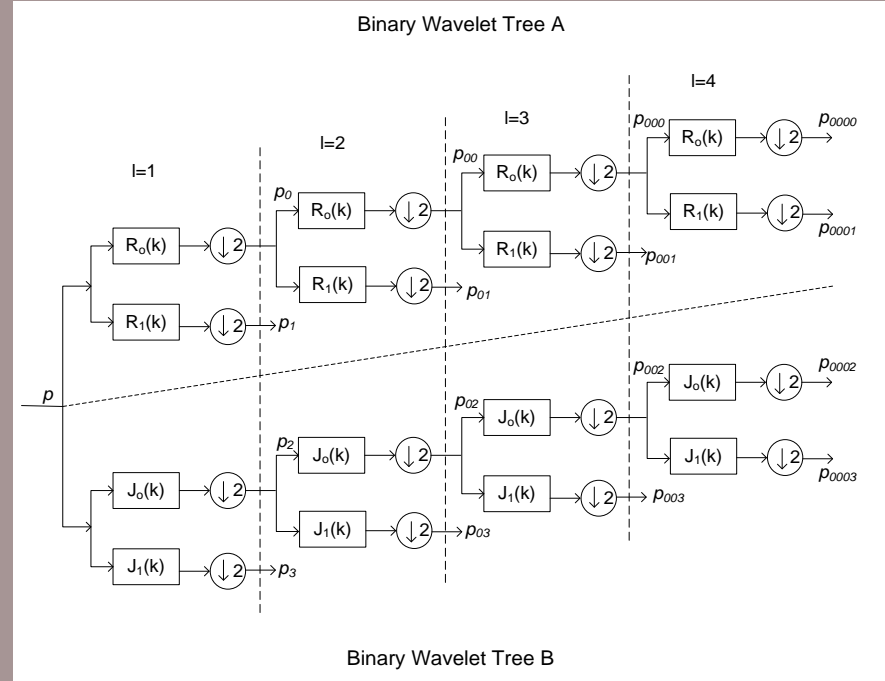
- Effectively measure image energy;
- Rotation and image noise resistant image feature vectors;
- i. g. Gabor filters, wavelet, Discrete Cosine Transform (DCT), curvelet, Discrete Wavelet Transform (DWT), contourlet;

The Dual-Tree Complex Wavelet Transform

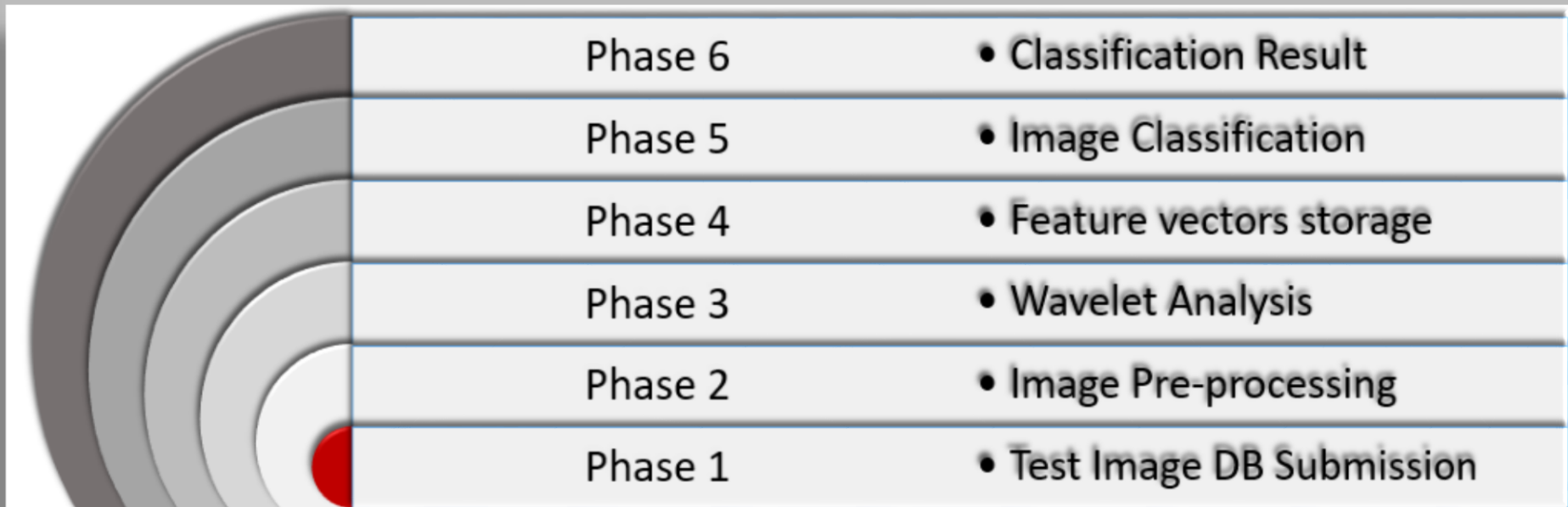
- Complex Wavelet Transform (CWT)
 - Complex valued scaling function
 - Complex-valued wavelet
-
- Basic idea – transform producing analytic signal (on the analogy of Fourier transform) with the following properties:
 - Smooth non-oscillating magnitude
 - Nearly shift-invariant magnitude
 - Significantly reduced aliasing effect
 - Directional wavelets in higher dimensions

DT CWT structure and realization

- Two different binary wavelet trees for real and imaginary part of DT CWT separately to produce analytic signal
- Two Discrete Wavelet Transforms (DWTs)



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Efficiency evaluation

Step1

Precision

$$\text{Precision} = \frac{TP}{(TP + FP)}$$

Step2

Recall

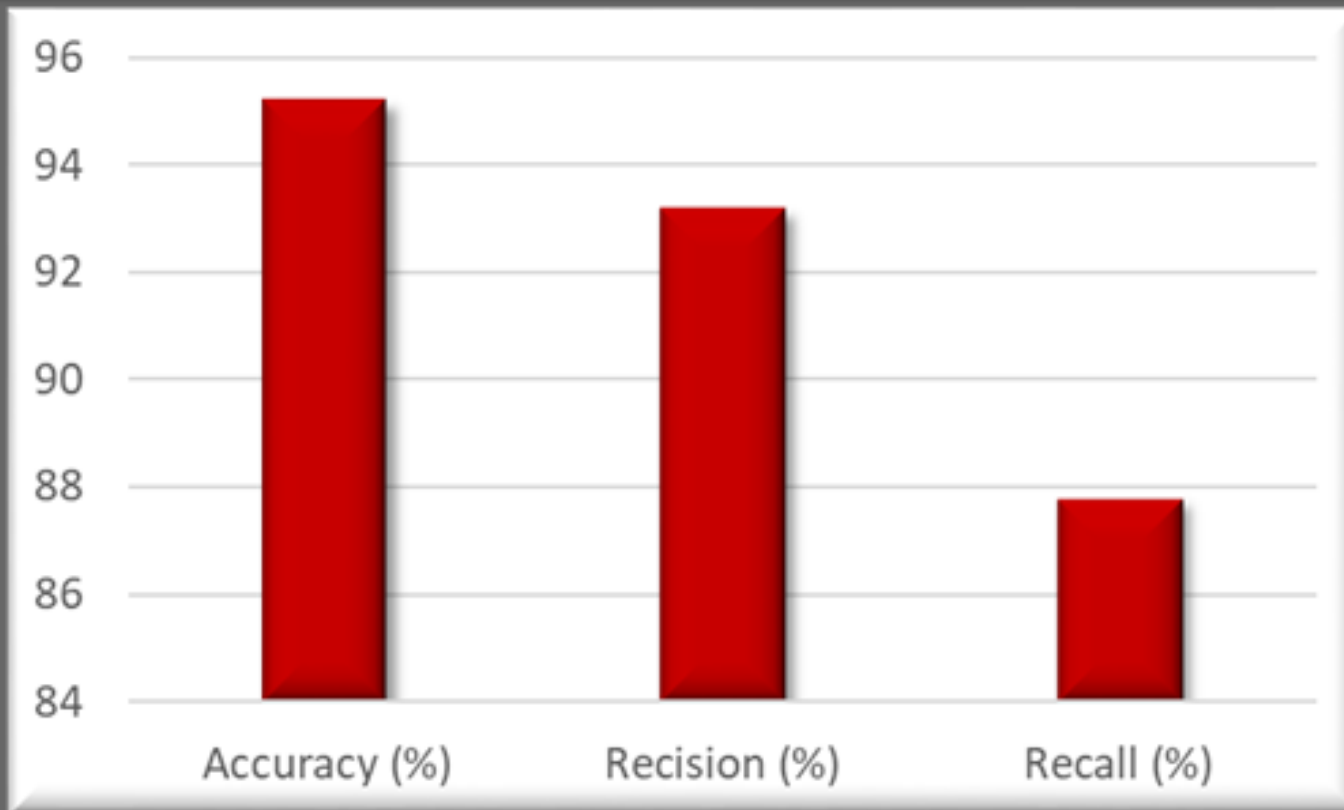
$$\text{Recall} = \frac{TP}{(TP + FN)}$$

Step3

Accuracy

$$\text{Accuracy} = \frac{(TP + TN)}{(TP + TN + FP + FN)}$$

Experimental results of the proposed algorithm based on DT CWT



Thank You!

Stella Vetova

vetova.bas@gmail.com