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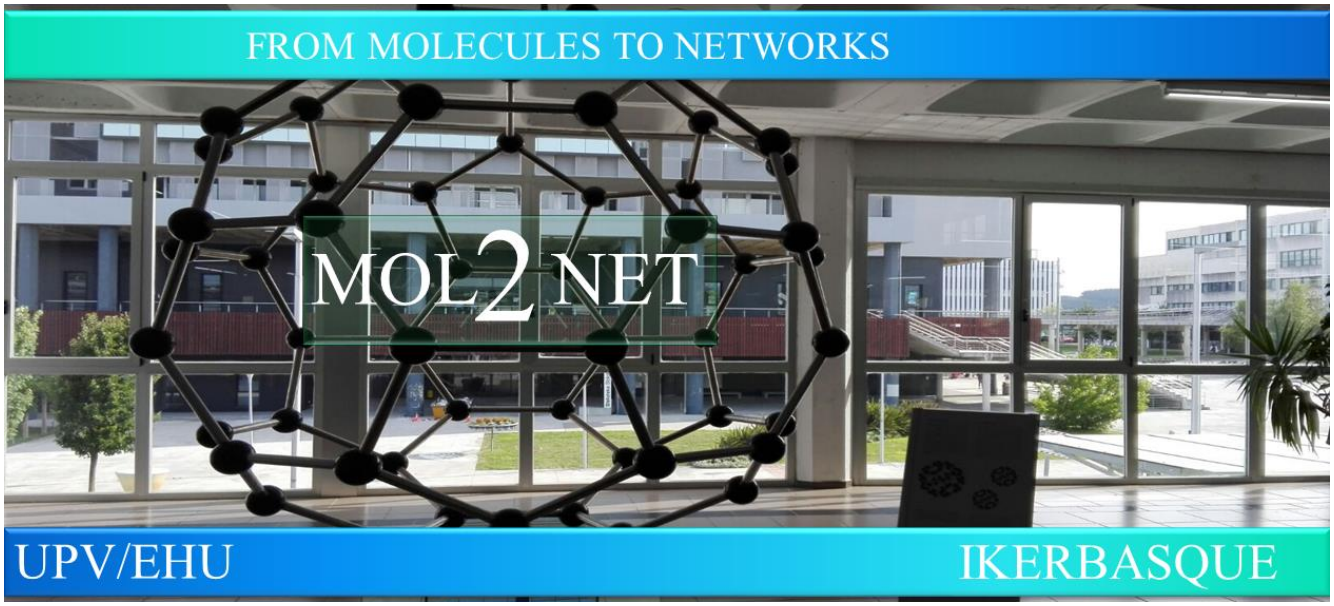

Effects of Mother Wavelet Selection in Classifying Power Quality Disturbances

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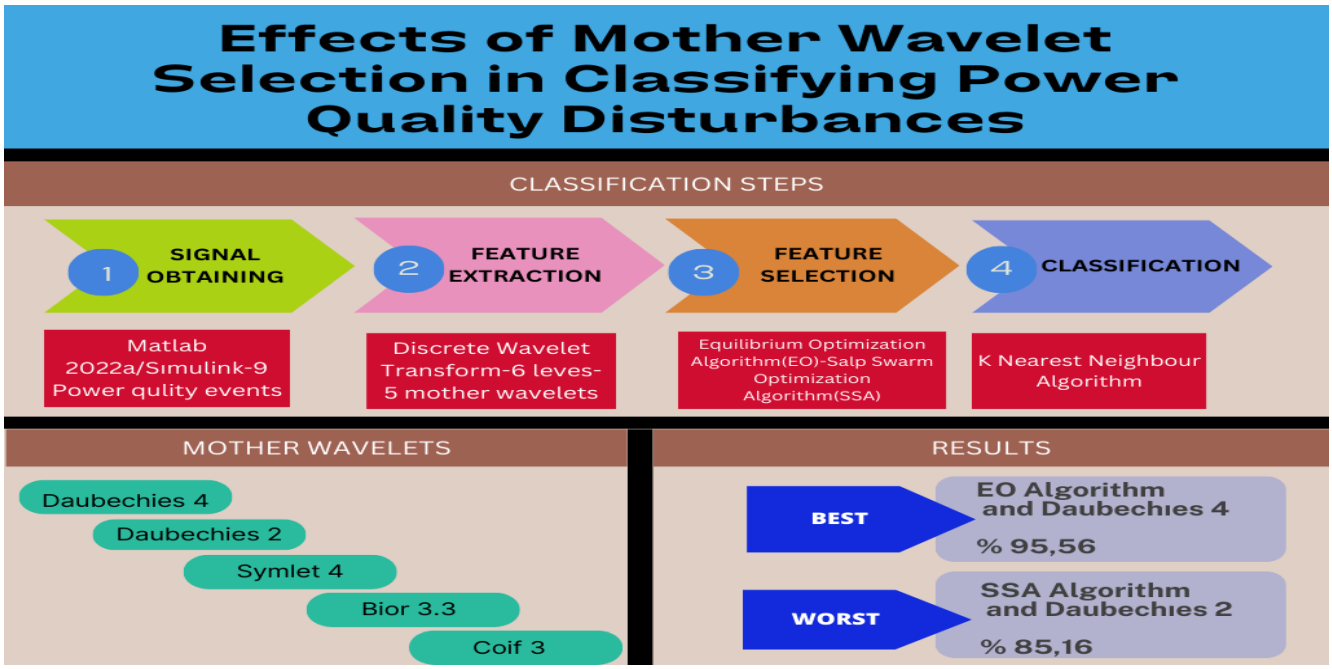

Abstract.

Power quality can be defined as the transmission of the generated energy to the end user without distortion in voltage and current values.[1] In recent years, the use of nonlinear loads such as Flexible AC Transmission Systems (FACTS) devices, power electronic converters, arc generation devices, and Variable Frequency Drives (VFDs) has led to disturbances in power quality.

Ensuring the uninterrupted and smooth operation of systems, delivering power to consumers in a clean manner without disturbance in power quality, is crucial both from a technical and economic perspective. Therefore, rapid detection, classification, and the generation of solutions based on power quality disturbances are essential.[2] This situation has led to a rapid increase in research and studies to solve the problem.

The classification of power quality disturbances essentially occurs in four stages. These stages are obtaining the signal, feature extraction, feature selection, and classification. The success of classification varies depending on the method used in each stage.[3]

In this study, for feature extraction the Discrete Wavelet Transform (DWT) method and five different mother wavelets were used after the signals were obtained. These mother wavelets are Daubechies4 (db4), Daubechies2 (db2), Symlet4(Sym4), Bior3.3 and Coiflet3.[4,5] In the feature selection stage, two different optimization algorithms were utilized. These are the Equilibrium Optimization Algorithm (EO) and the Swarm Optimization Algorithm (SSA) .[6,7] Finally, the K Nearest Neighbour (KNN) machine learning algorithm was employed for classification .[8]

Nine power quality events, one of which is a pure sinusoidal signal, were obtained in the Matlab 2022a/Simulink software and 150 different signals were generated from each of them. In the second step, the feature extraction for 6 levels was conducted using mother wavelets and DWT, and a dataset was obtained from the resulting feature vectors. This dataset was both normalized and logarithmically transformed. In the third step, feature selection was performed using EO and SSA, and finally, classification was performed using the KNN, and accuracy rates were compared.

The impact of mother wavelet selection on classification success was examined. The obtained datasets were divided into five parts, each corresponding to a specific mother wavelet. For each mother wavelet dataset, feature selection was again performed using EO and SSA, and classification successes were compared. According to the results, the Daubechies4 mother wavelet and EO algorithm yielded the best result with a success rate of %95.56. The worst result is obtained with the db2 and SSA algorithm, at a rate of 85.16%.

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