

## APPENDIX A

# EXPERIMENTAL RESULTS BY CRITERION 1

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This appendix contains the results obtained of the classification three classes of EEG signals, Ictal, Interictal and Healthy using several strategies and classifiers. The results reported here were obtained using the feature extraction calculated by the criterion 1, different combinations of filters and wavelet transforms. Two approaches for filtering were tested, FIR and IIR filters. The filtering of the EEG signals was performed in order to remove noise added during recording of the EEG signals. The decomposition of EEG signals into delta ( $\delta$ ) and alpha ( $\alpha$ ) sub-bands and feature extraction were carried out using the DWT and MODWT by the criterion 1 for the suitable wavelet choice. The criterion 1 uses the wavelet that gives the highest average of the correlations coefficients for each class of the EEG signals, therefore the feature extraction was done with Coiflet 3 (Coif3), Coiflet 5 (Coif5) and Daubechies 6 (Db6) for Ictal, Interictal and Healthy EEG signals, respectively. Then, each EEG signal was represented by a feature vector of six components, built using the mean, absolute median and variance of  $\delta$  and  $\alpha$  sub-bands. Therefore, the feature vectors obtained are considered as inputs for the classifiers described in this work. The EEG signals used in the experiments reported in this research come from a free-available EEG database, provided by the University of Bonn [BON16].

## A.1 RESULTS OF THE CLASSIFICATION OF THREE CLASSES OF EEG SIGNALS BASED ON FF-ANN AND ELMAN CLASSIFIERS BY DECOMPOSITION USING THE CRITERION 1.

Tables A.1 and A.2 present the results of the classification of three classes of EEG signals based on FFANN and Elman, respectively. These classifiers used features obtained of all the combinations of filters (Chebyshev, Elliptic, Equiripple and Least squares) and wavelets transforms (DWT and MODWT) by the criterion 1. In order to find the best number of hidden nodes for the FF-ANN and Elman networks, tests were done using 6, 9, 12, 15, 16, 18, 21 and 24 nodes in the hidden layer of each network. Levenberg-Marquardt algorithm was the training method used for the FF-ANN, whereas gradient descent was the training method used for the Elman network. The experimental results reported here were obtained with a learning rate of 0.05 , a  $MSE_{max}$ ) of 0.01, whereas the maximum number of training epochs was fixed at 1000. The experiments based on FFANN and Elman network were executed using two activation functions, Sigmoid and Hyperbolic tangent. The best results in each case are bolded and them are summarized in Table 5.3 of this thesis.

**Table A.1:** Results of the classification of three classes of EEG signals based on FF-ANN with Sigmoid and Hyperbolic tangent as activation functions with wavelet decomposition by criterion 1.

Activation function	Extraction feature	Hidden nodes	Accuracy (%)	
<b>Sigmoid</b>	Chebyshev II - DWT	9	89.33	
	Chebyshev II - MODWT	24	93.00	
	Elliptic - DWT	6	89.00	
	Elliptic - MODWT	12	89.66	
	Equiripple - DWT	21	92.00	
	Equiripple - MODWT	12	91.33	
	Least Squares - DWT	6	92.33	
	<b>Least Squares - MODWT</b>	<b>12</b>	<b>93.00</b>	
	<b>Hyperbolic tangent</b>	Chebyshev II - DWT	18	91.33
		Chebyshev II - MODWT	9	91.66
<b>Elliptic - DWT</b>		<b>15</b>	<b>92.66</b>	
Elliptic - MODWT		6	91.66	
Equiripple - DWT		12	88.66	
Equiripple - MODWT		6	92.00	
Least Squares - DWT		15	90.00	
Least Squares - MODWT		12	91.00	

**Table A.2:** Results of the classification of three classes of EEG signals based on Elman with Sigmoid and Hyperbolic tangent as activation functions with wavelet decomposition by criterion 1.

Activation function	Extraction feature	Hidden nodes	Accuracy (%)	
<b>Sigmoid</b>	Chebyshev II - DWT	15	71.00	
	Chebyshev II - MODWT	9	54.66	
	Elliptic - DWT	21	50.00	
	Elliptic - MODWT	15	66.00	
	Equiripple - DWT	18	48.66	
	Equiripple - MODWT	12	79.00	
	Least Squares - DWT	21	72.66	
	<b>Least Squares - MODWT</b>	<b>21</b>	<b>81.33</b>	
	<b>Hyperbolic tangent</b>	Chebyshev II - DWT	21	60.66
		<b>Chebyshev II - MODWT</b>	<b>15</b>	<b>86.00</b>
Elliptic - DWT		24	77.66	
Elliptic - MODWT		24	75.00	
Equiripple - DWT		24	71.33	
Equiripple - MODWT		18	83.66	
Least Squares - DWT		9	71.00	
Least Squares - MODWT		9	76.66	

## A.2 RESULTS OF THE CLASSIFICATION OF THREE CLASSES OF EEG SIGNALS BASED ON WNN CLASSIFIERS USING A BINARY-TREE STRATEGY WITH WAVELET DECOMPOSITION BY CRITERION 1.

Tables A.3 - A.8 present the results of the classification of three classes of EEG signals based on WNN (FFWNN, MRW-FFWNN, SRWNN and MR-SRWNN) with different structures using a binary-tree strategy. These classifiers used features obtained of all the combinations of filters (Chebyshev, Elliptic, Equiripple and Least squares) and wavelets transforms (DWT and MODWT) by the criterion 1. These experiments were executed using 60 neurons in the layer 2, a learning rate of 0.001, a  $MSE_{max}$  de 0.1, a  $N_{Epochs}$  of 100 and Mexican hat as activation function in each classifier. The best results in each case are bolded and them are summarized in Table 5.5 of this thesis.

## A.3 RESULTS OF THE CLASSIFICATION OF THREE CLASSES OF EEG SIGNALS BASED ON WNN CLASSIFIERS USING VOTE AND WV IN A OVO SCHEME WITH WAVELET DECOMPOSITION BY CRITERION 1.

Tables A.9 and A.10 present the results of the classification of three classes of EEG signals based on WNN (FFWNN, MRW-FFWNN, SRWNN and MR-SRWNN) by the VOTE and WV strategies using OVO decomposition scheme. These classi-

**Table A.3:** Classification of EEGs based on WNN with binary-tree structure: Ictal-Interictal-Healthy (Ic-In-H) by criterion 1.

Feature extraction	Classifier	Accuracy (%)				
		Ictal	Interictal	Healthy	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	65.49	61.34	51.91	13.33	61.67
	(4) MRW-FFWNN	88.67	82.55	56.44	2.67	79.67
	(5) SRWNN	70.08	68.07	43.21	11.00	63.67
	(6) MRW-SRWNN	70.02	73.16	33.13	13.33	62.00
Chebyshev II - MODWT	(3) FFWNN	77.44	63.02	69.33	6.33	72.00
	(4) MRW-FFWNN	97.33	91.14	87.53	1.00	93.00
	(5) SRWNN	75.17	56.86	69.42	9.00	69.00
	(6) MRW-SRWNN	76.77	88.31	32.81	4.00	68.00
Elliptic - DWT	(3) FFWNN	68.46	77.38	50.43	10.00	67.00
	(4) MRW-FFWNN	89.44	89.45	52.10	1.67	81.00
	(5) SRWNN	71.99	71.59	54.45	8.33	68.00
	(6) MRW-SRWNN	75.59	69.70	38.22	11.00	65.33
Elliptic - MODWT	(3) FFWNN	69.48	50.12	64.54	8.00	63.00
	(4) <b>MRW-FFWNN</b>	<b>100.00</b>	<b>95.42</b>	<b>91.84</b>	<b>0.00</b>	<b>96.67</b>
	(5) SRWNN	71.14	51.05	62.19	9.33	63.00
	(6) MRW-SRWNN	76.70	79.91	30.44	9.00	65.00
Equiripple - DWT	(3) FFWNN	72.60	64.88	48.65	9.00	65.00
	(4) MRW-FFWNN	94.19	81.16	45.53	1.00	79.67
	(5) SRWNN	67.61	61.82	38.16	13.00	59.00
	(6) MRW-SRWNN	75.99	44.26	37.72	10.67	58.33
Equiripple - MODWT	(3) FFWNN	76.36	59.42	67.41	5.00	69.67
	(4) MRW-FFWNN	98.79	92.74	90.99	0.00	95.33
	(5) SRWNN	71.37	56.92	65.84	8.00	66.00
	(6) MRW-SRWNN	76.85	90.27	33.00	7.00	68.33
Least squares - DWT	(3) FFWNN	72.89	67.37	28.63	11.33	62.00
	(4) MRW-FFWNN	96.62	71.54	44.36	0.67	78.33
	(5) SRWNN	74.83	72.37	36.60	11.00	66.00
	(6) MRW-SRWNN	78.71	54.83	37.05	13.67	62.33
Least squares - MODWT	(3) FFWNN	76.10	57.17	59.52	9.00	66.83
	(4) MRW-FFWNN	100.00	92.64	89.80	0.33	94.67
	(5) SRWNN	75.23	57.49	63.49	10.67	67.00
	(6) MRW-SRWNN	80.61	79.64	25.70	5.67	64.67

**Table A.4:** Classification of EEGs based on WNN using binary-tree structure: Ictal-Healthy-Interictal (Ic-H-In) with wavelet decomposition by criterion 1.

Feature extraction	Classifier	Accuracy (%)				
		Ictal	Healthy	Interictal	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	67.08	86.67	22.98	10.33	62.00
	(4) MRW-FFWNN	80.62	95.17	38.62	5.67	75.00
	(5) SRWNN	66.13	88.74	19.30	11.67	61.33
	(6) MRW-SRWNN	70.38	85.38	17.97	12.33	62.67
Chebyshev II - MODWT	(3) FFWNN	74.65	87.70	46.14	10.67	71.67
	(4) MRW-FFWNN	92.29	95.47	83.29	3.33	91.33
	(5) SRWNN	72.22	90.16	46.41	11.67	71.00
	(6) MRW-SRWNN	76.46	95.30	47.19	9.00	74.33
Elliptic - DWT	(3) FFWNN	73.78	79.40	47.64	10.67	69.67
	(4) MRW-FFWNN	89.90	94.46	46.81	2.67	81.00
	(5) SRWNN	72.47	85.40	39.54	10.00	67.67
	(6) MRW-SRWNN	72.51	79.28	19.91	12.00	61.67
Elliptic - MODWT	(3) FFWNN	67.53	80.14	40.56	8.33	62.67
	(4) MRW-FFWNN	94.46	95.71	80.55	2.00	91.00
	(5) SRWNN	71.22	83.86	43.96	9.67	66.67
	(6) MRW-SRWNN	71.42	93.71	49.09	11.33	69.33
Equiripple - DWT	(3) FFWNN	71.43	84.35	38.61	9.33	67.00
	(4) MRW-FFWNN	92.17	99.09	51.80	1.67	83.67
	(5) SRWNN	74.25	74.90	31.78	12.00	64.33
	(6) MRW-SRWNN	77.01	82.77	23.60	11.33	65.33
Equiripple - MODWT	(3) FFWNN	63.99	87.13	47.18	6.33	67.00
	(4) MRW-FFWNN	97.40	97.14	76.00	1.33	92.00
	(5) SRWNN	66.17	87.79	53.77	6.67	69.33
	(6) MRW-SRWNN	75.66	91.15	44.29	4.67	72.67
Least squares - DWT	(3) FFWNN	61.87	88.17	28.35	11.00	60.33
	(4) MRW-FFWNN	91.70	98.89	46.99	2.33	81.67
	(5) SRWNN	62.24	85.08	40.90	11.33	62.33
	(6) MRW-SRWNN	71.64	88.97	31.15	10.33	65.67
Least squares - MODWT	(3) FFWNN	69.06	86.45	34.53	9.67	64.67
	(4) <b>MRW-FFWNN</b>	<b>98.02</b>	<b>100.00</b>	<b>80.76</b>	<b>1.00</b>	<b>94.00</b>
	(5) SRWNN	68.75	82.68	40.46	6.67	64.67
	(6) MRW-SRWNN	76.40	86.65	38.84	8.33	69.33

**Table A.5:** Classification of EEGs based on WNN using binary-tree structure: Interictal-Ictal-Healthy (In-Ic-H) with wavelet decomposition by criterion 1.

Feature extraction	Classifier	Accuracy (%)				
		Interictal	Ictal	Healthy	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	74.09	61.65	47.22	7.67	63.33
	(4) MRW-FFWNN	82.78	82.55	53.78	2.00	75.67
	(5) SRWNN	67.21	59.57	41.75	10.33	59.00
	(6) MRW-SRWNN	73.02	71.16	28.86	9.67	60.33
Chebyshev II - MODWT	(3) FFWNN	56.14	58.29	57.69	13.00	57.33
	(4) MRW-FFWNN	94.34	90.22	95.00	0.33	93.33
	(5) SRWNN	58.95	60.81	55.56	8.67	58.67
	(6) MRW-SRWNN	82.91	74.50	49.81	5.33	71.33
Elliptic - DWT	(3) FFWNN	72.46	58.42	35.69	6.33	59.00
	(4) MRW-FFWNN	88.88	77.47	54.38	1.33	77.33
	(5) SRWNN	71.78	57.58	38.69	10.67	60.33
	(6) MRW-SRWNN	63.67	64.92	24.08	11.67	53.00
Elliptic - MODWT	(3) FFWNN	58.83	59.03	73.96	9.33	62.00
	(4) MRW-FFWNN	89.73	93.95	98.75	0.33	93.00
	(5) SRWNN	59.12	68.56	78.75	5.67	66.00
	(6) MRW-SRWNN	81.02	70.95	45.64	3.33	69.33
Equiripple - DWT	(3) FFWNN	73.57	67.40	47.67	7.00	64.33
	(4) MRW-FFWNN	88.27	83.84	59.10	0.33	80.00
	(5) SRWNN	77.07	61.22	41.10	11.00	63.33
	(6) MRW-SRWNN	69.18	80.49	22.62	10.67	60.00
Equiripple - MODWT	(3) FFWNN	55.64	59.66	71.51	9.33	60.00
	<b>(4) MRW-FFWNN</b>	<b>94.21</b>	<b>92.10</b>	<b>98.67</b>	<b>0.33</b>	<b>95.00</b>
	(5) SRWNN	59.25	62.24	63.58	10.67	60.33
	(6) MRW-SRWNN	84.90	74.86	49.11	3.67	73.33
Least squares - DWT	(3) FFWNN	73.62	58.07	49.71	9.67	64.33
	(4) MRW-FFWNN	84.70	86.21	60.98	1.00	79.67
	(5) SRWNN	78.58	65.26	40.23	7.00	65.67
	(6) MRW-SRWNN	74.37	72.70	33.65	11.67	65.00
Least squares - MODWT	(3) FFWNN	59.81	67.29	66.22	6.33	63.00
	(4) MRW-FFWNN	92.23	97.39	95.96	0.00	94.33
	(5) SRWNN	63.21	60.26	73.12	6.00	64.67
	(6) MRW-SRWNN	78.53	81.69	45.70	2.67	71.33



**Table A.6:** Classification of EEGs based on WNN using binary-tree structure: Interictal-Healthy-Ictal (In-H-Ic) with wavelet decomposition by criterion 1.

Feature extraction	Classifier	Accuracy (%)				
		Interictal	Healthy	Ictal	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	69.75	53.91	60.74	9.33	62.67
	(4) MRW-FFWNN	87.44	62.18	87.37	0.33	81.00
	(5) SRWNN	71.78	50.13	53.86	8.50	61.50
	(6) MRW-SRWNN	72.59	32.98	63.03	8.83	59.50
Chebyshev II - MODWT	(3) FFWNN	58.45	53.94	56.30	10.50	56.50
	(4) MRW-FFWNN	88.75	97.02	89.53	1.00	91.00
	(5) SRWNN	58.89	57.29	56.11	11.17	57.33
	(6) MRW-SRWNN	84.01	43.71	67.60	4.17	67.67
Elliptic - DWT	(3) FFWNN	74.60	46.03	61.47	8.33	63.83
	(4) MRW-FFWNN	90.13	56.67	84.97	1.33	80.33
	(5) SRWNN	69.73	43.61	57.85	8.83	60.17
	(6) MRW-SRWNN	78.05	26.53	67.65	7.33	63.33
Elliptic - MODWT	(3) FFWNN	58.12	58.03	67.25	11.67	60.33
	(4) MRW-FFWNN	92.02	96.53	88.23	0.33	92.00
	(5) SRWNN	57.41	62.64	59.41	11.33	59.00
	(6) MRW-SRWNN	77.81	50.36	67.36	5.67	68.00
Equiripple - DWT	(3) FFWNN	73.72	42.69	59.30	12.00	62.00
	(4) MRW-FFWNN	86.33	67.90	84.93	0.67	81.33
	(5) SRWNN	69.88	44.89	64.84	11.33	62.33
	(6) MRW-SRWNN	72.66	26.18	67.64	13.33	60.67
<b>Equiripple - MODWT</b>	(3) FFWNN	63.19	45.45	59.01	10.67	58.00
	<b>(4) MRW-FFWNN</b>	<b>92.29</b>	<b>100.00</b>	<b>92.70</b>	<b>0.00</b>	<b>94.33</b>
	(5) SRWNN	61.77	43.64	55.67	12.33	56.00
	(6) MRW-SRWNN	70.33	56.67	82.23	8.00	69.67
Least squares - DWT	(3) FFWNN	78.29	51.09	52.84	8.00	64.33
	(4) MRW-FFWNN	85.30	60.37	84.18	1.00	78.00
	(5) SRWNN	78.32	46.36	53.54	8.67	63.67
	(6) MRW-SRWNN	76.62	25.90	58.26	11.67	58.67
Least squares - MODWT	(3) FFWNN	54.03	73.40	53.85	12.00	58.67
	(4) MRW-FFWNN	83.47	94.82	93.33	3.00	89.00
	(5) SRWNN	52.90	64.07	59.20	13.00	56.67
	(6) MRW-SRWNN	79.31	50.14	60.59	2.67	67.33

**Table A.7:** Classification of EEGs based on WNN using binary-tree structure: Healthy-Ictal-Interictal (H-Ic-In) with wavelet decomposition by criterion 1.

Feature extraction	Classifier	Accuracy (%)				
		Healthy	Ictal	Interictal	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	88.95	64.36	32.62	7.00	68.33
	(4) MRW-FFWNN	90.26	81.49	41.25	3.00	76.33
	(5) SRWNN	78.35	57.43	19.46	12.00	58.67
	(6) MRW-SRWNN	90.27	68.01	20.89	7.67	67.33
Chebyshev II - MODWT	(3) FFWNN	90.33	65.76	34.74	10.33	69.67
	(4) MRW-FFWNN	100.00	89.31	76.18	0.00	91.33
	(5) SRWNN	91.74	61.33	35.69	9.33	70.00
	(6) MRW-SRWNN	99.38	56.81	39.24	5.33	73.67
Elliptic - DWT	(3) FFWNN	80.88	58.86	23.30	7.33	61.33
	(4) MRW-FFWNN	91.45	88.84	40.04	0.67	77.33
	(5) SRWNN	79.48	60.43	24.55	9.67	61.00
	(6) MRW-SRWNN	82.71	72.13	28.16	10.00	66.00
Elliptic - MODWT	(3) FFWNN	91.02	62.10	36.56	10.33	68.33
	<b>(4) MRW-FFWNN</b>	<b>100.00</b>	<b>97.01</b>	<b>84.88</b>	<b>0.00</b>	<b>95.00</b>
	(5) SRWNN	95.75	60.45	41.98	5.33	70.67
	(6) MRW-SRWNN	93.18	72.17	41.00	5.67	72.33
Equiripple - DWT	(3) FFWNN	81.49	55.25	32.26	8.67	64.67
	(4) MRW-FFWNN	97.04	93.94	49.08	0.33	85.33
	(5) SRWNN	72.30	63.16	37.08	8.67	62.33
	(6) MRW-SRWNN	76.22	69.35	27.63	9.67	63.33
Equiripple - MODWT	(3) FFWNN	95.63	57.28	36.81	5.00	72.33
	(4) MRW-FFWNN	100.00	91.22	80.63	0.00	93.33
	(5) SRWNN	92.11	60.99	31.34	9.33	70.33
	(6) MRW-SRWNN	96.55	66.20	32.02	4.67	74.33
Least squares - DWT	(3) FFWNN	72.86	73.62	37.59	8.33	64.33
	(4) MRW-FFWNN	91.51	89.65	51.13	0.67	81.00
	(5) SRWNN	72.90	71.92	35.83	9.33	63.00
	(6) MRW-SRWNN	70.16	72.20	25.88	13.00	60.00
Least squares - MODWT	(3) FFWNN	92.80	69.87	28.67	5.33	69.00
	(4) MRW-FFWNN	100.00	93.56	81.12	0.00	93.00
	(5) SRWNN	88.27	71.35	42.24	6.67	71.00
	(6) MRW-SRWNN	97.12	78.20	36.08	2.33	74.67

**Table A.8:** Classification of EEGs based on WNN using binary-tree structure: Healthy-Interictal-Ictal (H-In-Ic) with wavelet decomposition by criterion 1.

Feature extraction	Classifier	Accuracy (%)				
		Healthy	Interictal	Ictal	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	83.67	32.55	77.71	9.67	67.67
	(4) MRW-FFWNN	91.25	62.44	82.69	1.33	81.33
	(5) SRWNN	74.06	38.39	60.61	11.67	61.00
	(6) MRW-SRWNN	71.89	27.06	70.64	9.67	59.33
Chebyshev II - MODWT	(3) FFWNN	93.30	38.53	61.36	7.67	70.00
	(4) MRW-FFWNN	99.29	82.24	90.06	0.67	92.00
	(5) SRWNN	97.06	43.93	53.62	5.67	71.00
	(6) MRW-SRWNN	93.83	50.31	65.09	3.33	74.33
Elliptic - DWT	(3) FFWNN	79.33	35.71	62.43	5.67	67.00
	(4) MRW-FFWNN	93.39	48.57	68.01	1.33	78.00
	(5) SRWNN	72.92	42.18	57.55	11.67	64.00
	(6) MRW-SRWNN	76.20	41.17	49.89	9.33	61.67
Elliptic - MODWT	(3) FFWNN	91.85	47.41	61.32	6.33	72.33
	(4) MRW-FFWNN	100.00	87.09	90.93	0.00	94.33
	(5) SRWNN	91.11	44.92	57.62	7.00	70.33
	(6) MRW-SRWNN	91.47	46.92	66.53	6.00	73.67
Equiripple - DWT	(3) FFWNN	86.39	28.27	50.70	8.33	63.00
	(4) MRW-FFWNN	97.52	47.47	80.12	1.00	80.33
	(5) SRWNN	76.54	30.07	52.28	10.33	58.67
	(6) MRW-SRWNN	79.18	26.99	60.20	8.33	61.33
<b>Equiripple - MODWT</b>	(3) FFWNN	90.72	36.07	54.56	8.33	67.67
	<b>(4) MRW-FFWNN</b>	<b>100.00</b>	<b>86.84</b>	<b>92.65</b>	<b>0.00</b>	<b>94.67</b>
	(5) SRWNN	94.58	35.98	57.38	6.67	70.00
	(6) MRW-SRWNN	97.00	56.81	67.87	2.00	79.00
Least squares - DWT	(3) FFWNN	77.20	30.37	60.83	13.67	61.00
	(4) MRW-FFWNN	93.51	48.68	77.37	1.00	78.67
	(5) SRWNN	76.54	42.75	54.22	8.00	62.33
	(6) MRW-SRWNN	79.12	27.36	62.43	7.33	62.00
Least squares - MODWT	(3) FFWNN	84.44	41.54	59.75	12.33	66.00
	(4) MRW-FFWNN	100.00	85.10	90.29	0.00	93.33
	(5) SRWNN	91.25	41.88	58.75	7.00	69.00
	(6) MRW-SRWNN	95.82	40.91	70.10	3.67	74.67

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fiers used features obtained of all the combinations of filters (Chebyshev, Elliptic, Equiripple and Least squares) and wavelets transforms (DWT and MODWT) by the criterion 1. These experiments were executed using 60 neurons in the layer 2, a learning rate of 0.001, a  $MSE_{max}$  de 0.1, a  $N_{Epochs}$  of 100 and Mexican hat as activation function in each classifier. The best results in each case are bolded and them are summarized in Table 5.7 of this thesis.

**Table A.9:** Classification of EEGs based on WNN using Vote strategy (VOTE) in a OVO decomposition scheme with wavelet decomposition by criterion 1.

Feature extraction	Classifier	Accuracy (%)			
		Ictal	Interictal	Healthy	Total
Chebyshev II - DWT	(3) FFWNN	81.34	46.54	83.84	70.33
	(4) MRW-FFWNN	96.00	100.00	0.00	70.00
	(5) SRWNN	70.87	42.23	83.94	65.17
	(6) MRW-SRWNN	84.50	96.41	3.50	62.50
Chebyshev II - MODWT	(3) FFWNN	91.14	22.96	98.82	71.17
	(4) MRW-FFWNN	100.00	100.00	0.00	73.33
	(5) SRWNN	76.46	26.20	97.81	67.00
	(6) MRW-SRWNN	90.03	100.00	0.95	64.67
Elliptic - DWT	(3) FFWNN	90.70	35.34	90.27	70.50
	(4) MRW-FFWNN	88.24	92.31	29.41	73.33
	(5) SRWNN	75.38	45.68	85.56	67.67
	(6) MRW-SRWNN	89.22	97.41	0.00	63.83
Elliptic - MODWT	(3) FFWNN	93.42	39.33	99.38	78.83
	(4) MRW-FFWNN	94.84	99.55	38.35	77.17
	(5) SRWNN	75.18	39.11	98.04	71.67
	(6) MRW-SRWNN	94.53	97.05	6.21	66.00
Equiripple - DWT	(3) FFWNN	94.10	26.29	96.59	72.17
	(4) MRW-FFWNN	77.78	58.82	100.00	81.33
	(5) SRWNN	78.76	32.82	95.04	68.83
	(6) MRW-SRWNN	90.29	92.10	9.65	64.17
Equiripple - MODWT	(3) FFWNN	95.40	43.71	97.14	78.67
	(4) MRW-FFWNN	94.74	100.00	25.00	68.33
	(5) SRWNN	75.10	16.32	99.05	65.00
	(6) MRW-SRWNN	92.93	99.13	0.00	61.00
<b>Least squares - DWT</b>	(3) FFWNN	95.06	25.20	96.94	71.00
	<b>(4) MRW-FFWNN</b>	<b>80.00</b>	<b>69.57</b>	<b>95.45</b>	<b>81.67</b>
	(5) SRWNN	75.47	31.21	92.18	65.67
	(6) MRW-SRWNN	89.91	81.77	22.86	64.67
Least squares - MODWT	(3) FFWNN	98.17	54.77	86.89	73.67
	(4) MRW-FFWNN	88.89	100.00	52.17	78.33
	(5) SRWNN	73.61	19.23	100.00	63.00
	(6) MRW-SRWNN	95.11	96.93	12.17	69.67

**Table A.10:** Classification of EEGs based on WNN using Weighted voting strategy (WV) in a OVO decomposition scheme with wavelet decomposition by criterion 1.

Feature extraction	Classifier	Accuracy (%)			
		Ictal	Interictal	Healthy	Total
Chebyshev II - DWT	(3) FFWNN	64.01	51.56	82.56	67.33
	(4) MRW-FFWNN	84.62	100.00	0.00	68.33
	(5) SRWNN	63.36	47.59	76.90	64.33
	(6) MRW-SRWNN	78.95	96.55	11.60	61.00
Chebyshev II - MODWT	(3) FFWNN	77.70	44.59	94.46	73.00
	(4) MRW-FFWNN	94.74	100.00	26.09	70.00
	(5) SRWNN	80.84	29.31	96.40	69.33
	(6) MRW-SRWNN	80.54	97.94	13.69	62.33
Elliptic - DWT	(3) FFWNN	74.94	78.17	70.17	74.33
	(4) MRW-FFWNN	81.82	100.00	0.00	61.67
	(5) SRWNN	63.60	67.62	68.84	67.00
	(6) MRW-SRWNN	66.09	98.89	1.57	51.00
Elliptic - MODWT	(3) FFWNN	90.11	44.33	96.94	75.33
	(4) MRW-FFWNN	<b>100.00</b>	<b>100.00</b>	<b>15.33</b>	<b>78.67</b>
	(5) SRWNN	80.55	37.71	99.05	70.33
	(6) MRW-SRWNN	81.40	99.00	11.90	67.33
Equiripple - DWT	(3) FFWNN	85.64	35.37	96.66	72.33
	(4) MRW-FFWNN	90.00	90.91	22.22	70.00
	(5) SRWNN	69.88	22.47	98.82	63.67
	(6) MRW-SRWNN	78.67	96.27	7.55	60.67
Equiripple - MODWT	(3) FFWNN	90.69	54.72	100.00	<b>83.00</b>
	(4) MRW-FFWNN	85.19	100.00	37.50	76.67
	(5) SRWNN	75.64	43.90	100.00	74.33
	(6) MRW-SRWNN	83.60	100.00	13.72	64.67
Least squares - DWT	(3) FFWNN	85.98	28.93	95.76	69.33
	(4) MRW-FFWNN	100.00	95.00	20.83	66.67
	(5) SRWNN	71.90	42.29	96.87	70.00
	(6) MRW-SRWNN	77.19	98.09	5.72	60.33
Least squares - MODWT	(3) FFWNN	94.31	33.95	100.00	73.33
	(4) MRW-FFWNN	83.33	100.00	47.37	78.33
	(5) SRWNN	74.78	27.13	100.00	64.33
	(6) MRW-SRWNN	83.61	100.00	14.63	67.67