INESC TEC - Report III

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1   Introduction

This report presents the results of the three experiments, the first without the lines and generators statuses variations, the second with these variations and the third with variations of two extra angle variables, but without statuses variations. Sections 2, 3 and 4 explain, respectively, the details of the 1st, 2nd and 3rd experiments. For last, Section 5 shows the results obtained.

2 1st experiment

The first experiment, without the statuses variations, only used the following input features: (1) Carga subrede de 138 kV, (2) Potência solar gerada subrede 138 kV, (3) Potência eólica gerada subrede 138 kV, (4) Carga subrede de 230 kV, (5) Potência solar gerada subrede 230 kV, (6) Potência eólica gerada subrede 230 kV. As presented on the Report I, the architecture maintained the same.

3 2nd experiment

The second experiment, which contained all the statuses, used the previous input features combined with generator and line status from the 138kV grid.

The architecture differed from the first experiment in the sense that: (1) there was no addition in the dataset from the output of the "Magnitude tensão barramento" features to predict the others, (2) each neural network also had to take into account the statuses, increasing the neurons from the first layer from six to 81, and (3) there was no feature augmentation given the already high count of features.

As for the hyperparameters, the batch size was set to 30 and the epoch to 20.

4 3rd experiment

The third experiment was a variation of the first one, whereas for each original data point, some of the possible variations of the "Phase-shift transformador 3-24" and "Relação transformação transformador 3-24" features were included. This resulted in an increase from 8759 data points to 183960. As a result of these two extra features, the input dataset contained eight features (the two presented previously and all the other six detailed in the 1st experiment section).

The neural network architecture maintained the same one as the 1st experiment, meaning that the dataset was augmented, since without it the RSME errors were larger, and the predictions of the three "Tensão ..." features were given as input to the other features.

As for the hyperparameters, the batch size was set to 50 and the epoch to 20.

5 Results

Table 1 presents the results obtained in the three experiments. In order to help the analysis of the results, the description of the output data used in the 1st, 2nd and 3rd experiments are present on tables 2, 3 and 4.

Table 1: RMSE results for the three experiments

Feature	1st experiment	2nd experiment	3rd experiment
Magnitude tensão barramento 11	0.0061	0.0046	0.0027
Magnitude tensão barramento 12	0.0060	0.0045	0.0025
Magnitude tensão barramento 24	0.0059	0.0046	0.0034
Potência ativa injetada barramento 11	4.6515	4.8033	3.7546
Potência ativa injetada barramento 12	6.3831	3.3279	3.6737
Potência ativa injetada barramento 24	4.3864	4.8998	2.8233
Potência reativa injetada barramento 11	5.7905	4.5519	2.9314
Potência reativa injetada barramento 12	5.1032	3.9487	2.3608
Potência reativa injetada barramento 24	2.5648	1.7550	1.1084

Table 2: Description of the output dataset used in the 1st experiment

	mean	std	min	max
Magnitude tensão barramento 11	0.996569	0.021639	0.952364	1.034885
Magnitude tensão barramento 12	0.997564	0.021008	0.953941	1.032754
Magnitude tensão barramento 24	0.993244	0.021868	0.950000	1.022086
Potência ativa injetada barramento 11	44.794038	32.318890	-27.531718	159.904392
Potência ativa injetada barramento 12	65.017462	46.834371	-45.061452	233.978721
Potência ativa injetada barramento 24	98.531922	53.707492	-29.154621	261.648979
Potência reativa injetada barramento 11	-15.602551	11.060453	-34.601205	16.029554
Potência reativa injetada barramento 12	-3.119726	15.983727	-30.758948	47.883536
Potência reativa injetada barramento 24	25.755603	10.808798	-0.197103	57.932657

Table 3: Description of the output dataset used in the 2nd experiment

	mean	std	min	max
Magnitude tensão barramento 11	0.930757	0.245329	0.000000	1.037192
Magnitude tensão barramento 12	0.932674	0.245811	0.000000	1.040975
Magnitude tensão barramento 24	0.928119	0.244779	0.000000	1.050000
Potência ativa injetada barramento 11	61.921753	74.191413	-141.873767	465.782920
Potência ativa injetada barramento 12	91.009106	60.936221	-82.386932	466.262804
Potência ativa injetada barramento 24	69.871945	52.058470	-26.491069	273.246314
Potência reativa injetada barramento 11	-0.993731	21.132315	-45.583309	81.584726
Potência reativa injetada barramento 12	2.929570	19.695334	-39.121608	70.183933
Potência reativa injetada barramento 24	19.667142	11.887073	-4.390776	68.135129

Table 4: Description of the output dataset used in the 3rd experiment

	mean	std	min	max
Magnitude tensão barramento 11	1.007676	0.007695	0.980477	1.027129
Magnitude tensão barramento 12	1.008743	0.006889	0.984902	1.026293
Magnitude tensão barramento 24	1.011133	0.014318	0.966169	1.043700
Potência ativa injetada barramento 11	103.697940	72.485245	-48.999844	373.637597
Potência ativa injetada barramento 12	126.950992	53.670348	13.442532	371.282757
Potência ativa injetada barramento 24	100.662457	53.799509	-22.405030	280.025114
Potência reativa injetada barramento 11	4.492659	17.052300	-38.358104	57.765010
Potência reativa injetada barramento 12	7.020446	14.801137	-22.550256	50.862751
Potência reativa injetada barramento 24	20.341227	13.107093	-21.859628	55.485767