

Fault Distance Estimation for Transmission Lines with Dynamic Regressor Selection

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Abstract

This Supplementary Material companion the paper entitled “Fault Distance Estimation for Transmission Lines with Dynamic Regressor Selection”, published in Neural Computing and Applications, vol. XX, no. XX, pp. XX–XX, year 202X, doi: XXXXXXXXXX. This document is not intended to be self-contained and should be read jointly with the original paper.

1 Additional Information

Table 1 shows the features ordered individually by their importance for the Extremely Randomized Trees (ERT) algorithm considering the Gini score, as mentioned in Section 7.4 (page 18) of the paper.

Table 1 Features ordered by their importance for the ERT algorithm, considering the mean and standard deviation, in parentheses, of the Gini score calculated considering the ten pre-trained ERT models.

Ranking	Feature	Gini score
#1	stdev_phase_A_current	4.2000E-02 (2.6056E-03)
#2	stdev_phase_C_current	4.1800E-02 (2.2051E-03)
#3	stdev_phase_B_current	3.9100E-02 (2.3033E-03)
#4	variance_phase_B_current	2.9300E-02 (1.2778E-03)
#5	variance_phase_A_current	2.8300E-02 (1.7970E-03)
#6	variance_phase_C_current	2.7800E-02 (2.3230E-03)
#7	geometric_mean_phase_B_current	2.7400E-02 (1.6177E-03)
#8	geometric_mean_phase_A_current	2.6000E-02 (2.1522E-03)
#9	geometric_mean_phase_C_current	2.3800E-02 (2.1111E-03)
#10	distance_phase_B_voltage	2.3100E-02 (8.7426E-04)
#11	distance_phase_C_voltage	2.1900E-02 (8.3371E-04)
#12	auc_phase_B_current	2.0600E-02 (1.4745E-03)
#13	auc_phase_C_current	2.0300E-02 (2.3626E-03)
#14	covariance_phase_A_C_current	1.9900E-02 (1.5607E-03)
#15	covariance_phase_B_C_current	1.9600E-02 (1.0864E-03)
#16	distance_phase_A_voltage	1.9500E-02 (6.5629E-04)
#17	covariance_phase_A_B_current	1.9400E-02 (8.5223E-04)
#18	auc_phase_A_current	1.9200E-02 (1.6199E-03)
#19	energy_phase_C_voltage	1.8000E-02 (9.7622E-04)
#20	variance_phase_A_voltage	1.7900E-02 (1.1498E-03)
#21	variance_phase_B_voltage	1.7900E-02 (9.7280E-04)
#22	energy_phase_A_voltage	1.7800E-02 (1.4003E-03)
#23	energy_phase_B_voltage	1.7700E-02 (9.1380E-04)
#24	variance_phase_C_voltage	1.7000E-02 (9.5077E-04)
#25	rms_phase_C_current	1.6100E-02 (1.3401E-03)
#26	rms_phase_B_current	1.5500E-02 (1.8063E-03)
#27	rms_phase_B_voltage	1.5400E-02 (9.9355E-04)
#28	rms_phase_A_voltage	1.5400E-02 (1.3677E-03)
#29	stdev_phase_B_voltage	1.5300E-02 (1.1439E-03)
#30	stdev_phase_A_voltage	1.5200E-02 (1.0014E-03)
#31	rms_phase_A_current	1.5200E-02 (1.2586E-03)
#32	stdev_phase_C_voltage	1.5000E-02 (6.2306E-04)
#33	rms_phase_C_voltage	1.4800E-02 (9.1283E-04)
#34	auc_phase_C_voltage	1.3400E-02 (8.4250E-04)
#35	auc_phase_B_voltage	1.3000E-02 (6.8464E-04)
#36	auc_phase_A_voltage	1.3000E-02 (1.0135E-03)
#37	correlation_phase_A_B_voltage	1.0900E-02 (9.9020E-04)
#38	correlation_phase_A_C_voltage	1.0500E-02 (7.5469E-04)
#39	correlation_phase_B_C_voltage	1.0500E-02 (6.7458E-04)
#40	energy_phase_C_current	1.0200E-02 (8.2585E-04)

Table 2 shows the features grouped and ordered by their importance for the ERT algorithm considering the Gini score, as also mentioned in Section 7.4 (page 18) of the paper.

Table 1 Continued from the previous page.

Ranking	Feature	Gini score
#41	energy_phase.B_current	9.6700E-03 (9.5086E-04)
#42	pk_pk_distance_phase.C_current	8.8800E-03 (1.1211E-03)
#43	energy_phase.A_current	8.8100E-03 (1.0431E-03)
#44	distance_phase.B_current	8.8100E-03 (1.1723E-03)
#45	pk_pk_distance_phase.B_current	8.7700E-03 (1.2930E-03)
#46	distance_phase.A_current	8.7600E-03 (7.7535E-04)
#47	distance_phase.C_current	8.3400E-03 (9.7109E-04)
#48	pk_pk_distance_phase.A_current	8.2100E-03 (9.9163E-04)
#49	covariance_phase.A_C_voltage	8.0500E-03 (3.1886E-04)
#50	covariance_phase.B_C_voltage	7.9600E-03 (4.2570E-04)
#51	covariance_phase.A_B_voltage	7.8800E-03 (3.5044E-04)
#52	maxFrequency_phase.C_current	6.9700E-03 (4.5325E-04)
#53	min_phase.B_current	6.8400E-03 (1.7545E-03)
#54	max_phase.C_current	6.7900E-03 (1.1355E-03)
#55	max_phase.A_current	6.3000E-03 (1.2483E-03)
#56	maxFrequency_phase.A_current	5.9600E-03 (4.9666E-04)
#57	min_phase.A_current	5.6500E-03 (8.0015E-04)
#58	min_phase.C_current	5.6500E-03 (7.3590E-04)
#59	correlation_phase.A_C_current	5.4900E-03 (1.5362E-04)
#60	correlation_phase.B_C_current	5.4700E-03 (1.9980E-04)
#61	maxFrequency_phase.B_current	5.4200E-03 (4.3794E-04)
#62	correlation_phase.A_B_current	5.3400E-03 (3.6046E-04)
#63	max_phase.B_current	5.3000E-03 (5.3685E-04)
#64	geometric_mean_phase.A_voltage	5.1000E-03 (4.7386E-04)
#65	geometric_mean_phase.B_voltage	4.9100E-03 (5.4003E-04)
#66	geometric_mean_phase.C_voltage	4.6300E-03 (2.8865E-04)
#67	pk_pk_distance_phase.B_voltage	4.0900E-03 (8.0593E-04)
#68	pk_pk_distance_phase.C_voltage	3.2300E-03 (5.6128E-04)
#69	pk_pk_distance_phase.A_voltage	2.7600E-03 (4.2818E-04)
#70	maxFrequency_phase.C_voltage	2.2100E-03 (2.0645E-04)
#71	maxFrequency_phase.B_voltage	1.8800E-03 (1.5277E-04)
#72	maxFrequency_phase.A_voltage	1.7900E-03 (1.3512E-04)
#73	kurtosis_phase.A_current	9.7200E-04 (6.7805E-05)
#74	kurtosis_phase.C_current	9.4900E-04 (6.3416E-05)
#75	kurtosis_phase.B_current	8.7200E-04 (7.4582E-05)
#76	max_phase.C_voltage	5.4300E-04 (1.6194E-04)
#77	kurtosis_phase.B_voltage	5.2500E-04 (1.9223E-05)
#78	max_phase.B_voltage	4.6800E-04 (7.5995E-05)
#79	kurtosis_phase.A_voltage	4.1400E-04 (2.5856E-05)
#80	min_phase.B_voltage	4.0500E-04 (1.8585E-04)
#81	kurtosis_phase.C_voltage	3.9300E-04 (1.8621E-05)
#82	min_phase.A_voltage	3.7900E-04 (1.2338E-04)

Table 1 Continued from the previous page.

Ranking	Feature	Gini score
#83	min_phase_C_voltage	3.4400E-04 (1.6889E-04)
#84	max_phase_A_voltage	3.1700E-04 (7.8298E-05)
#85	harmonic_mean_phase_C_current	2.3400E-04 (1.3946E-04)
#86	harmonic_mean_phase_B_current	1.8600E-04 (1.5282E-04)
#87	harmonic_mean_phase_A_current	1.5300E-04 (1.0500E-04)
#88	mean_phase_B_current	1.5000E-04 (2.5766E-05)
#89	mean_phase_C_current	1.4900E-04 (3.3544E-05)
#90	shannon_entropy_phase_B_current	1.4800E-04 (5.1165E-05)
#91	shannon_entropy_phase_C_current	1.3300E-04 (3.0557E-05)
#92	mean_phase_A_current	1.3200E-04 (2.8143E-05)
#93	shannon_entropy_phase_A_current	9.8200E-05 (3.6484E-05)
#94	median_phase_A_current	8.3000E-05 (2.8707E-05)
#95	median_phase_C_current	7.7100E-05 (2.3456E-05)
#96	median_phase_B_current	7.3700E-05 (1.7774E-05)
#97	skewness_phase_C_current	6.4600E-05 (4.5346E-06)
#98	median_phase_B_voltage	6.3500E-05 (2.5503E-06)
#99	skewness_phase_A_current	6.3400E-05 (6.1738E-06)
#100	median_phase_A_voltage	6.2900E-05 (3.8083E-06)
#101	skewness_phase_B_current	6.2200E-05 (3.1106E-06)
#102	shannon_entropy_phase_A_voltage	6.2000E-05 (3.2964E-06)
#103	median_phase_C_voltage	6.1400E-05 (2.8213E-06)
#104	shannon_entropy_phase_B_voltage	5.0900E-05 (2.6573E-06)
#105	shannon_entropy_phase_C_voltage	4.9300E-05 (1.0120E-06)
#106	skewness_phase_C_voltage	4.7600E-05 (3.6985E-06)
#107	skewness_phase_A_voltage	4.7500E-05 (3.3593E-06)
#108	skewness_phase_B_voltage	4.6600E-05 (3.6953E-06)
#109	powerBandwidth_phase_C_voltage	4.1800E-05 (2.7130E-06)
#110	powerBandwidth_phase_B_voltage	3.8800E-05 (2.5542E-06)
#111	powerBandwidth_phase_A_voltage	3.4700E-05 (2.6729E-06)
#112	harmonic_mean_phase_B_voltage	3.3500E-05 (9.5276E-07)
#113	harmonic_mean_phase_A_voltage	3.2600E-05 (6.8064E-07)
#114	harmonic_mean_phase_C_voltage	3.1800E-05 (9.5736E-07)
#115	mean_phase_A_voltage	3.0500E-05 (6.2406E-06)
#116	slope_phase_B_voltage	3.0500E-05 (3.0171E-06)
#117	mean_phase_B_voltage	3.0400E-05 (3.3780E-06)
#118	mean_phase_C_voltage	2.9200E-05 (2.3653E-06)
#119	slope_phase_C_voltage	2.8700E-05 (3.4836E-06)
#120	slope_phase_C_current	2.6300E-05 (2.0945E-06)
#121	slope_phase_A_current	2.5700E-05 (1.6138E-06)
#122	slope_phase_B_current	2.5500E-05 (8.6944E-07)
#123	slope_phase_A_voltage	2.4800E-05 (1.6786E-06)
#124	powerBandwidth_phase_C_current	4.5000E-06 (2.1050E-06)
#125	powerBandwidth_phase_A_current	3.3700E-06 (1.0928E-06)
#126	powerBandwidth_phase_B_current	2.9400E-06 (7.2434E-07)

Table 2 Features ordered by their importance for the ERT algorithm, considering the mean and standard deviation, in parentheses, of the Gini score calculated considering the ten pre-trained ERT models. Here, we grouped the features previously separated for each phase (A, B, or C) into a single feature.

Ranking	Feature	Gini score
#1	stdev_current	4.0967E-02 (1.6197E-03)
#2	variance_current	2.8467E-02 (7.6376E-04)
#3	geometric_mean_current	2.5733E-02 (1.8148E-03)
#4	distance_voltage	2.1500E-02 (1.8330E-03)
#5	auc_current	2.0033E-02 (7.3711E-04)
#6	covariance_current	1.9633E-02 (2.5166E-04)
#7	energy_voltage	1.7833E-02 (1.5275E-04)
#8	variance_voltage	1.7600E-02 (5.1962E-04)
#9	rms_current	1.5600E-02 (4.5826E-04)
#10	rms_voltage	1.5200E-02 (3.4641E-04)
#11	stdev_voltage	1.5167E-02 (1.5275E-04)
#12	auc_voltage	1.3133E-02 (2.3094E-04)
#13	correlation_voltage	1.0633E-02 (2.3094E-04)
#14	energy_current	9.5600E-03 (7.0150E-04)
#15	pk_pk_distance_current	8.6200E-03 (3.5930E-04)
#16	distance_current	8.6367E-03 (2.5813E-04)
#17	covariance_voltage	7.9633E-03 (8.5049E-05)
#18	maxFrequency_current	6.1167E-03 (7.8679E-04)
#19	min_current	6.0467E-03 (6.8705E-04)
#20	max_current	6.1300E-03 (7.5941E-04)
#21	correlation_current	5.4333E-03 (8.1445E-05)
#22	geometric_mean_voltage	4.8800E-03 (2.3643E-04)
#23	pk_pk_distance_voltage	3.3600E-03 (6.7446E-04)
#24	maxFrequency_voltage	1.9600E-03 (2.2113E-04)
#25	kurtosis_current	9.3100E-04 (5.2374E-05)
#26	max_voltage	4.4267E-04 (1.1511E-04)
#27	kurtosis_voltage	4.4400E-04 (7.0930E-05)
#28	min_voltage	3.7600E-04 (3.0610E-05)
#29	harmonic_mean_current	1.9100E-04 (4.0731E-05)
#30	mean_current	1.4367E-04 (1.0116E-05)
#31	shannon_entropy_current	1.2640E-04 (2.5548E-05)
#32	median_current	7.7933E-05 (4.7057E-06)
#33	skewness_current	6.3400E-05 (1.2000E-06)
#34	median_voltage	6.2600E-05 (1.0817E-06)
#35	shannon_entropy_voltage	5.4067E-05 (6.9169E-06)
#36	skewness_voltage	4.7233E-05 (5.5076E-07)
#37	powerBandwidth_voltage	3.8433E-05 (3.5642E-06)
#38	harmonic_mean_voltage	3.2633E-05 (8.5049E-07)
#39	mean_voltage	3.0033E-05 (7.2342E-07)
#40	slope_voltage	2.8000E-05 (2.9138E-06)
#41	slope_current	2.5833E-05 (4.1633E-07)
#42	powerBandwidth_current	3.6033E-06 (8.0575E-07)