

Supplementary Information

Supplementary Table 1: Summary Table of Model Parameters and Performances

This table summarizes various model parameters and their corresponding performances. The performance metrics include the Pearson's correlation coefficient (r), mean squared error (MSE), and the p-value of the fitted model. Additionally, the table lists the features sorted by importance, starting from the most important feature (First Feature) to the least important feature (Twelfth Feature).

Supplementary table 2: Summary table of hyperparameter tuning

This table shows the hyperparameter values estimated during the nested leave-one-out optimization method.

Supplementary Table 1

model_name	r	mse	p	First Feat	Second Feat	Third Feat	Fourth Feat	Fifth Feat	Six Feat
Original model (along trajectory)	0.49	0.0933	4.596e-05	Beta_21-35Hz_L	PDQ39_score_pre	LEDD_ratio	Age	TimeSinceSurgery	z_R
Final position (all contacts)	0.36	0.1096	4.282e-03	PDQ39_score_pre	Beta_21-35Hz_L	LEDD_ratio	Age	TimeSinceSurgery	Alpha_8-12Hz_L
Active contacts	0.35	0.1133	4.923e-03	PDQ39_score_pre	Beta_21-35Hz_L	Theta_3-7Hz_L	LEDD_ratio	Age	TimeSinceSurgery
Along trajectory (average of both sides)	0.4	0.1062	1.279e-03	PDQ39_score_pre	Beta_21-35Hz_L	LEDD_ratio	Age	z	TimeSinceSurgery
Affected hemisphere	0.34	0.1111	6.546e-03	PDQ39_score_pre	LEDD_ratio	Beta_13-20Hz_noDom	TimeSinceSurgery	Age	Beta_21-35Hz_Dom
Absolute scores	0.44	0.8243	2.968e-04	PDQ39_score_pre	TimeSinceSurgery	z_L	LEDD_ratio	Beta_21-35Hz_L	Age
Distance and amplitude	0.44	0.0996	2.609e-04	PDQ39_score_pre	Beta_21-35Hz_L	LEDD_ratio	Age	TimeSinceSurgery	L_dist
Model with 12 features	0.55	0.086	3.50E-06	PDQ39_score_pre	Beta_21-35Hz_L	LEDD_ratio	Age	TimeSinceSurgery	z_R

model_name	r	mse	p	Seventh Feat	Eight Feat	Ninth Feat	Tenth Feat	Eleventh Feat	Twelveth Feat
Original model (along trajectory)	0.49	0.0933	4.596e-05	z_L	Theta_3-7Hz_L	beta_low_mean_L	Alpha_8-12Hz_R	Beta_13-20Hz_R	Alpha_8-12Hz_L
Final position (all contacts)	0.36	0.1096	4.282e-03	z_R	Theta_3-7Hz_L	z_L	Alpha_8-12Hz_R	Beta_13-20Hz_L	x_R
Active contacts	0.35	0.1133	4.923e-03	Alpha_8-12Hz_L	z_R	Theta_3-7Hz_R	Beta_13-20Hz_L	y_L	z_L
Along trajectory (average of both sides)	0.4	0.1062	1.279e-03	x	Alpha_8-12Hz	Beta_13-20Hz	Theta_3-7Hz	y	Disease_duration
Affected hemisphere	0.34	0.1111	6.546e-03	z_R	Beta_21-35Hz_noDom	Alpha_8-12Hz_noDom	Theta_3-7Hz_noDom	z_L	y_R
Absolute scores	0.44	0.8243	2.968e-04	Beta_13-20Hz_L	z_R	Theta_3-7Hz_L	Beta_13-20Hz_R	Disease_duration	x_R
Distance and amplitude	0.44	0.0996	2.609e-04	Theta_3-7Hz_L	A_R	Beta_13-20Hz_L	R_dist	Alpha_8-12Hz_R	mean_dist
Model with 12 features	0.55	0.086	3.50E-06	z_L	Theta_3-7Hz_L	Beta_13-20Hz_L	Alpha_8-12Hz_R	Alpha_8-12Hz_R	Beta_13-20Hz_R

Supplementary Table 2

Left out PatID	mse	pearson	reg_alpha	colsample_bytree	subsample	gamma	max_depth	min_child_weight	learning_rate	n_estimators	eval_metric
1	0.083655862	0.554067838	0.004933966	0.879824604	0.829281818	0.030751486	2	10.5339829	0.025	189	rms
2	0.082492625	0.541463674	0	0.989011636	0.842895963	0.058898566	4	9.631485331	0.025	144	rms
3	0.083688123	0.561626017	0	0.99815832	0.775713483	0.034538093	6	5.82008788	0.025	80	rms
4	0.087397447	0.518584331	0	0.83604585	0.984320403	0.012201218	7	9.05382708	0.025	117	rms
5	0.085790709	0.570506522	0	0.975465503	0.851470946	0.019187485	3	8.727021031	0.025	114	rms
6	0.086497481	0.52995023	0	0.996343849	0.737351193	0.04041722	9	8.380326118	0.025	123	rms
7	0.085192149	0.552895462	0	0.945334392	0.835621498	0.061352881	3	8.82450461	0.025	157	rms
8	0.079352495	0.559715962	0	0.943295861	0.79945396	0.003374807	9	8.82010562	0.025	136	rms
9	0.087139881	0.54588015	0	0.948862908	0.834136817	0.045406825	2	9.966001255	0.025	139	rms
10	0.083633331	0.598571487	0.154464748	0.953946979	0.780342519	1.1008431172	4	1.008431172	0.025	88	rms
11	0.083637749	0.562360978	0.13309095	0.941108933	0.785329225	3.1597E-05	9	6.30541569	0.025	112	rms
12	0.087158642	0.552353997	0	0.936153349	0.809406211	0.064159105	10	8.807528994	0.025	144	rms
13	0.087340992	0.554570013	0	0.949150845	0.819246873	0.066590862	2	11.9272829	0.025	157	rms
14	0.090958484	0.545544533	0.008880602	0.854139331	0.806372965	0.043650415	2	9.328661735	0.025	197	rms
15	0.090855397	0.519119048	0.00170341	0.985425405	0.933543384	0.050355963	6	8.062373355	0.025	72	rms
16	0.086207214	0.507699585	0.043416089	0.998948586	0.950857119	0.050355963	2	10.18350048	0.025	182	rms
17	0.087803141	0.535191777	0	0.983163473	0.815548179	0.097872321	6	9.463184306	0.025	132	rms
18	0.087231549	0.553178907	0.011227692	0.967074063	0.806917941	0.065415992	4	9.020723662	0.025	157	rms
19	0.089295943	0.535049102	0	0.949507242	0.802522802	0.060168207	7	10.1561052	0.025	175	rms
20	0.089416287	0.54179876	0.009086003	0.674165754	0.779250695	0.031487488	7	8.218039776	0.025	192	rms
21	0.087482721	0.555000698	0.00487545	0.942346123	0.799793924	0.008507638	3	6.604859483	0.025	105	rms
22	0.089445026	0.53187688	0	0.945347374	0.637664491	0.029051064	3	6.572872119	0.025	132	rms
23	0.088619935	0.514068039	0	0.986573053	0.819002666	0.054036027	2	10.73827001	0.025	158	rms
24	0.08636667	0.553941206	0.018691233	0.839926918	0.638184402	0.0247711316	8	6.062676327	0.025	133	rms
25	0.084808661	0.589912042	0.010434746	0.88107113	0.976904456	0.066764232	9	10.86508978	0.025	146	rms
26	0.090643983	0.56286538	0.000173822	0.815738563	0.676375584	0.005294991	4	6.629170807	0.025	146	rms
27	0.090261354	0.600818782	0	0.948864103	0.621670281	0.057787805	3	6.042327208	0.025	132	rms
28	0.090792875	0.552805169	0.043091935	0.709016751	0.623031485	0.071971588	3	6.239122292	0.025	173	rms
29	0.089735221	0.552655354	0.006190892	0.998110695	0.86792474	0.100845979	6	8.230865948	0.025	107	rms
30	0.081277235	0.617856042	0.001015864	0.722919351	0.824993107	0.061224198	4	7.378296266	0.025	164	rms
31	0.090273391	0.540277724	0	0.8	0.8	0.21382844	3	3.363384734	0.025	77	rms
32	0.0512676587	0.890473095	0.01266658	0.890473095	0.924680691	0.059971658	9	6.550241784	0.025	66	rms
33	0.088083238	0.489521109	0.009178102	0.934758914	0.812831806	0.148181962	5	7.621389947	0.025	67	rms
34	0.08727682	0.538998424	0.000721983	0.991488825	0.80259252	0.076249667	10	8.20697759	0.025	87	rms
35	0.069134801	0.64492503	0.000503509	0.847269062	0.869386552	0.058408401	2	10.3568621	0.025	156	rms
36	0.065493386	0.615642359	0.041346794	0.862228996	0.962042699	0.058408401	2	10.3436796	0.025	148	rms
37	0.077452317	0.597054498	0	0.86025241	0.801627778	0.090051013	2	9.146488023	0.025	96	rms
38	0.077633785	0.581976588	0	0.840512799	0.862059297	0.019141009	5	7.677662151	0.025	339	rms
39	0.077242351	0.581629229	0.019172326	0.708615492	0.810505532	0.019141009	7	10.97027738	0.025	192	rms
40	0.07089664	0.589789298	0.028376254	0.60245219	0.985799045	0.035091394	2	11.04974962	0.025	1000	rms
41	0.076054539	0.581635544	0	0.537894219	0.728209903	0.093377844	4	8.548094784	0.025	308	rms
42	0.080351747	0.597767083	0.005710628	0.806477712	0.798947217	0.088032218	6	8.85021124	0.025	119	rms
43	0.086687268	0.542028793	0.057805302	0.716572918	0.855194779	0.04033737	5	7.590103582	0.025	164	rms
44	0.086029175	0.563500833	0	0.887090545	0.779131525	0.000833421	3	8.597221501	0.025	243	rms
45	0.092029402	0.595156572	0	0.713847403	0.692281115	0.10845246	3	5.784613516	0.025	178	rms
46	0.095336791	0.434700206	0	0.95216323	0.929545194	0.028896571	6	7.538354319	0.025	120	rms
47	0.083209869	0.606760041	0	0.912124768	0.783866547	0.105040625	8	7.692714684	0.025	203	rms
48	0.085015288	0.553207332	0.043011311	0.968887297	0.924773762	0.049370705	7	7.419270553	0.025	60	rms
49	0.088084816	0.556637351	0.020418632	0.868853512	0.781066774	0.05956065	3	6.876906786	0.025	50	rms
50	0.088674674	0.557586295	0.001019314	0.908851843	0.784397315	0.111128788	3	7.654049995	0.025	49	rms
51	0.086013515	0.579708926	0.08233547	0.994465844	0.923911011	0.074780096	4	8.355050272	0.025	60	rms
52	0.094187888	0.498860833	0	0.998911484	0.855738285	0.123174049	3	7.231057356	0.025	58	rms
53	0.08784184	0.573030281	0.00329485	0.849847779	0.783252717	0.115961387	8	7.908750585	0.025	60	rms
54	0.090112274	0.505295007	0	0.808861104	0.8363984	0.015689114	6	8.042774426	0.025	93	rms
55	0.090711531	0.552030101	0.00579627	0.987094551	0.816949415	0.009037672	3	7.455228159	0.025	112	rms
56	0.081169693	0.607699063	0.005545385	0.98578492	0.853657348	0.000974912	6	7.476361529	0.025	78	rms
57	0.085897341	0.568713901	0.039383177	0.948908132	0.854894155	0.067336508	5	8.244609355	0.025	101	rms
58	0.087163679	0.570171114	0	0.939132524	0.839400317	0.097223974	6	7.68357252	0.025	101	rms
59	0.08425872	0.561618888	0	0.935359234	0.840716947	0.053538633	8	7.793080006	0.025	78	rms
60	0.08761986	0.535719378	0	0.965277676	0.900871702	0.063790869	6	5.969026848	0.025	128	rms
61	0.083367339	0.536283376	0	0.849319206	0.854020201	0.03407956	3	3.097155255	0.025	79	rms
62	0.088856422	0.586392406	0	0.8	0.8	0.04826017	6	6.715574109	0.025	57	rms
63	0.086913005	0.544803891	0	0.845321706	0.98645482	0.031179557	9	6.715574109	0.025	57	rms
mean	0.085925564	0.556994774	0.014717383	0.877263484	0.819852727	0.055769875	5.031746	8.040990373	0.025	142.2380952	
Std	0.005440306	0.034893442	0.029308499	0.121731771	0.086720242	0.040260104	2.4294447	1.958128486	2.79785E-17	124.1163235	