

Supplementary Information

Table S1. Correlations between percent power change from baseline and LEDD. r denotes the Pearson correlation coefficient. p-values are uncorrected.

	T0	T10	T25	T40
tbTUS – Passive Sham	r = 0.68 p = 0.001	r = 0.6511 p = 0.0034	r = 0.6146 p = 0.0066	r = 0.5432 p = 0.0198
tbTUS – Active Sham	r = 0.66 p = 0.002	r = 0.6224 p = 0.0058	r = 0.5371 p = 0.0215	r = 0.5612 p = 0.0154
10 Hz TUS – Passive Sham	r = 0.63 p = 0.004	r = 0.6958 p = 0.001	r = 0.6259 p = 0.0055	r = 0.6139 p = 0.0067
10 Hz TUS – Active Sham	r = 0.35 p = 0.14	r = 0.5543 p = 0.0170	r = 0.5745 p = 0.0126	r = 0.6340 p = 0.0047
Active Sham – Passive Sham	r = 0.1495 p = 0.55	r = -0.10 p = 0.63	r = 0.10 p = 0.669	r = -0.12 p = 0.6268

Table S2. tbTUS and 10 Hz TUS parameters. PRI: pulse repetition interval, DC: Duty Cycle, PRF: pulse repetition frequency, FF: Fundamental frequency, ISPPA: spatial-peak pulse-average intensity, ISPTA: spatial-peak temporal average intensity

	Pulse duration	PRI	DC	PRF	Stimulus Duration	FF	ISPPA in water	ISPTA in water
tbTUS	20 ms	200 ms	10%	5 Hz	120 s	500 kHz	30 W/cm ²	3 W/cm ²
10 Hz TUS	30 ms	100 ms	30%	10 Hz	40 s	500 kHz	30 W/cm ²	9 W/cm ²

Table S3. Physical parameters used for acoustic and thermal modelling in BabelBrain simulations. ρ , c_L , c_S , α_L , α_S , k , H and ω are, respectively, the density, longitudinal speed of sound, shear speed of sound, longitudinal attenuation, shear attenuation, thermal conductivity, specific heat and perfusion. Acoustic properties ρ , c_L , c_S , α_L , α_S are calculated from Table I in Pichardo, 2023. Thermal properties k , H and ω are as reported in the IT'IS Foundation database V4.1⁸³.

Property Material	ρ (kg/m ³)	c_L (m/s)	c_S (m/s)	α_L (Np/m)	α_S (Np/m)	k (W/m/°C)	H (J/kg/°C)	ω (ml/min/kg)
Water	1000	1500	-	-	-	0.6	4178	-
Skin	1116	1537	-	2.3	-	0.37	3391	106
Brain	1041	1562	-	3.45	-	0.51	3630	559
Cortical bone	1896.5	2475	1542	81.5	114.5	0.32	1313	10
Trabecular bone	1738.0	2205	1312	81	114.5	0.31	2274	30

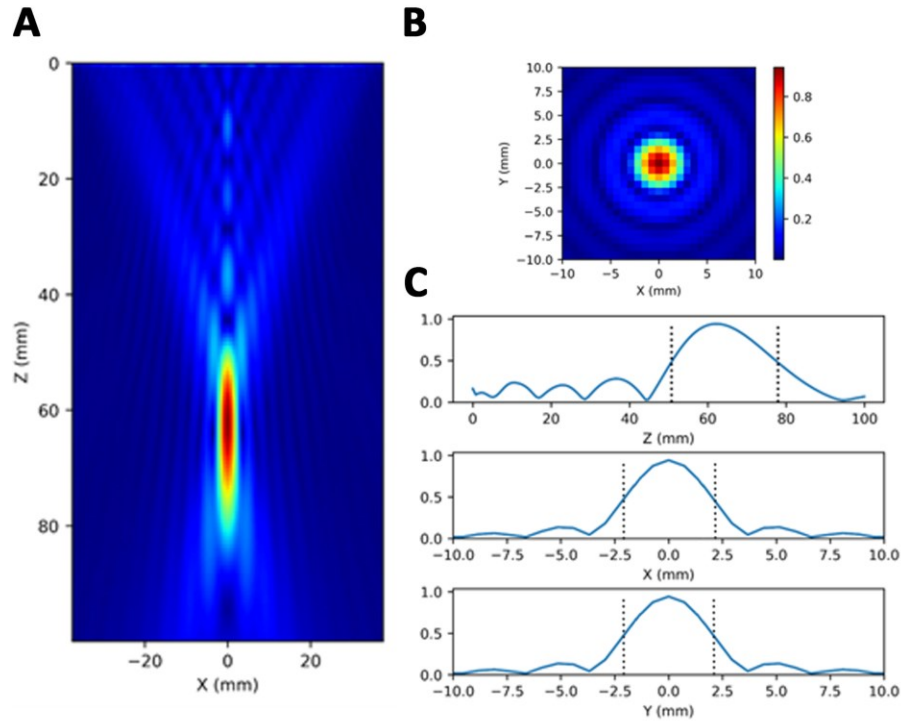


Figure S1. Free field acoustic simulations for NeuroFUS device. Simulations were performed at fundamental frequency of 500 kHz, intensity of 30 W/cm² ISPPA, and focal point 60 mm (A-B). The color gradient represents the intensity of the pressure field in mega Pascal (MPa). The maximum pressure at the TUS focus was 1.0 MPa. Pressure variations along each respective axes: the Z-axis (depth), X-axis (horizontal), and Y-axis (vertical) are also shown in (C), with the peak pressure corresponding to the focal point of the ultrasound beam and the dashed lines indicating the full width at half maximum (FWHM).

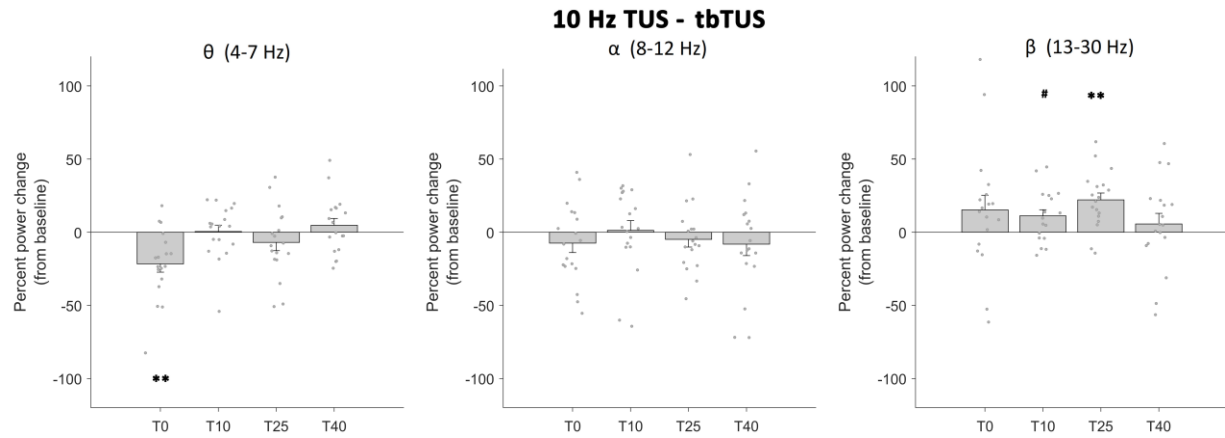


Figure S2. Differential effects of tbTUS and 10 Hz TUS on percent power changes across frequency bands. Bar plots show the percent power changes from baseline in the theta (4–7 Hz), alpha (8–12 Hz), and beta (13–30 Hz) frequency bands at different time points (T0, T10, T25, and T40). Significant differences between conditions are denoted by ** ($p < 0.01$, Benjamini-Hochberg adjusted), indicating distinct effects of tbTUS and 10 Hz TUS on neural activity within these frequency bands. Error bars represent the standard error of the mean (SEM). # represents $p = 0.06$.

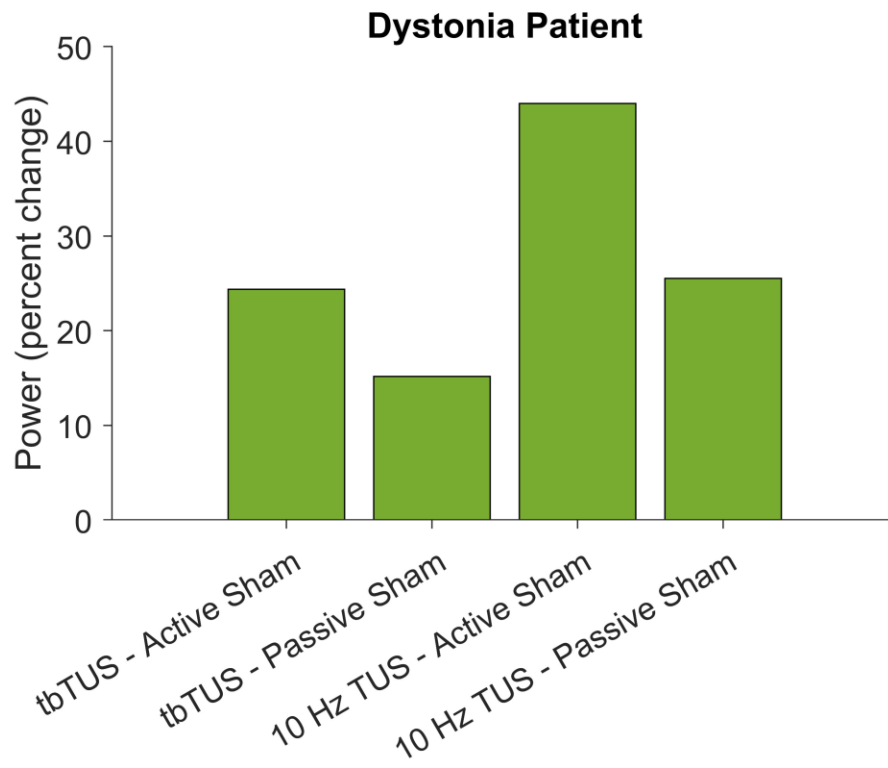


Figure S3. Spectral power changes across different stimulation protocols for n=1 dystonia patient. Similar to the PD patients, both tbTUS and 10 Hz TUS increased the overall spectral power of the GPi LFPs in this dystonia patient.

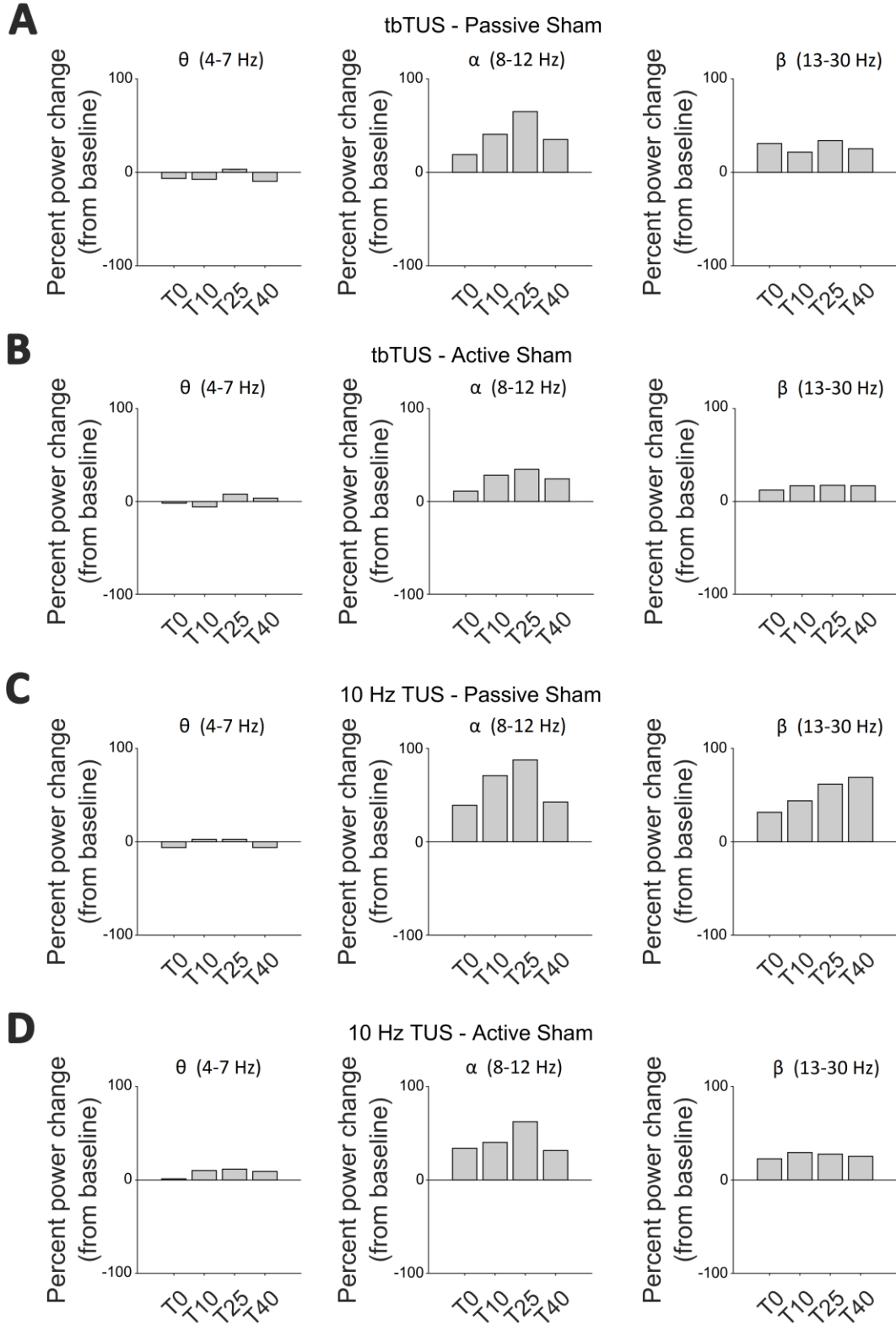


Figure S4. Spectral power changes across different stimulation protocols for n=1 dystonia patient. Similar to the PD patients, both tbTUS and 10 Hz TUS increased the overall spectral power of the GPi LFPs in this dystonia patient.

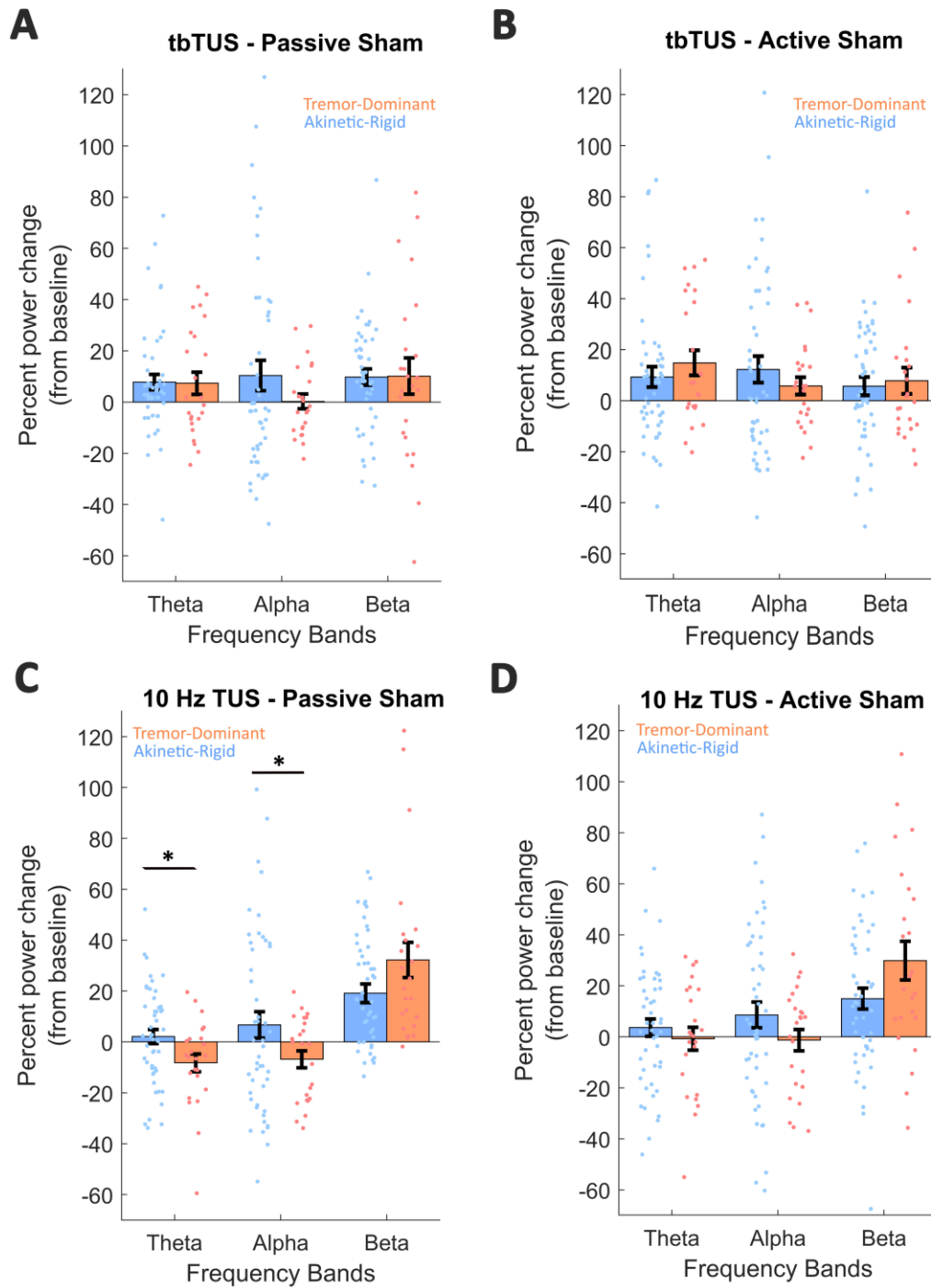


Figure S5. Percent power change from baseline in distinct frequency bands in response to TUS of GPi in two patient subpopulations. Data are presented for two patient populations: tremor-dominant (orange) and akinetic-rigid (blue). Error bars represent the standard error of the mean. Panels compare the effects of different TUS conditions on these populations: (A) tbTUS - Passive Sham, showing no significant changes; (B) tbTUS - Active Sham, also showing no significant changes; (C) 10 Hz TUS - Passive Sham, highlighting significant differences in α and β power (* indicates $p < 0.05$, two-sample t-test); and (D) 10 Hz TUS - Active Sham, demonstrating no significant difference in power for the two groups. Statistical significance is denoted by asterisks (* indicates $p < 0.05$, two-sample t-test).