SUPPLEMENTARY INFORMATION

Supplementary Methods

Analysis controlling for the direction from the reference to the referred tetrode

Based on the direction from the reference to the referred tetrodes along the proximo-distal and septo-temporal axes, the data for co-occurrence and relative amplitude were each separated into four groups – tetrode pairs having more proximal and septal reference tetrodes than their corresponding referred tetrodes (PD ST), tetrode pairs having more distal and septal reference tetrodes than their corresponding referred tetrodes (DP ST), tetrode pairs having more proximal and temporal reference tetrodes than their corresponding referred tetrodes (PD TS), and tetrode pairs having more distal and temporal reference tetrodes than their corresponding referred tetrodes (DP TS). This was done to ensure that there was no influence of directionality.

Analysis using comparable spatial spreads

To ascertain that our results were not influenced by the differences in the spatial spread of the tetrodes across the proximo-distal and septo-temporal axes, the ripple co-occurrence, amplitude and propagation analyses were repeated by eliminating tetrodes to make the spatial spread along the two axes comparable. The elimination was done so as to maximize the spread along the septo-temporal axis and minimize the difference in the spatial spread along the two axes. At most three tetrodes were eliminated from each rat. Seven rats were utilized for the co-occurrence and amplitude analyses under this condition (for rat 302, no combination of tetrode elimination yielded a comparable spatial spread across the two axes even for the required minimum two tetrodes because of which it was eliminated from the analysis). For the propagation analysis, five rats were utilized as the remaining three (rat 302, rat 305, rat 392) did not satisfy the criterion of having a minimum of six tetrodes after eliminating tetrodes.

Supplementary Tables

Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
	partial slope	p-value	partial slope	p-value	
2-4 SD	-2.58	0.04*	-0.49	0.79	0.17
4-6 SD	-0.65	0.42	-0.93	0.42	0.58
≥ 6 SD	2.06	0.011*	-0.073	0.95	0.084

Supplementary Table 1 Rate of ripple occurrence.

Change of rate of ripple occurrence as a function of relative position (count/min/mm) along the proximo-distal and septo-temporal axes for 2-4 SD, 4-6 SD, and ≥ 6 SD.

Rat number	Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
302	≥ 2 SD	-9.2	0.03*	1.97	0.77	0.22
	2-4 SD	-8.99	0.02*	1.8	0.76	0.19
	4-6 SD	-3.4	0.02*	0.76	0.74	0.20
	≥ 6 SD	3.21	0.005*	-0.60	0.65	0.096
305	≥ 2 SD	-6.1	0.37	4.8	0.65	0.46
	2-4 SD	-7.03	0.3	4.3	0.63	0.39
	4-6 SD	-2.66	0.36	2.04	0.64	0.45
	≥ 6 SD	3.64	0.18	-1.54	0.59	0.27
391	≥ 2 SD	-3.17	0.21	-1.71	0.62	0.37
	2-4 SD	-4.4	0.03*	-0.43	0.84	0.11
	4-6 SD	-1.22	0.19	-0.87	0.49	0.41
	≥ 6 SD	2.48	0.0014*	-0.41	0.43	0.13
392	≥ 2 SD	-2.6	0.4	-4.23	0.3	0.66
	2-4 SD	-2.97	0.21	-3.84	0.22	0.62
	4-6 SD	-1.14	0.33	-2.33	0.16	0.78
	≥ 6 SD	1.44	0.15	1.93	0.14	0.67
416	≥ 2 SD	-1.72	0.45	-9.08	0.09	0.88
	2-4 SD	-4.08	0.02*	-3.42	0.23	0.42
	4-6 SD	-1.004	0.17	-3.11	0.06	0.87
	≥ 6 SD	3.35	0.0069*	-2.56	0.16	0.35
417	≥ 2 SD	-2.4	0.4	4.3	0.2	0.67
	2-4 SD	-3.03	0.09	5.27	0.02*	0.97
	4-6 SD	-2.32	0.08	1.54	0.24	0.33
	≥ 6 SD	3.00	6×10^{-4}*	-2.53	0.002*	0.23
432	≥ 2 SD	0.43	0.66	2.74	0.1	0.89
	2-4 SD	0.07	0.89	0.22	0.03*	0.97
	4-6 SD	-0.05	0.85	1.1	0.02*	0.98
	≥ 6 SD	0.42	0.52	-0.67	0.49	0.59
441	≥ 2 SD	2.2	0.6	5.5	0.4	0.71
	2-4 SD	-0.3	0.92	1.83	0.72	0.63
	4-6 SD	0.68	0.56	1.86	0.34	0.75
	≥ 6 SD	1.87	0.015*	1.81	0.092	0.47

Supplementary Table 2 Rat-wise rate of ripple occurrence.

Change of rate of ripple occurrence as a function of relative position (count/min/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD for each rat separately. Consistent with the average data, a majority of the rats showed opposing trends between 2-4 SD and ≥ 6 SD, though they were not always significant. Each rat has a corresponding colored dot in Figure 1B: black – rat 302, red – rat 305, dark blue – rat 391, sea green – rat 392, light blue – rat 416, lime green – rat 417, purple – rat 432, pink – rat 441.

Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
	partial slope	p-value	partial slope	p-value	
≥ 2 SD	0.09	0.97	-0.21	0.95	0.51
2-4 SD	-0.19	0.91	0.34	0.86	0.52
4-6 SD	-0.25	0.83	-0.49	0.71	0.55
≥ 6 SD	0.57	0.59	-0.039	0.97	0.37

Supplementary Table 3 Rate of ripple occurrence for comparable spatial spreads.

Change of rate of ripple occurrence as a function of relative position (count/min/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD after controlling for differences in spatial spreads of tetrodes along the proximo-distal and septo-temporal axes.

Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
	partial slope	p-value	partial slope	p-value	
≥ 2 SD	0.02	0.21	0.018	0.43	0.47
2-4 SD	-0.034	0.066	-0.0082	0.76	0.22
4-6 SD	-0.038	0.087	-0.0015	0.96	0.18
≥ 6 SD	-0.046	0.13	0.046	0.31	0.49

Supplementary Table 4 Ripple amplitude.

Change of ripple amplitude as a function of relative position (amplitude/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD.

Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
	partial slope	p-value	partial slope	p-value	
≥ 2 SD	-0.00022	0.68	0.00027	0.72	0.52
2-4 SD	-0.00018	0.36	-0.00015	0.61	0.46
4-6 SD	-0.00088	0.0014*	0.000091	0.81	0.051
≥ 6 SD	-0.0024	1×10^{-5}*	-0.00017	0.82	0.0093*

Supplementary Table 5 Ripple duration.

Change of ripple duration as a function of relative position (ms/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD.

Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
	partial slope	p-value	partial slope	p-value	
≥ 2 SD	-1.13	0.094	1.25	0.21	0.54
2-4 SD	-0.88	0.34	1.87	0.17	0.72
4-6 SD	-1.54	0.057	1.23	0.29	0.41
≥ 6 SD	-0.78	0.15	0.88	0.27	0.54

Supplementary Table 6 Ripple frequency.

Change of ripple frequency as a function of relative position (Hz/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD.

Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
	partial slope	p-value	partial slope	p-value	
2-4 SD	-0.069	$< 10^{-5}$*	-0.022	0.12	0.003*
4-6 SD	-0.088	$< 10^{-5}$*	-0.032	0.006*	$< 10^{-5}$*
≥ 6 SD	-0.039	$< 10^{-5}$*	-0.017	3×10^{-4}*	2×10^{-5}*

Supplementary Table 7 Ripple co-occurrence.

Change of fraction of co-occurring ripples as a function of relative distance between tetrode pairs (fraction of co-occurring ripples/mm) along the proximo-distal and septo-temporal axes for 2-4 SD, 4-6 SD, and ≥ 6 SD.

Rat number	Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
302	≥ 2 SD	-0.093	0.002*	0.089	0.16	0.48
	2-4 SD	-0.11	2×10^{-4}*	0.075	0.18	0.28
	4-6 SD	-0.12	2×10^{-5}*	0.087	0.08	0.27
	≥ 6 SD	-0.04	$< 10^{-5}$*	0.02	0.16	0.12
305	≥ 2 SD	-0.17	0.14	-0.046	0.71	0.14
	2-4 SD	-0.16	0.12	-0.046	0.67	0.14
	4-6 SD	-0.18	0.13	-0.052	0.69	0.14
	≥ 6 SD	-0.089	0.08	-0.013	0.79	0.075
391	≥ 2 SD	-0.08	1×10^{-5}*	0.027	0.18	0.0096*
	2-4 SD	-0.13	2×10^{-5}*	0.025	0.44	0.003*
	4-6 SD	-0.11	$< 10^{-5}$*	0.037	0.15	0.007*
	≥ 6 SD	-0.024	6×10^{-5}*	0.0077	0.25	0.015*
392	≥ 2 SD	-0.03	0.05	-0.0011	0.96	0.13
	2-4 SD	-0.029	0.063	-0.010	0.66	0.23
	4-6 SD	-0.039	0.014*	-0.029	0.22	0.35
	≥ 6 SD	-0.025	2×10^{-5}*	-0.0044	0.54	0.0065*
416	≥ 2 SD	-0.05	2×10^{-5}*	-0.084	8×10^{-5}*	0.96
	2-4 SD	-0.045	0.0014*	-0.11	0.0001*	0.99
	4-6 SD	-0.079	$< 10^{-5}$*	-0.10	$< 10^{-5}$*	0.9
	≥ 6 SD	-0.033	$< 10^{-5}$*	-0.04	5×10^{-5}*	0.9
417	≥ 2 SD	-0.07	$< 10^{-5}$*	-0.05	2×10^{-4}*	0.07
	2-4 SD	-0.046	$< 10^{-5}$*	-0.052	$< 10^{-5}$*	0.74
	4-6 SD	-0.093	$< 10^{-5}$*	-0.049	0.0016*	0.014*
	≥ 6 SD	-0.064	$< 10^{-5}$*	-0.023	0.003*	1×10^{-4}*
432	≥ 2 SD	-0.06	$< 10^{-5}$*	-0.023	0.08	0.007*
	2-4 SD	-0.073	2×10^{-4}*	-0.034	0.18	0.072
	4-6 SD	-0.084	$< 10^{-5}$*	-0.04	0.0082*	0.0013*
	≥ 6 SD	-0.025	$< 10^{-5}$*	-0.0098	0.018*	$< 10^{-5}$*
441	≥ 2 SD	-0.089	$< 10^{-5}$*	-0.007	0.72	7×10^{-4}*
	2-4 SD	-0.071	1×10^{-5}*	-0.022	0.27	0.021*
	4-6 SD	-0.10	$< 10^{-5}$*	-0.022	0.31	0.0014*
	≥ 6 SD	-0.049	$< 10^{-5}$*	-0.01	0.24	2×10^{-4}*

Supplementary Table 8 Rat-wise ripple co-occurrence.

Change of fraction of co-occurring ripples as a function of relative distance between tetrode pairs (fraction of co-occurring ripples/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD for each rat separately. Consistent with the average data, 7/8 rats showed a significant decrease along the proximo-distal axis in two or more amplitude groups, while the decrease along the septo-temporal axis was not so reliable across rats.

Amplitude group	Direction from reference to referred	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
≥ 2 SD	PD ST	-0.093	< 10^{-5}*	-0.039	0.14	0.033*
	DP ST	-0.076	< 10^{-5}*	0.0064	0.82	0.0016*
	PD TS	-0.078	2×10^{-5}*	0.0083	0.73	0.0093*
	DP TS	-0.048	0.0016*	-0.044	0.038*	0.43
2-4 SD	PD ST	-0.074	2×10^{-4}*	-0.023	0.39	0.052
	DP ST	-0.089	1×10^{-5}*	-0.013	0.62	0.0093*
	PD TS	-0.079	2×10^{-4}*	-0.01	0.72	0.021*
	DP TS	-0.029	0.13	-0.019	0.49	0.36
4-6 SD	PD ST	-0.086	< 10^{-5}*	-0.051	0.013*	0.063
	DP ST	-0.11	< 10^{-5}*	-0.0017	0.93	4×10^{-5}*
	PD TS	-0.092	< 10^{-5}*	-0.025	0.24	0.0044*
	DP TS	-0.074	< 10^{-5}*	-0.038	0.08	0.074
≥ 6 SD	PD ST	-0.034	< 10^{-5}*	-0.025	5×10^{-4}*	0.11
	DP ST	-0.049	< 10^{-5}*	-0.0044	0.59	< 10^{-5}*
	PD TS	-0.033	< 10^{-5}*	-0.012	0.094	0.005*
	DP TS	-0.045	< 10^{-5}*	-0.023	0.0069*	0.0095*

Supplementary Table 9 Ripple co-occurrence accounting for the direction from the reference to the referred tetrode.

Change of fraction of co-occurring ripples as a function of relative distance between tetrode pairs (fraction of co-occurring ripples/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD after controlling for the direction from the reference to the referred tetrode along the two axes (as described in Supplementary Methods). PD denotes the reference tetrode being more proximal to the referred tetrode, DP denotes the reference tetrode being more distal to the referred tetrode, ST denotes the reference tetrode being more septal to the referred tetrode, while TS denotes the reference tetrode being more temporal to the referred tetrode.

Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
	partial slope	p-value	partial slope	p-value	
≥ 2 SD	-0.058	0.0012*	-0.025	0.14	0.088
2-4 SD	-0.077	8×10^{-4}*	-0.026	0.22	0.052
4-6 SD	-0.081	$< 10^{-5}$*	-0.031	0.047*	0.015*
≥ 6 SD	-0.028	$< 10^{-5}$*	-0.015	0.003*	0.046*

Supplementary Table 10 Ripple co-occurrence for comparable spatial spreads.

Change of fraction of co-occurring ripples as a function of relative distance between tetrode pairs (fraction of co-occurring ripples/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD after controlling for differences in spatial spreads of tetrodes along the proximo-distal and septo-temporal axes.

Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
	partial slope	p-value	partial slope	p-value	
2-4 SD	6×10^{-5}	0.99	0.0099	0.32	0.8
4-6 SD	-0.0048	0.44	-0.0006	0.94	0.34
≥ 6 SD	-0.057	$< 10^{-5}$*	-0.031	7×10^{-5}*	0.0012*

Supplementary Table 11 Relative ripple amplitude.

Change of relative ripple amplitude as a function of relative distance between tetrode pairs (relative amplitude/mm) along the proximo-distal and septo-temporal axes for 2-4 SD, 4-6 SD, and ≥ 6 SD.

Rat number	Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
302	≥ 2 SD	-0.04	0.0011*	0.029	0.25	0.35
	2-4 SD	-0.0068	0.46	0.011	0.65	0.55
	4-6 SD	-0.007	0.49	0.019	0.46	0.65
	≥ 6 SD	-0.056	1×10^{-4}*	0.049	0.08	0.42
305	≥ 2 SD	-0.055	0.10	-0.016	0.65	0.12
	2-4 SD	-0.046	0.075	-0.015	0.56	0.11
	4-6 SD	-0.037	0.34	-0.017	0.72	0.32
	≥ 6 SD	-0.11	0.062	-0.027	0.62	0.077
391	≥ 2 SD	-0.012	0.02*	0.009	0.17	0.36
	2-4 SD	0.029	0.069	0.014	0.51	0.27
	4-6 SD	0.03	0.013*	0.004	0.78	0.07
	≥ 6 SD	-0.05	$< 10^{-5}$*	0.0077	0.5	5×10^{-4}*
392	≥ 2 SD	-0.0034	0.56	0.0066	0.46	0.63
	2-4 SD	0.015	0.10	-0.029	0.054	0.81
	4-6 SD	0.033	2×10^{-4}*	0.015	0.18	0.077
	≥ 6 SD	-0.038	5×10^{-5}*	-0.006	0.58	0.01*
416	≥ 2 SD	-0.015	0.15	-0.05	0.009*	0.97
	2-4 SD	0.025	0.016*	-0.029	0.14	0.57
	4-6 SD	-0.002	0.77	-0.002	0.87	0.5
	≥ 6 SD	-0.05	$< 10^{-5}$*	-0.056	6×10^{-5}*	0.73
417	≥ 2 SD	-0.037	$< 10^{-5}$*	-0.018	0.003*	0.011*
	2-4 SD	0.001	0.85	-0.017	0.0037*	0.98
	4-6 SD	-0.043	0.003*	-0.0032	0.8	0.013*
	≥ 6 SD	-0.087	$< 10^{-5}$*	-0.038	0.001*	6×10^{-4}*
432	≥ 2 SD	-0.0016	0.90	0.037	0.063	0.96
	2-4 SD	0.016	0.009*	0.02	0.023*	0.68
	4-6 SD	0.0094	0.011*	0.015	0.0054*	0.86
	≥ 6 SD	-0.044	$< 10^{-5}$*	-0.016	0.024*	1×10^{-4}*
441	≥ 2 SD	-0.038	2×10^{-5}*	-0.0015	0.89	0.0038*
	2-4 SD	-0.015	0.23	-0.006	0.73	0.33
	4-6 SD	-0.0066	0.56	0.0022	0.89	0.41
	≥ 6 SD	-0.07	$< 10^{-5}$*	-0.0024	0.82	$< 10^{-5}$*

Supplementary Table 12 Rat-wise relative ripple amplitude.

Change of relative ripple amplitude as a function of relative distance between tetrode pairs (relative amplitude/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD for each rat separately. Consistent with the average data, for ≥ 2 SD, 4 rats showed a significant decrease along the proximo-distal axis and none of the rats showed the opposite trend. Relative amplitude for 2-4 SD and 4-6 SD did not show any gradients along the proximo-distal or septo-temporal axes in the average data, however, the rat-wise data showed a variation of positive and negative gradients among the different rats. Consistent with the average data, for ≥ 6 SD the decrease along the proximo-distal axis was significant for 7/8 rats, while the decrease along the septo-temporal axis was not as reliable across rats.

Amplitude group	Direction from reference to referred	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
≥ 2 SD	PD ST	-0.043	0.10	0.014	0.70	0.23
	DP ST	-0.0043	0.84	-0.035	0.25	0.79
	PD TS	-0.024	0.25	0.037	0.19	0.64
	DP TS	-0.024	0.21	-0.027	0.31	0.54
2-4 SD	PD ST	-0.04	0.09	0.005	0.87	0.16
	DP ST	0.04	0.12	-0.023	0.55	0.33
	PD TS	0.014	0.62	0.085	0.028*	0.93
	DP TS	0.011	0.71	-0.004	0.91	0.44
4-6 SD	PD ST	-0.019	0.25	-0.017	0.46	0.46
	DP ST	0.025	0.13	-0.032	0.16	0.6
	PD TS	0.0045	0.84	0.044	0.16	0.84
	DP TS	-0.019	0.28	-0.0053	0.83	0.3
≥ 6 SD	PD ST	-0.057	$< 10^{-5}$*	-0.031	0.038*	0.05
	DP ST	-0.066	$< 10^{-5}$*	-0.036	0.06	0.10
	PD TS	-0.053	4×10^{-4}*	-0.016	0.44	0.066
	DP TS	-0.069	$< 10^{-5}$*	-0.034	0.048*	0.037*

Supplementary Table 13 Relative ripple amplitude accounting for the direction from the reference to the referred tetrode.

Change of relative ripple amplitude as a function of relative distance between tetrode pairs (fraction of co-occurring ripples/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD after controlling for the direction from the reference to the referred tetrode along the two axes (as described in Supplementary Methods). PD denotes the reference tetrode being more proximal to the referred tetrode, DP denotes the reference tetrode being more distal to the referred tetrode, ST denotes the reference tetrode being more septal to the referred tetrode, while TS denotes the reference tetrode being more temporal to the referred tetrode.

Amplitude group	Proximo-distal		Septo-temporal		p-value of comparison of slopes
	partial slope	p-value	partial slope	p-value	
≥ 2 SD	0.002	0.87	-0.005	0.61	0.59
2-4 SD	0.021	0.18	0.0013	0.93	0.18
4-6 SD	0.031	0.021*	-0.004	0.76	0.072
≥ 6 SD	-0.035	0.0033*	-0.029	0.011*	0.35

Supplementary Table 14 Relative ripple amplitude for comparable spatial spreads.

Change of relative ripple amplitude as a function of relative distance between tetrode pairs (relative amplitude/mm) along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD after controlling for differences in spatial spreads of tetrodes along the proximo-distal and septo-temporal axes.

Amplitude group	Direction of propagation	Number of ripples	Proximo-distal		Septo-temporal		p-value of comparison of slopes	Resultant speed
			partial slope	p-value	partial slope	p-value		
2-4 SD	Prox-dist	139 (30%)	32.4	< 10⁻⁵*	0.51	0.86	< 10⁻⁵*	0.031
	Dist-prox	117 (25%)	-25.3	< 10⁻⁵*	0.84	0.77	< 10⁻⁵*	0.039
	Sept-temp	118(25%)	-0.65	0.64	33.9	< 10⁻⁵*	0*	0.029
	Temp-sept	94 (20%)	4.25	0.081	-34.7	< 10⁻⁵*	< 10⁻⁵*	0.029
4-6 SD	Prox-dist	300 (37%)	16.9	< 10⁻⁵*	-1.59	0.29	< 10⁻⁵*	0.059
	Dist-prox	173 (22%)	-25.2	< 10⁻⁵*	-1.89	0.35	< 10⁻⁵*	0.039
	Sept-temp	150 (19%)	-2.13	0.16	26.6	< 10⁻⁵*	< 10⁻⁵*	0.037
	Temp-sept	175 (22%)	2.6	0.11	-20.7	< 10⁻⁵*	< 10⁻⁵*	0.048
≥ 6 SD	Prox-dist	1286 (33%)	10.02	< 10⁻⁵*	0.086	0.84	0*	0.099
	Dist-prox	1269 (32%)	-11.3	< 10⁻⁵*	0.18	0.82	< 10⁻⁵*	0.089
	Sept-temp	704 (18%)	1.45	0.19	12.8	< 10⁻⁵*	< 10⁻⁵*	0.078
	Temp-sept	674 (17%)	0.52	0.55	-15.4	< 10⁻⁵*	< 10⁻⁵*	0.065

Supplementary Table 15 Ripple propagation.

Statistics for ripple propagation along the proximo-distal and septo-temporal axes for 2-4 SD, 4-6 SD, and ≥ 6 SD. Partial slopes in this case are the difference in time of occurrence of ripples as a function of distance along the proximo-distal and septo-temporal axes. The unit of the partial slopes is ms/mm while that of resultant speeds is mm/ms.

2-4 SD: number of putative events = 2579; number of propagating events = 468; percentage of propagating events = 18%; ratio for direction = 1.21; ratio for slopes = 0.833; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, $Z = 2$, $p = 0.02*$.

4-6 SD: number of putative events = 4484; number of propagating events = 798; percentage of propagating events = 18%; ratio for direction = 1.46; ratio for slopes = 0.418; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, $Z = 5$, $p < 10^{-5}*$.

≥ 6 SD: number of putative events = 18219; number of propagating events = 3933; percentage of propagating events = 21%; ratio for direction = 1.84; ratio for slopes = 0.328; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 19, p < 10^{-5}*.

Amplitude group	Direction of propagation	Number of ripples	Proximo-distal		Septo-temporal		p-value of comparison of slopes	Resultant speed
			partial slope	p-value	partial slope	p-value		
≥ 2 SD	Prox-dist	83 (41%)	11.5	0.0071*	-3.90	0.46	0.15	0.082
	Dist-prox	75 (37%)	-17.2	0.013*	4.63	0.63	0.17	0.056
	Sept-temp	21 (11%)	-4.42	0.019*	12.9	0.015*	0.042*	0.073
	Temp-sept	21 (11%)	10.9	0.0022*	-29.2	0.0022*	0.0092*	0.032
2-4 SD	Prox-dist	8 (35%)	28.3	0.022*	-8.30	0.66	0.22	0.034
	Dist-prox	8 (35%)	-25.1	0.034*	7.31	0.71	0.25	0.038
	Sept-temp	4 (17%)	0.44	0.36	7.64	0.0062*	0.0078*	0.13
	Temp-sept	3 (13%)	14.8	0.001*	-35.7	0.0014*	0.0068*	0.026
4-6 SD	Prox-dist	13 (43%)	14.5	0.0067*	-8.10	0.25	0.23	0.060
	Dist-prox	10 (33%)	-20.2	0.011*	1.76	0.87	0.12	0.049
	Sept-temp	4 (13%)	-15.5	0.026*	30.9	0.054	0.16	0.029
	Temp-sept	3 (10%)	19.5	0.0042*	-34.01	0.014*	0.095	0.025
≥ 6 SD	Prox-dist	62 (42%)	9.13	0.0047*	-2.82	0.44	0.11	0.10
	Dist-prox	57 (39%)	-15.3	0.011*	4.74	0.55	0.17	0.062
	Sept-temp	13 (9%)	-2.53	0.01*	9.01	0.0044*	0.012*	0.11
	Temp-sept	15 (10%)	8.59	0.0048*	-22.3	0.0052*	0.021*	0.042

Supplementary Table 16a Ripple propagation for **rat 302.**

≥ 2 SD: number of putative events = 1365; number of propagating events = 200; percentage of propagating events = 15%; ratio for direction = 3.67; ratio for slopes = 0.115; test of proportions comparing the

observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, $Z = 8$, $p < 10^{-5}$*.

2-4 SD: number of putative events = 188; number of propagating events = 23; percentage of propagating events = 12%; ratio for direction = 2.28; ratio for slopes = 0; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, $Z = 1.87$, $p = 0.03$*.

4-6 SD: number of putative events = 297; number of propagating events = 30; percentage of propagating events = 10%; ratio for direction = 3.29; ratio for slopes = 0; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, $Z = 3$, $p = 0.0017$*.

$\geq$ 6 SD: number of putative events = 880; number of propagating events = 147; percentage of propagating events = 17%; ratio for direction = 4.25; ratio for slopes = 0.130; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, $Z = 7.5$, $p < 10^{-5}$*.

Amplitude group	Direction of propagation	Number of ripples	Proximo-distal		Septo-temporal		p-value of comparison of slopes	Resultant speed
			partial slope	p-value	partial slope	p-value		
≥ 2 SD	Prox-dist	440 (40%)	13.8	7×10^{-5}*	-1.57	0.26	7×10^{-4}*	0.072
	Dist-prox	421 (39%)	-16.1	8×10^{-5}*	0.44	0.78	6×10^{-4}*	0.062
	Sept-temp	140 (13%)	0.58	0.67	14.2	0.0018*	0.0026*	0.071
	Temp-sept	85 (8%)	6.45	0.052	-23.9	0.0025*	0.0091*	0.040
2-4 SD	Prox-dist	17 (31%)	48.3	0.0025*	-16.9	0.18	0.041*	0.019
	Dist-prox	17 (31%)	-42.5	3×10^{-5}*	2.34	0.49	3×10^{-4}*	0.023
	Sept-temp	13 (24%)	2.11	0.72	39.7	0.0079*	0.011*	0.025
	Temp-sept	7 (13%)	22.05	0.077	-79.8	0.0046*	0.016*	0.012
4-6 SD	Prox-dist	73 (51%)	15.4	2×10^{-4}*	-2.26	0.25	0.0018*	0.064
	Dist-prox	35 (24%)	-27.7	3×10^{-4}*	-1.69	0.65	0.0021*	0.036
	Sept-temp	24 (17%)	1.85	0.034*	11.9	2×10^{-4}*	4×10^{-4}*	0.082
	Temp-sept	12 (8%)	18.8	0.0047*	-29.5	0.0039*	0.085	0.029
≥ 6 SD	Prox-dist	350 (39%)	12.03	4×10^{-5}*	-0.43	0.66	3×10^{-4}*	0.083
	Dist-prox	369 (42%)	-13.8	8×10^{-5}*	0.64	0.64	$< 10^{-5}$*	0.072
	Sept-temp	103 (12%)	-1.22	0.32	11.1	0.0024*	0.0045*	0.089
	Temp-sept	66 (7%)	1.69	0.42	-18.2	0.0029*	0.0051*	0.055

Supplementary Table 16b Ripple propagation for **rat 391.**

≥ 2 SD: number of putative events = 6040; number of propagating events = 1086; percentage of propagating events = 18%; ratio for direction = 3.87; ratio for slopes = 0.108; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 19, p < 10^{-5}*.

2-4 SD: number of putative events = 457; number of propagating events = 54; percentage of propagating events = 12%; ratio for direction = 1.70; ratio for slopes = 0; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 19, p = 0.029*.

4-6 SD: number of putative events = 976; number of propagating events = 144; percentage of propagating events = 15%; ratio for direction = 3; ratio for slopes = 0.083; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 6, $p < 10^{-5}$*.

≥ 6 SD: number of putative events = 4607; number of propagating events = 888; percentage of propagating events = 19%; ratio for direction = 4.25; ratio for slopes = 0.116; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 18, $p < 10^{-5}$*.

Amplitude group	Direction of propagation	Number of ripples	Proximo-distal		Septo-temporal		p-value of comparison of slopes	Resultant speed
			partial slope	p-value	partial slope	p-value		
≥ 2 SD	Prox-dist	180 (36%)	13.2	3×10^{-4}*	2.94	0.12	0.0012*	0.074
	Dist-prox	105 (21%)	-10.8	$< 10^{-5}$*	-2.76	0.12	0.0024*	0.089
	Sept-temp	150 (30%)	3.42	0.0079*	14.1	9×10^{-5}*	1×10^{-4}*	0.069
	Temp-sept	62 (12%)	-6.25	0.037*	-19.6	0.0018*	0.0036*	0.049
2-4 SD	Prox-dist	22 (48%)	25.02	6×10^{-4}*	1.83	0.60	0.001*	0.039
	Dist-prox	7 (15%)	-19.5	0.0011*	-5.17	0.17	0.0047*	0.049
	Sept-temp	9 (20%)	2.68	0.32	37.4	3×10^{-4}*	2×10^{-4}*	0.027
	Temp-sept	8 (17%)	-8.69	0.11	-36.6	0.0026*	0.0035*	0.027
4-6 SD	Prox-dist	29 (45%)	16.9	4×10^{-4}*	2.98	0.22	0.0013*	0.058
	Dist-prox	9 (14%)	-26.4	4×10^{-4}*	-13.6	0.014*	0.0085*	0.034
	Sept-temp	12 (18%)	-3.94	0.39	41.6	0.0015*	0.0011*	0.024
	Temp-sept	15 (23%)	-3.88	0.064	-19.8	6×10^{-4}*	7×10^{-4}*	0.049
≥ 6 SD	Prox-dist	129 (33%)	10.7	3×10^{-4}*	2.93	0.074	0.0015*	0.090
	Dist-prox	89 (23%)	-8.89	8×10^{-4}*	-1.36	0.35	0.0021*	0.11
	Sept-temp	129 (33%)	3.86	6×10^{-4}*	9.58	5×10^{-5}*	2×10^{-4}*	0.097
	Temp-sept	39 (10%)	-4.77	0.059	-16.2	0.0025*	0.0045*	0.059

Supplementary Table 16c Ripple propagation for **rat 392.**

≥ 2 SD: number of putative events = 2828; number of propagating events = 497; percentage of propagating events = 18%; ratio for direction = 1.39; ratio for slopes = 0.490; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 3.3, p = 5 × 10^{-4}*.

2-4 SD: number of putative events = 276; number of propagating events = 46; percentage of propagating events = 17%; ratio for direction = 1.71; ratio for slopes = 0.500; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 1.77, p = 0.039*.

4-6 SD: number of putative events = 420; number of propagating events = 65; percentage of propagating events = 15%; ratio for direction = 1.41; ratio for slopes = 0.250; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 1.36, p = 0.087.

≥ 6 SD: number of putative events = 2132; number of propagating events = 386; percentage of propagating events = 18%; ratio for direction = 1.29; ratio for slopes = 0.545; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 2.54, p = 0.0055*.

Amplitude group	Direction of propagation	Number of ripples	Proximo-distal		Septo-temporal		p-value of comparison of slopes	Resultant speed
			partial slope	p-value	partial slope	p-value		
≥ 2 SD	Prox-dist	189 (33%)	12.7	$< 10^{-5}$*	-0.023	0.98	2×10^{-4}*	0.078
	Dist-prox	92 (17%)	-13.3	$< 10^{-5}$*	-1.28	0.39	5×10^{-4}*	0.075
	Sept-temp	142 (26%)	2.49	0.052	22.3	1×10^{-4}*	3×10^{-4}*	0.045
	Temp-sept	133 (24%)	-3.55	0.025*	-29.6	5×10^{-5}*	1×10^{-4}*	0.034
2-4 SD	Prox-dist	12 (31%)	40.1	3×10^{-4}*	-1.44	0.88	0.0095*	0.025
	Dist-prox	7 (18%)	-43.04	0.0011*	-11.0	0.44	0.54	0.023
	Sept-temp	9 (23%)	-0.074	0.97	44.5	1×10^{-4}*	2×10^{-4}*	0.022
	Temp-sept	11 (28%)	-3.09	0.33	-36.8	0.0014*	0.0029*	0.027
4-6 SD	Prox-dist	20 (28%)	21.7	3×10^{-5}*	-0.52	0.87	0.0015*	0.034
	Dist-prox	8 (11%)	-29.6	4×10^{-5}*	-0.97	0.84	0.002*	0.044
	Sept-temp	16 (22%)	1.54	0.31	31.7	9×10^{-5}*	2×10^{-4}*	0.032
	Temp-sept	27 (38%)	-9.38	0.0025*	-39.6	8×10^{-5}*	4×10^{-4}*	0.025
≥ 6 SD	Prox-dist	157 (35%)	10.2	$< 10^{-5}$*	0.076	0.94	3×10^{-4}*	0.098
	Dist-prox	77 (17%)	-11.1	$< 10^{-5}$*	0.64	0.59	3×10^{-4}*	0.090
	Sept-temp	117 (26%)	3.14	0.012*	18.1	1×10^{-4}*	4×10^{-4}*	0.055
	Temp-sept	95 (21%)	-1.72	0.16	-26.7	6×10^{-5}*	1×10^{-4}*	0.037

Supplementary Table 16d Ripple propagation for **rat 416.**

≥ 2 SD: number of putative events = 2520; number of propagating events = 556; percentage of propagating events = 22%; ratio for direction = 0.97; ratio for slopes = 0.636; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 0.25, p = 0.4.

2-4 SD: number of putative events = 202; number of propagating events = 39; percentage of propagating events = 19%; ratio for direction = 0.95; ratio for slopes = 1.500; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = -0.16, p = 0.44.

4-6 SD: number of putative events = 407; number of propagating events = 71; percentage of propagating events = 17%; ratio for direction = 0.65; ratio for slopes = 4; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = -1.78, p = 0.038*.

≥ 6 SD: number of putative events = 1911; number of propagating events = 446; percentage of propagating events = 23%; ratio for direction = 1.10; ratio for slopes = 0.575; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 1.05, p = 0.15.

| Amplitude group | Direction of propagation | Number of ripples | Proximo-distal | | Septo-temporal | | p-value of comparison of slopes | Resultant speed |
			partial slope	p-value	partial slope	p-value		
≥ 2 SD	Prox-dist	321 (31%)	13.0	2×10^{-4}*	-1.64	0.29	0.0015*	0.076
	Dist-prox	232 (23%)	-20.7	1×10^{-4}*	0.36	0.86	7×10^{-4}*	0.048
	Sept-temp	208 (20%)	7.86	0.076	4.99	0.47	0.65	0.12
	Temp-sept	261 (26%)	2.06	0.14	-14.8	6×10^{-4}*	0.0015*	0.067
2-4 SD	Prox-dist	35 (23%)	30.05	0.0012*	-3.25	0.56	0.0078*	0.033
	Dist-prox	39 (26%)	-29.6	2×10^{-4}*	0.17	0.96	0.0011*	0.034
	Sept-temp	41 (27%)	6.26	0.026*	21.7	9×10^{-4}*	0.0041*	0.044
	Temp-sept	36 (24%)	9.38	0.011*	-31.1	4×10^{-4}*	0.0022*	0.031
4-6 SD	Prox-dist	68 (30%)	18.9	7×10^{-4}*	-4.38	0.19	0.0079*	0.051
	Dist-prox	57 (25%)	-28.2	2×10^{-4}*	0.54	0.86	9×10^{-4}*	0.036
	Sept-temp	40 (18%)	5.27	0.051	16.9	0.0039*	0.015*	0.056
	Temp-sept	62 (27%)	4.81	0.0029*	-21.5	3×10^{-5}*	1×10^{-4}*	0.045
≥ 6 SD	Prox-dist	218 (34%)	10.8	4×10^{-5}*	-0.71	0.41	3×10^{-4}*	0.093
	Dist-prox	136 (21%)	-15.6	1×10^{-4}*	0.14	0.93	6×10^{-4}*	0.064
	Sept-temp	127 (20%)	6.23	0.13	0.59	0.93	0.78	0.16
	Temp-sept	163 (25%)	0.82	0.37	-14.3	2×10^{-4}*	4×10^{-4}*	0.069

Supplementary Table 16e Ripple propagation for **rat 417.**

≥ 2 SD: number of putative events = 5210; number of propagating events = 1022; percentage of propagating events = 20%; ratio for direction = 1.25; ratio for slopes = 0.637; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 2.63, p = 0.0043*.

2-4 SD: number of putative events = 705; number of propagating events = 151; percentage of propagating events = 21%; ratio for direction = 0.96; ratio for slopes = 1.667; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = -0.24, p = 0.4.

4-6 SD: number of putative events = 1172; number of propagating events = 227; percentage of propagating events = 19%; ratio for direction = 1.22; ratio for slopes = 0.812; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 1.53, p = 0.064.

≥ 6 SD: number of putative events = 3333; number of propagating events = 644; percentage of propagating events = 19%; ratio for direction = 1.22; ratio for slopes = 0.603; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 2.5, p = 0.0058*.

Amplitude group	Direction of propagation	Number of ripples	Proximo-distal		Septo-temporal		p-value of comparison of slopes	Resultant speed
			partial slope	p-value	partial slope	p-value		
≥ 2 SD	Prox-dist	282 (30%)	12.7	$< 10^{-5}$*	1.47	0.31	2×10^{-4}*	0.078
	Dist-prox	273 (29%)	-11.8	$< 10^{-5}$*	1.43	0.068	$< 10^{-5}$*	0.084
	Sept-temp	199 (21%)	-4.42	0.019*	20.2	7×10^{-5}*	3×10^{-4}*	0.048
	Temp-sept	184 (20%)	1.91	0.21	-17.02	2×10^{-4}*	3×10^{-4}*	0.058
2-4 SD	Prox-dist	19 (25%)	43.2	2×10^{-4}*	14.4	0.12	0.0095*	0.022
	Dist-prox	17 (23%)	-27.3	$< 10^{-5}$*	10.6	0.0014*	1×10^{-4}*	0.034
	Sept-temp	28 (37%)	-11.6	0.0093*	34.2	3×10^{-4}*	0.0027*	0.028
	Temp-sept	11 (15%)	9.35	0.0019*	-28.8	4×10^{-5}*	4×10^{-4}*	0.033
4-6 SD	Prox-dist	59 (39%)	15.1	2×10^{-5}*	3.50	0.11	8×10^{-4}*	0.064
	Dist-prox	22 (15%)	-28.0	4×10^{-4}*	7.38	0.26	0.012*	0.034
	Sept-temp	39 (26%)	-6.60	0.0085*	27.8	3×10^{-5}*	2×10^{-4}*	0.035
	Temp-sept	30 (20%)	3.94	0.0018*	-14.5	1×10^{-5}*	9×10^{-5}*	0.066
≥ 6 SD	Prox-dist	204 (29%)	10.3	$< 10^{-5}$*	0.75	0.52	1×10^{-4}*	0.097
	Dist-prox	234 (33%)	-10.4	$< 10^{-5}$*	0.88	0.13	$< 10^{-5}$*	0.096
	Sept-temp	132 (18%)	-3.16	0.022*	16.9	3×10^{-5}*	1×10^{-4}*	0.058
	Temp-sept	143 (20%)	1.17	0.46*	-15.8	4×10^{-4}*	6×10^{-4}*	0.063

Supplementary Table 16f Ripple propagation for **rat 432.**

≥ 2 SD: number of putative events = 3928; number of propagating events = 938; percentage of propagating events = 16%; ratio for direction = 1.48; ratio for slopes = 0.422; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 5.6, p < 10^{-5}*.

2-4 SD: number of putative events = 428; number of propagating events = 75; percentage of propagating events = 17%; ratio for direction = 0.92; ratio for slopes = 1; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = -0.35, p = 0.36.

4-6 SD: number of putative events = 737; number of propagating events = 150; percentage of propagating events = 20%; ratio for direction = 1.17; ratio for slopes = 0.231; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 2=0.98, p = 0.16.

≥ 6 SD: number of putative events = 2763; number of propagating events = 713; percentage of propagating events = 26%; ratio for direction = 1.59; ratio for slopes = 0.407; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 6.1, p < 10^{-5}*.

Amplitude group	Direction of propagation	Number of ripples	Proximo-distal		Septo-temporal		p-value of comparison of slopes	Resultant speed
			partial slope	p-value	partial slope	p-value		
≥ 2 SD	Prox-dist	230 (26%)	14.1	< 10^{-5}*	3.85	0.008*	1 × 10^{-5}*	0.068
	Dist-prox	361 (40%)	-15.3	< 10^{-5}*	-4.34	0.0033*	< 10^{-5}*	0.063
	Sept-temp	112 (12%)	0.12	0.94	19.4	2 × 10^{-4}*	5 × 10^{-5}*	0.052
	Temp-sept	197 (22%)	-7.35	4 × 10^{-4}*	-20.5	2 × 10^{-5}*	7 × 10^{-5}*	0.046
2-4 SD	Prox-dist	26 (33%)	31.8	3 × 10^{-5}*	6.96	0.17	4 × 10^{-4}*	0.031
	Dist-prox	22 (28%)	-26.2	< 10^{-5}*	-5.16	0.094	5 × 10^{-5}*	0.037
	Sept-temp	14 (17%)	-2.11	0.41	32.9	1 × 10^{-4}*	6 × 10^{-5}*	0.030
	Temp-sept	18 (22%)	-6.53	0.12	-49.4	1 × 10^{-4}*	9 × 10^{-5}*	0.020
4-6 SD	Prox-dist	38 (34%)	21.6	1 × 10^{-4}*	5.62	0.22	0.0026*	0.045
	Dist-prox	32 (29%)	-24.7	1 × 10^{-5}*	-3.98	0.24	1 × 10^{-4}*	0.040
	Sept-temp	15 (14%)	-3.24	0.13	20.3	5 × 10^{-4}*	4 × 10^{-4}*	0.049
	Temp-sept	26 (23%)	-10.2	0.0012*	-25.8	1 × 10^{-4}*	5 × 10^{-4}*	0.036
≥ 6 SD	Prox-dist	166 (23%)	11.05	< 10^{-5}*	2.83	6 × 10^{-4}*	< 10^{-5}*	0.088
	Dist-prox	307 (43%)	-14.4	< 10^{-5}*	-3.78	0.0057*	< 10^{-5}*	0.067
	Sept-temp	83 (12%)	0.54	0.73	18.5	3 × 10^{-4}*	1 × 10^{-4}*	0.054
	Temp-sept	153 (22%)	-6.50	2 × 10^{-5}*	-15.7	< 10^{-5}*	1 × 10^{-5}*	0.059

Supplementary Table 16g Ripple propagation for **rat 441.**

≥ 2 SD: number of putative events = 3391; number of propagating events = 900; percentage of propagating events = 16%; ratio for direction = 1.93; ratio for slopes = 0.356; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 9.4, p < 10^{-5}*.

2-4 SD: number of putative events = 323; number of propagating events = 80; percentage of propagating events = 25%; ratio for direction = 1.50; ratio for slopes = 1; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 1.79, p = 0.037*.

4-6 SD: number of putative events = 475; number of propagating events = 111; percentage of propagating events = 23%; ratio for direction = 1.71; ratio for slopes = 0.714; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 2.75, p = 0.003*.

≥ 6 SD: number of putative events = 2593; number of propagating events = 709; percentage of propagating events = 27%; ratio for direction = 2.00; ratio for slopes = 0.229; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 8.9, p < 10^{-5}*.

Supplementary Table 16 Rat-wise ripple propagation.

Statistics for ripple propagation along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD for each rat separately. Partial slopes in this case are the difference in time of occurrence of ripples as a function of distance along the proximo-distal and septo-temporal axes. The unit of the partial slopes are ms/mm while that of resultant speeds are mm/ms. Most of the rats showed trends similar to the average data.

Amplitude group	Direction of propagation	Number of ripples	Proximo-distal		Septo-temporal		p-value of comparison of slopes	Resultant speed
			partial slope	p-value	partial slope	p-value		
≥ 2 SD	Prox-dist	970 (31%)	12.7	< 10^{-5}*	2.01	0.02*	< 10^{-5}*	0.078
	Dist-prox	873 (28%)	-14.3	< 10^{-5}*	-0.72	0.47	< 10^{-5}*	0.07
	Sept-temp	582 (19%)	1.60	0.33	19.4	< 10^{-5}*	< 10^{-5}*	0.051
	Temp-sept	665 (22%)	-3.79	0.034*	-15.3	< 10^{-5}*	7 × 10^{-4}*	0.064
2-4 SD	Prox-dist	46 (25%)	48.1	0.038*	6.27	0.72	0.11	0.021
	Dist-prox	44 (24%)	-34.1	< 10^{-5}*	0.58	0.87	< 10^{-5}*	0.029
	Sept-temp	56 (30%)	4.53	0.26	45.7	< 10^{-5}*	< 10^{-5}*	0.022
	Temp-sept	38 (21%)	1.54	0.75	-36.6	2 × 10^{-5}*	4 × 10^{-4}*	0.027
4-6 SD	Prox-dist	143 (33%)	16.3	0.0019*	-1.54	0.46	0.0086*	0.061
	Dist-prox	90 (21%)	-22.1	< 10^{-5}*	-4.27	0.12	3 × 10^{-4}*	0.044
	Sept-temp	91 (21%)	1.01	0.76	30.4	< 10^{-5}*	< 10^{-5}*	0.033
	Temp-sept	105 (25%)	-8.66	0.0036*	-19.3	6 × 10^{-5}*	0.026*	0.047
≥ 6 SD	Prox-dist	781 (31%)	10.6	< 10^{-5}*	2.59	4 × 10^{-4}*	< 10^{-5}*	0.092
	Dist-prox	739 (30%)	-12.2	< 10^{-5}*	0.53	0.56	< 10^{-5}*	0.082
	Sept-temp	435 (18%)	1.55	0.27	15.8	< 10^{-5}*	< 10^{-5}*	0.063
	Temp-sept	522 (21%)	-3.42	0.03*	-14.2	< 10^{-5}*	4 × 10^{-4}*	0.068

Supplementary Table 17 Ripple propagation for comparable spatial spreads.

Statistics for ripple propagation along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD after controlling for differences in spatial spreads of tetrodes along the proximo-distal and septo-temporal axes. Partial slopes in this case are the difference in time of occurrence of ripples as a function of distance along the proximo-distal and septo-temporal axes. The unit of the partial slopes are ms/mm while that of resultant speeds are mm/ms.

≥ 2 SD: number of putative events = 19253; number of propagating events = 3090; percentage of propagating events = 16%; ratio for direction = 1.48; ratio for slopes = 0.513; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 11, p < 10^{-5}*.

2-4 SD: number of putative events = 1374; number of propagating events = 184; percentage of propagating events = 13%; ratio for direction = 0.96; ratio for slopes = 0.857; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = -0.29, p = 0.38.

4-6 SD: number of putative events = 3052; number of propagating events = 429; percentage of propagating events = 14%; ratio for direction = 1.19; ratio for slopes = 0.5; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 1.79, p = 0.037*.

≥ 6 SD: number of putative events = 14827; number of propagating events = 2477; percentage of propagating events = 17%; ratio for direction = 1.59; ratio for slopes = 0.497; test of proportions comparing the observed proportion of events with the 50% propagation along the proximo-distal axis expected by chance, Z = 11, $p < 10^{-5}$*.

Consistent with the original data, the bias for propagation along the proximo-distal axis was higher for subgroups with higher amplitude on the reference tetrode, and the speeds remained similar to those in the original data for all amplitude groups.

Amplitude group	Direction of propagation	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
≥ 2 SD	Prox-dist	0.13	0.31	0.16	0.35	0.57
	Dist-prox	-0.04	0.74	-0.062	0.72	0.54
	Sept-temp	0.35	0.013*	0.42	0.093	0.39
	Temp-sept	0.048	0.56	-0.054	0.74	0.48
2-4 SD	Prox-dist	-0.12	0.2	0.12	0.37	0.49
	Dist-prox	-0.3	0.11	0.34	0.2	0.54
	Sept-temp	0.12	0.37	0.34	0.15	0.19
	Temp-sept	0.05	0.63	-0.13	0.53	0.37
4-6 SD	Prox-dist	0.11	0.21	0.14	0.23	0.6
	Dist-prox	0.0083	0.92	-0.085	0.45	0.7
	Sept-temp	0.14	0.24	0.46	0.029*	0.079
	Temp-sept	0.15	0.078	-0.13	0.43	0.55
≥ 6 SD	Prox-dist	0.14	0.18	0.17	0.25	0.56
	Dist-prox	-0.077	0.51	-0.0022	0.99	0.36
	Sept-temp	0.26	0.035*	0.48	0.027*	0.17
	Temp-sept	0.1	0.25	-0.062	0.72	0.58

Supplementary Table 18 Relative ripple amplitude for propagating ripples.

Statistics for relative ripple amplitude for propagating ripples along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD. The unit of the partial slopes is relative amplitude/mm.

Amplitude group	Direction of propagation	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
≥ 2 SD	Prox-dist	-0.0018	0.0097*	0.0011	0.24	0.26
	Dist-prox	-0.0011	0.1	-0.00098	0.29	0.46
	Sept-temp	-0.00074	0.21	0.00061	0.56	0.54
	Temp-sept	0.000054	0.95	0.0039	0.03*	0.025*
2-4 SD	Prox-dist	-0.0071	6×10^{-5}*	0.0022	0.33	0.033*
	Dist-prox	0.0027	0.23	0.0031	0.33	0.54
	Sept-temp	-0.0028	0.097	-0.0075	0.016*	0.08
	Temp-sept	0.0013	0.48	0.0039	0.28	0.25
4-6 SD	Prox-dist	-0.0013	0.22	0.0004	0.79	0.29
	Dist-prox	-0.00071	0.52	0.0019	0.2	0.74
	Sept-temp	-0.0017	0.23	0.0016	0.54	0.52
	Temp-sept	-0.00016	0.89	0.0031	0.17	0.12
≥ 6 SD	Prox-dist	-0.0016	0.0099*	0.00079	0.34	0.19
	Dist-prox	-0.0017	0.023*	-0.0018	0.072	0.55
	Sept-temp	0.000076	0.92	0.00082	0.55	0.31
	Temp-sept	-0.00051	0.58	0.0036	0.047*	0.058

Supplementary Table 19 Ripple duration for propagating ripples.

Statistics for ripple duration for propagating ripples along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD. The unit of the partial slopes is ms/mm.

Amplitude group	Direction of propagation	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
≥ 2 SD	Prox-dist	-2.09	9×10^{-4}*	0.34	0.68	0.034*
	Dist-prox	0.35	0.59	1.37	0.13	0.82
	Sept-temp	-0.92	0.11	-0.92	0.37	0.49
	Temp-sept	1.12	0.065	-0.39	0.73	0.71
2-4 SD	Prox-dist	-0.95	0.49	0.97	0.62	0.5
	Dist-prox	-0.69	0.42	-1.88	0.12	0.78
	Sept-temp	0.53	0.55	2.11	0.19	0.19
	Temp-sept	0.28	0.81	-3.07	0.19	0.14
4-6 SD	Prox-dist	-1.39	0.14	1.0	0.43	0.39
	Dist-prox	-2.45	0.041*	0.55	0.73	0.18
	Sept-temp	-2.21	0.084	-1.12	0.62	0.67
	Temp-sept	3.55	0.0014*	-1.93	0.35	0.76
≥ 6 SD	Prox-dist	-2.0812	0.001*	0.17	0.83	0.025*
	Dist-prox	0.81	0.22	1.91	0.04*	0.83
	Sept-temp	-1.04	0.089	-1.22	0.26	0.44
	Temp-sept	0.29	0.57	0.52	0.61	0.42

Supplementary Table 20 Ripple frequency for propagating ripples.

Statistics for ripple frequency for propagating ripples along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD. The unit of the partial slopes is Hz/mm.

Amplitude group	Direction of propagation	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
≥ 2 SD	Prox-dist	0.19	0.13	0.29	0.11	0.67
	Dist-prox	-0.014	0.91	-0.13	0.44	0.71
	Sept-temp	0.37	0.0034*	0.3	0.18	0.62
	Temp-sept	0.036	0.63	-0.074	0.62	0.41
2-4 SD	Prox-dist	-0.011	0.92	0.18	0.26	0.82
	Dist-prox	-0.14	0.31	-0.35	0.067	0.82
	Sept-temp	0.83	0.0011*	0.056	0.89	0.94
	Temp-sept	0.17	0.11	0.039	0.85	0.72
4-6 SD	Prox-dist	0.24	0.031*	0.012	0.93	0.096
	Dist-prox	-0.056	0.58	-0.15	0.29	0.69
	Sept-temp	0.44	0.001*	0.25	0.27	0.78
	Temp-sept	0.14	0.1	-0.1	0.56	0.59
≥ 6 SD	Prox-dist	0.19	0.076	0.26	0.08	0.66
	Dist-prox	-0.02	0.86	-0.069	0.65	0.6
	Sept-temp	0.37	0.001*	0.35	0.072	0.53
	Temp-sept	0.092	0.21	-0.0077	0.96	0.7

Supplementary Table 21 Relative ripple amplitude for non-propagating ripples.

Statistics for relative ripple amplitude for non-propagating ripples along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD. The unit of the partial slopes is relative amplitude/mm.

Amplitude group	Direction of propagation	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
≥ 2 SD	Prox-dist	-0.00049	0.34	0.0011	0.14	0.75
	Dist-prox	-0.0012	0.1	0.00025	0.81	0.23
	Sept-temp	-0.00092	0.13	-0.0015	0.17	0.31
	Temp-sept	-0.00037	0.53	0.0018	0.11	0.12
2-4 SD	Prox-dist	0.0036	0.29	-0.00094	0.84	0.31
	Dist-prox	-0.0021	0.52	-0.0011	0.81	0.43
	Sept-temp	-0.00069	0.79	0.0036	0.44	0.28
	Temp-sept	-0.00061	0.83	0.0099	0.079	0.066
4-6 SD	Prox-dist	-0.00062	0.75	-0.0063	0.021*	0.97
	Dist-prox	0.0012	0.46	-0.0011	0.63	0.48
	Sept-temp	0.0016	0.37	0.0052	0.11	0.15
	Temp-sept	0.004	0.054	0.00081	0.84	0.77
≥ 6 SD	Prox-dist	-0.0012	0.05	0.0016	0.053	0.68
	Dist-prox	-0.00077	0.17	-0.00038	0.62	0.34
	Sept-temp	-0.00021	0.73	-0.00046	0.68	0.42
	Temp-sept	-0.0016	0.0031*	0.00086	0.41	0.75

Supplementary Table 22 Ripple duration for non-propagating ripples.

Statistics for ripple duration for non-propagating ripples along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD. The unit of the partial slopes is ms/mm.

Amplitude group	Direction of propagation	Proximo-distal		Septo-temporal		p-value of comparison of slopes
		partial slope	p-value	partial slope	p-value	
≥ 2 SD	Prox-dist	-0.55	0.41	0.14	0.88	0.35
	Dist-prox	-1.73	0.0012*	0.76	0.28	0.14
	Sept-temp	-1.19	0.039*	1.61	0.12	0.36
	Temp-sept	0.84	0.15	-1.93	0.093	0.19
2-4 SD	Prox-dist	1.21	0.61	-0.85	0.79	0.46
	Dist-prox	-1.1	0.62	2.27	0.47	0.62
	Sept-temp	3.24	0.051	0.87	0.77	0.77
	Temp-sept	-3.62	0.039*	-0.33	0.92	0.81
4-6 SD	Prox-dist	-1.27	0.31	1.14	0.51	0.47
	Dist-prox	-2.49	0.053	0.68	0.7	0.21
	Sept-temp	-2.76	0.058	0.63	0.81	0.77
	Temp-sept	-3.67	0.046*	-5.89	0.099	0.28
≥ 6 SD	Prox-dist	-0.32	0.59	0.37	0.65	0.52
	Dist-prox	-0.32	0.49	1.56	0.021*	0.93
	Sept-temp	-0.36	0.45	0.75	0.39	0.34
	Temp-sept	0.41	0.36	-1.34	0.13	0.17

Supplementary Table 23 Ripple frequency for non-propagating ripples.

Statistics for ripple frequency for non-propagating ripples along the proximo-distal and septo-temporal axes for ≥ 2 SD, 2-4 SD, 4-6 SD, and ≥ 6 SD. The unit of the partial slopes is Hz/mm.

Supplementary Figure 1
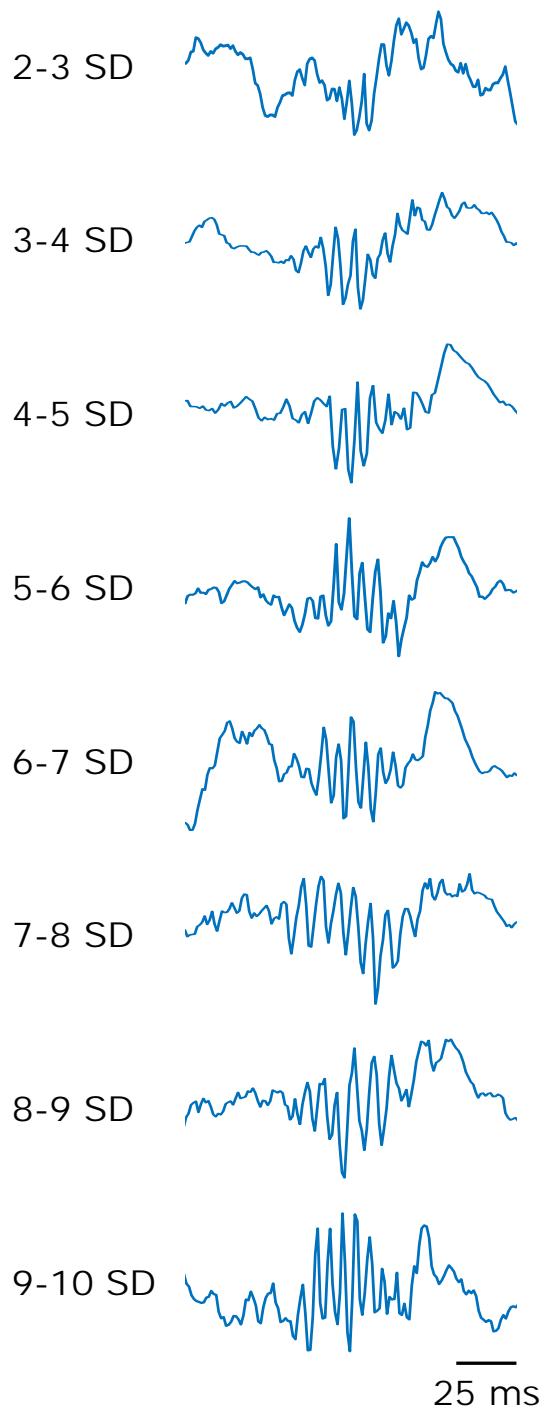
Supplementary Figure 1 Example raw LFP ripple traces.

Raw LFP traces for detected ripples from one randomly chosen tetrode from a randomly chosen rat (rat 392) arranged in increasing order of amplitude range.

Supplementary Figure 2
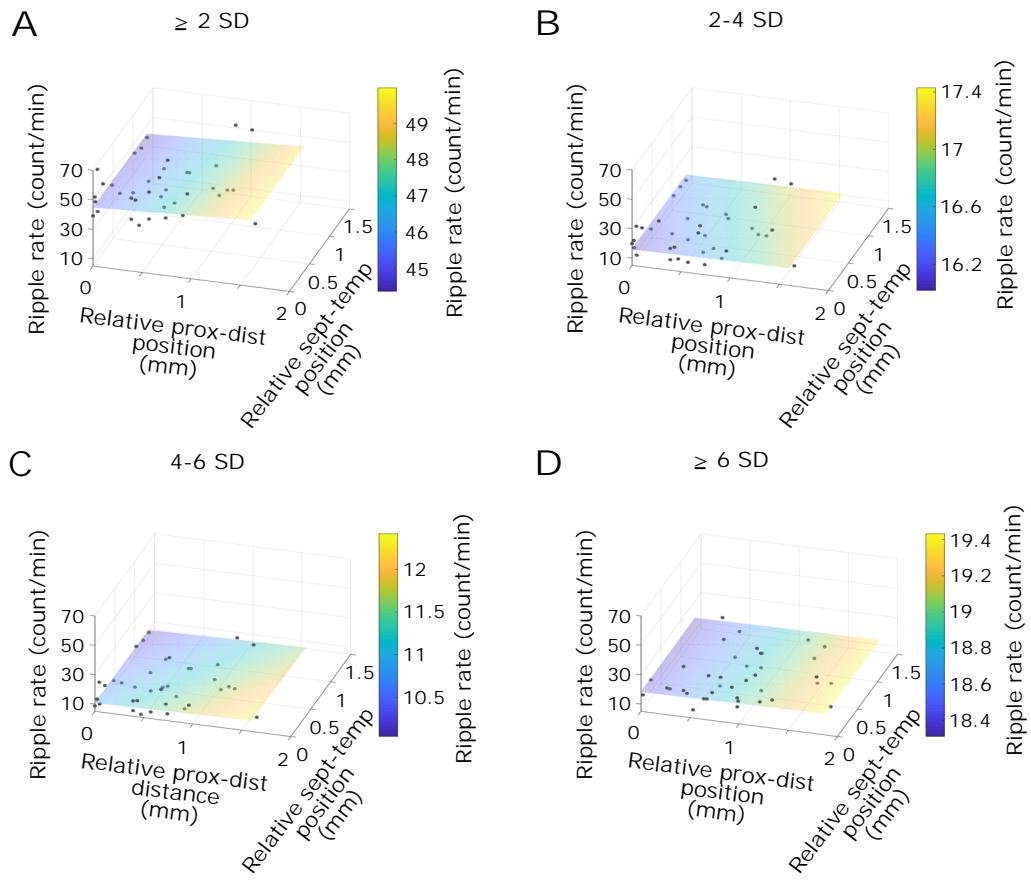
Supplementary Figure 2 Rate of ripple occurrence using comparable spatial spreads along the proximo-distal and septo-temporal axes.

Rate of ripple occurrence as a function of relative position along the proximo-distal and septo-temporal axes for all rats with the 2D fit (plane) for $\geq$ 2 SD (A), 2-4 SD (B), 4-6 SD (C), and $\geq$ 6 SD (D).

Supplementary Figure 3

A ≥ 2 SD

B 2-4 SD

C 4-6 SD
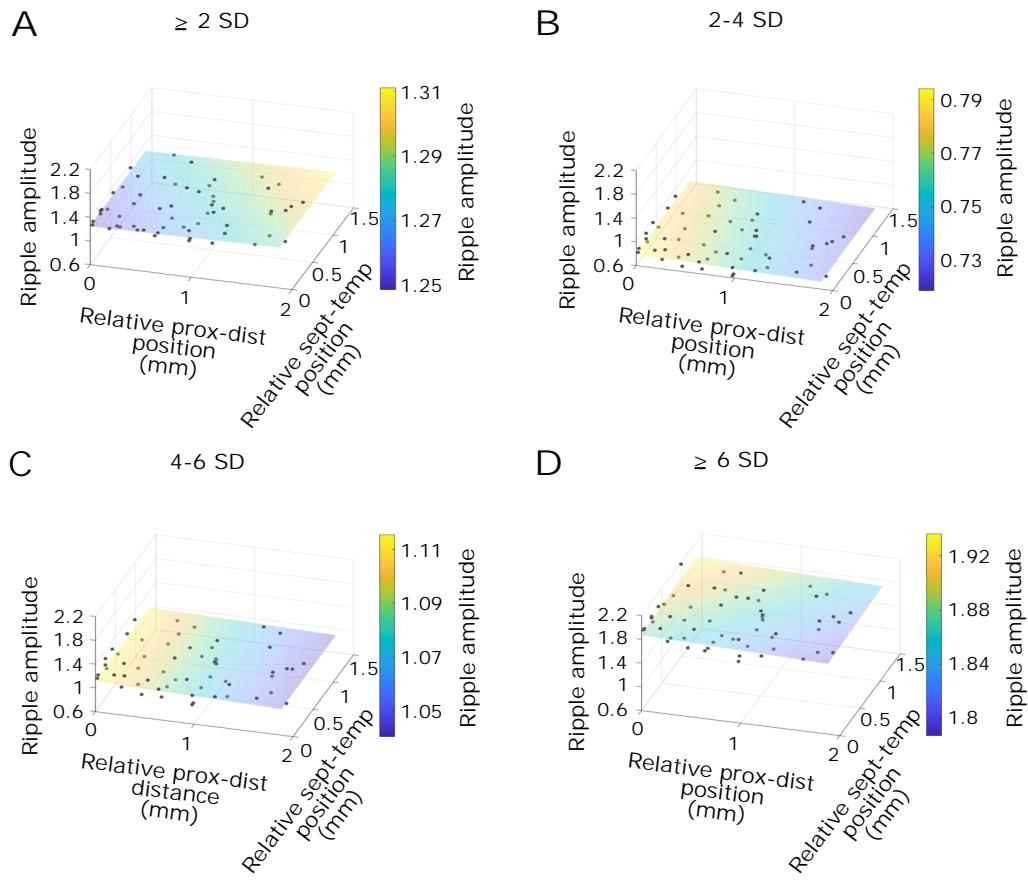
D ≥ 6 SD

Supplementary Figure 3 Ripple amplitude.

Ripple amplitude as a function of relative position along the proximo-distal and septo-temporal axes for all rats collectively with the 2D fit (plane) for ≥ 2 SD (A), 2-4 SD (B), 4-6 SD (C), and ≥ 6 SD (D).

Supplementary Figure 4
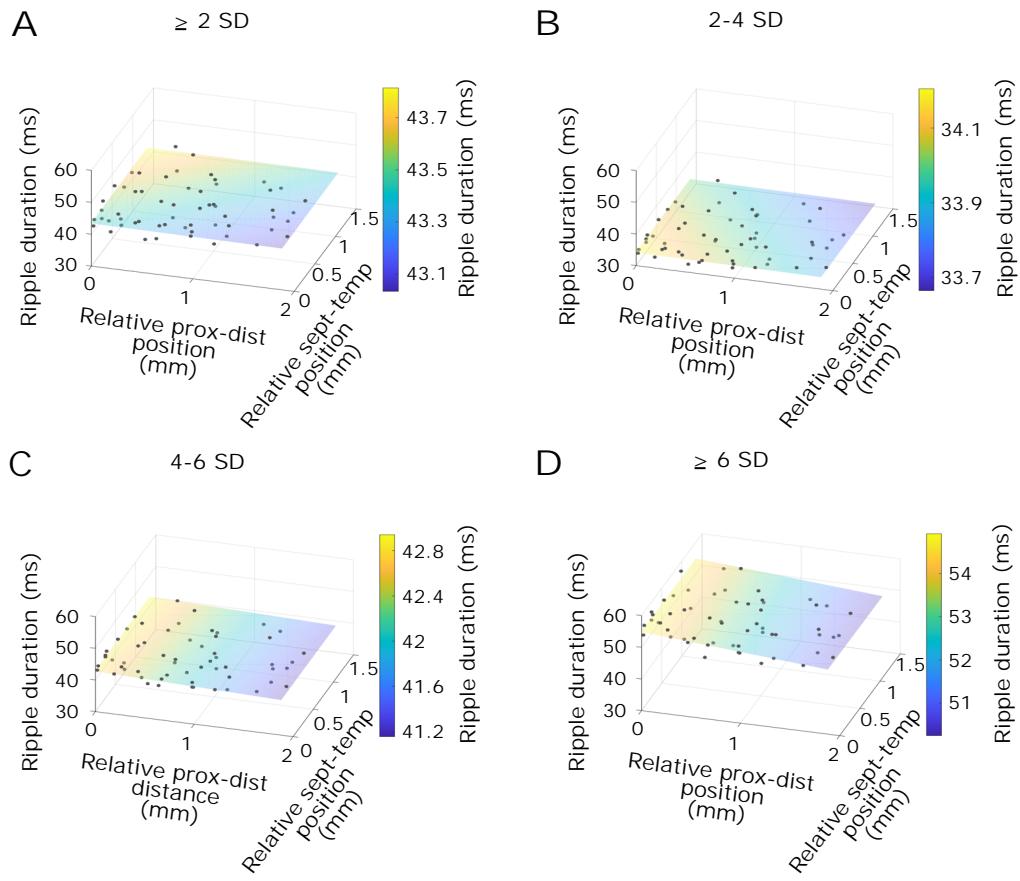
Supplementary Figure 4 Ripple duration.

Ripple duration as a function of relative position along the proximo-distal and septo-temporal axes for all rats collectively with the 2D fit (plane) for ≥ 2 SD (A), 2-4 SD (B), 4-6 SD (C), and ≥ 6 SD (D).

Supplementary Figure 5
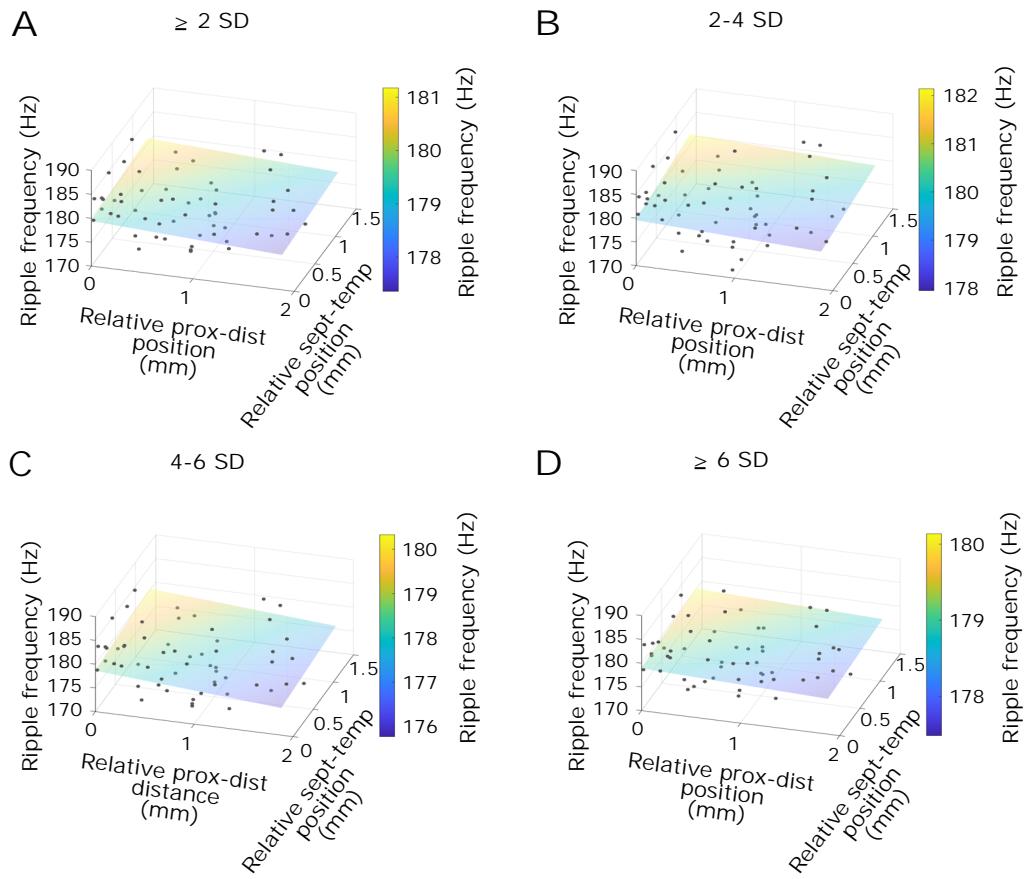
Supplementary Figure 5 Ripple frequency.

Ripple frequency as a function of relative position along the proximo-distal and septo-temporal axes for all rats collectively with the 2D fit (plane) for ≥ 2 SD (A), 2-4 SD (B), 4-6 SD (C), and ≥ 6 SD (D).

Supplementary Figure 6

A — Long-duration ripples
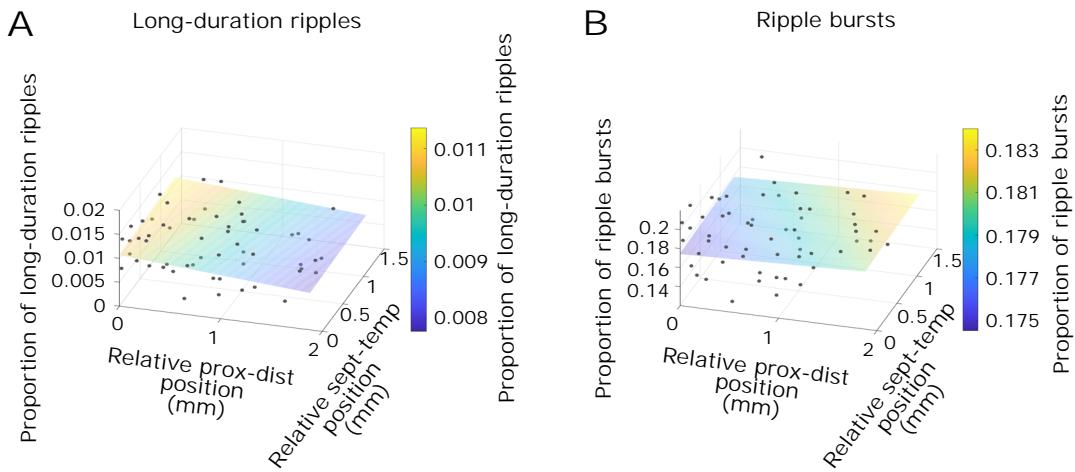
B — Ripple bursts

Supplementary Figure 6 Long-duration ripples and ripple bursts.

(A) Proportion of ripples with long durations (> 100 ms) as a function of position along the proximo-distal and septo-temporal axes for all rats collectively with the 2D fit (plane) for ≥ 2 SD (proximo-distal partial slope = -0.0016 proportion/mm, p = 0.06; septo-temporal partial slope = 0.0005 proportion/mm, p = 0.68; one-tailed t-test for comparison of slopes along the two axes, p = 0.24).

(B) Proportion of ripple bursts as a function of position along the proximo-distal and septo-temporal axes for all rats collectively with the 2D fit (plane) for ≥ 2 SD (proximo-distal partial slope = 0.0033 proportion/mm, p = 0.55; septo-temporal partial slope = 0.0024 proportion/mm, p = 0.77; one-tailed t-test for comparison of slopes along the two axes, p = 0.46).

Supplementary Figure 7
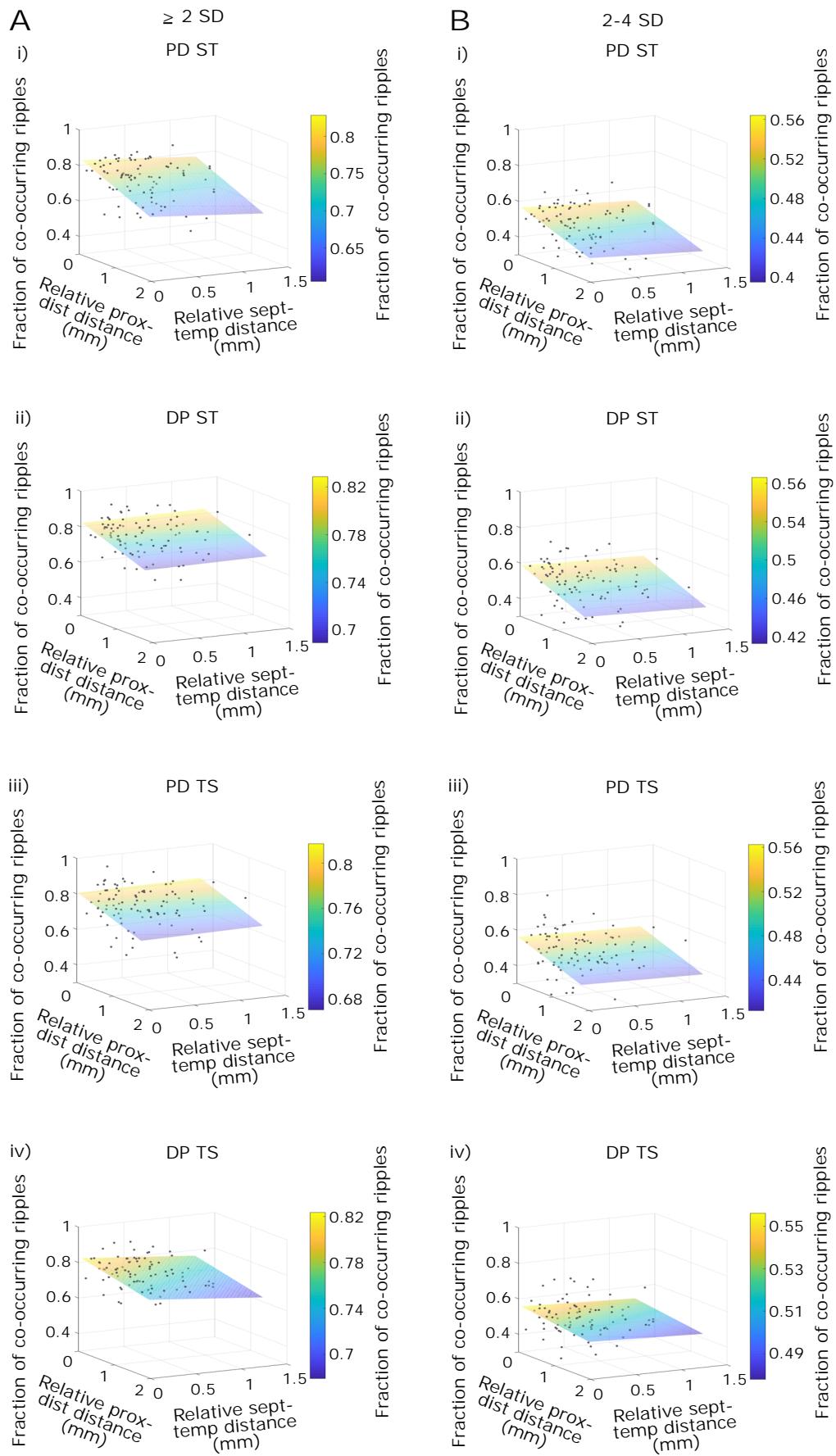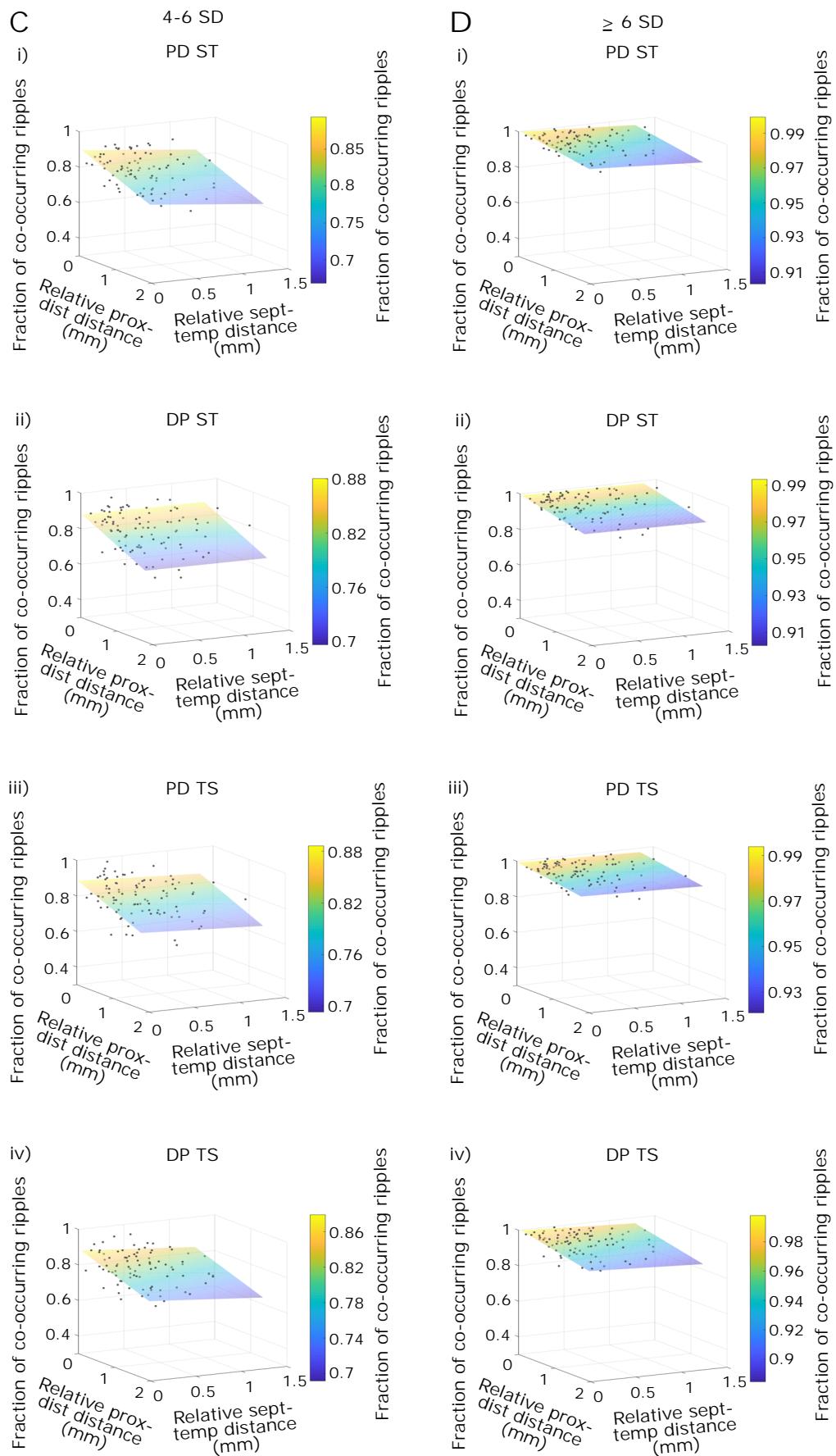
Supplementary Figure 7 Ripple co-occurrence accounting for the direction from the reference to the referred tetrode.

(A) Fraction of co-occurring ripples for tetrode pairs having (i) reference tetrode more proximal and septal to referred tetrode (ii) reference tetrode more distal and septal to referred tetrode (iii) reference tetrode more proximal and temporal to referred tetrode (iv) reference tetrode more distal and temporal to referred tetrode with the 2D fit (plane) obtained from multiple linear regression analysis.

(B)-(D) Same as (A) but for 2-4 SD, 4-6 SD, and ≥ 6 SD.

Supplementary Figure 8
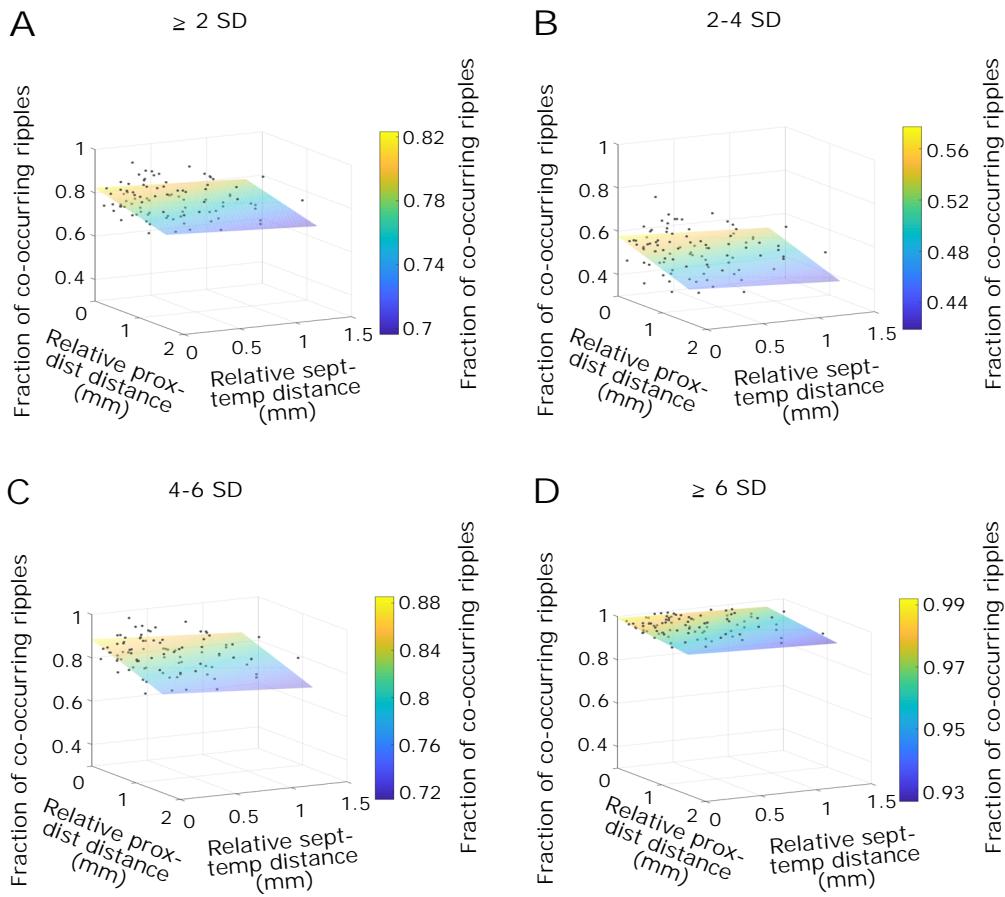
Supplementary Figure 8 Ripple co-occurrence using comparable spatial spreads along the proximo-distal and septo-temporal axes.

Fraction of co-occurring ripples as a function of relative distance along the proximo-distal and septo-temporal axes for all rats with the 2D fit (plane) for ≥ 2 SD (A), 2-4 SD (B), 4-6 SD (C), and ≥ 6 SD (D).

Supplementary Figure 9

A ≥ 2 SD

i) PD ST

ii) DP ST

iii) PD TS

iv) DP TS

B 2-4 SD

i) PD ST

ii) DP ST

iii) PD TS

iv) DP TS
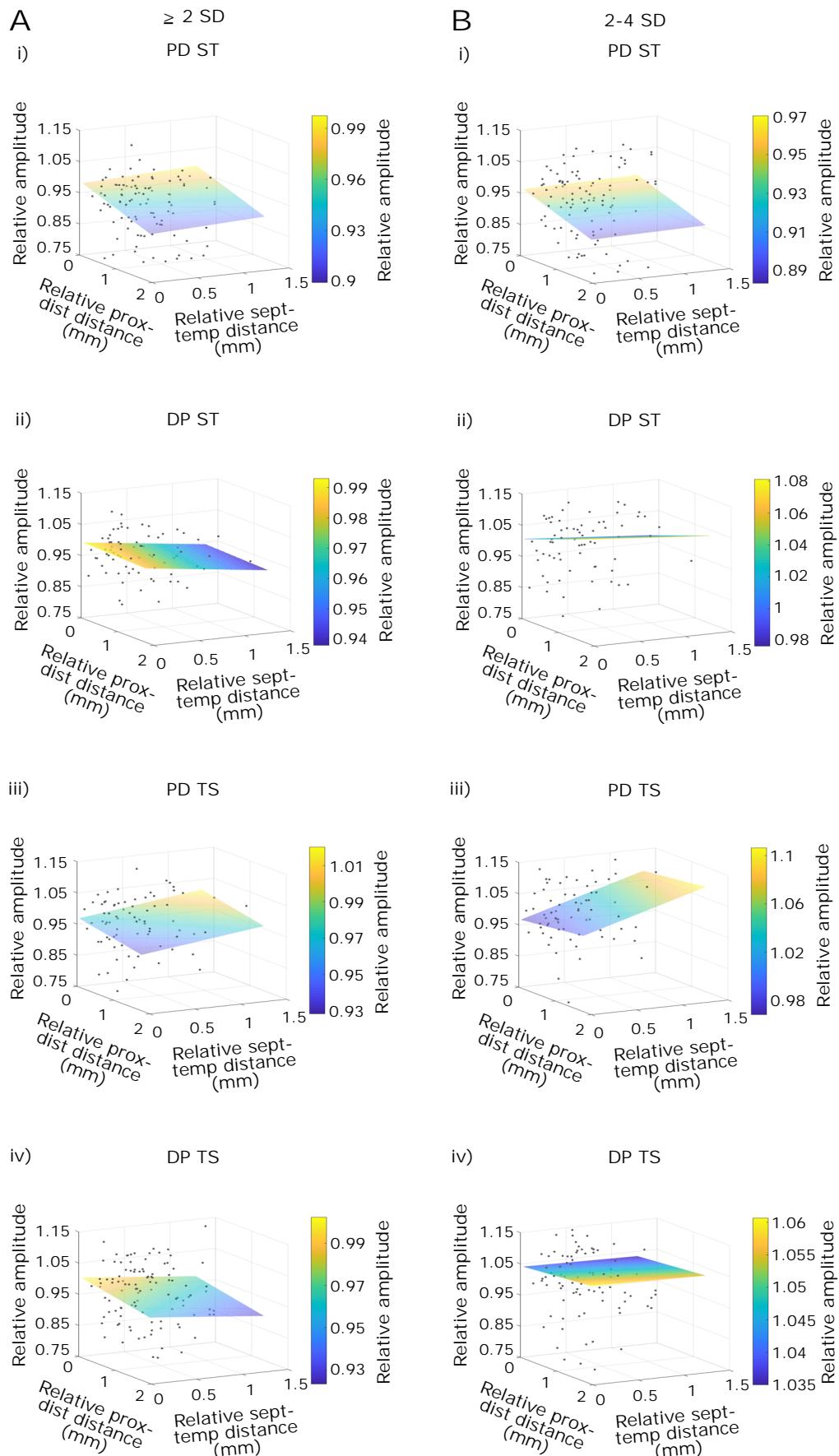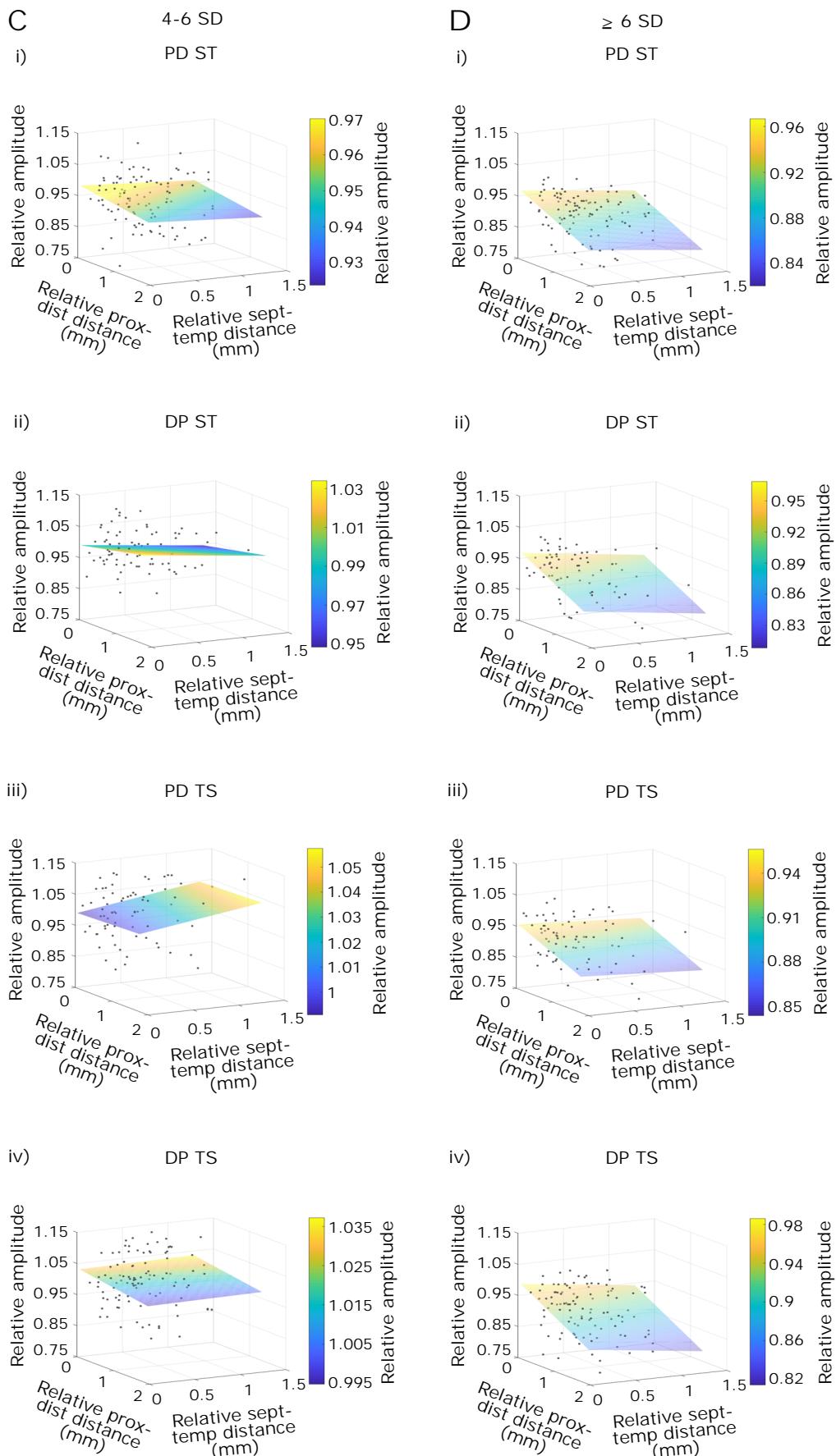
Supplementary Figure 9 Relative ripple amplitude accounting for the direction from the reference to the referred tetrode.

Figure organization is the same as that in Supplementary Figure 7, but for relative ripple amplitude.

Supplementary Figure 10
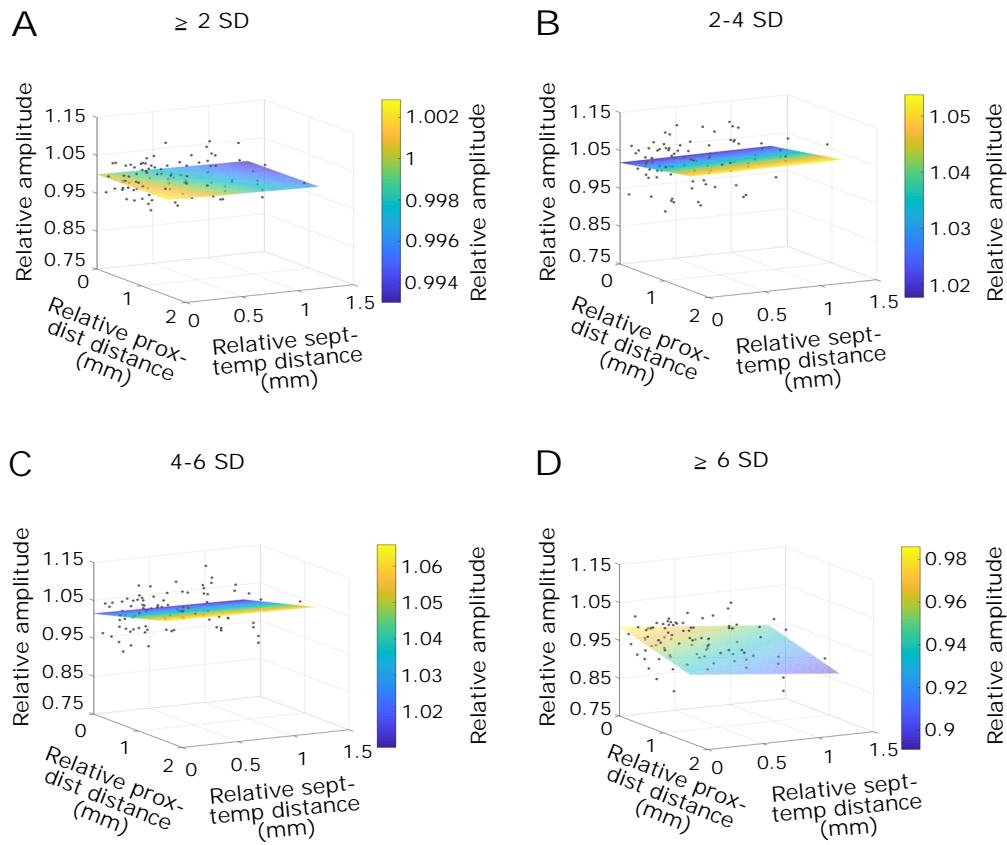
Supplementary Figure 10 Relative ripple amplitude using comparable spatial spreads along the proximo-distal and septo-temporal axes.

Relative ripple amplitude as a function of relative distance along the proximo-distal and septo-temporal axes for all rats with the 2D fit (plane) for $\geq$ 2 SD (A), 2-4 SD (B), 4-6 SD (C), and $\geq$ 6 SD (D).

Supplementary Figure 11

A Polar distribution of propagation angles

B Distribution of partial slopes

C Distribution of partial slope p-values

i) For proximo-distal partial slope

ii) For septo-temporal partial slope

D Distribution of p-values of 2D fit

E Distribution of resultant speeds
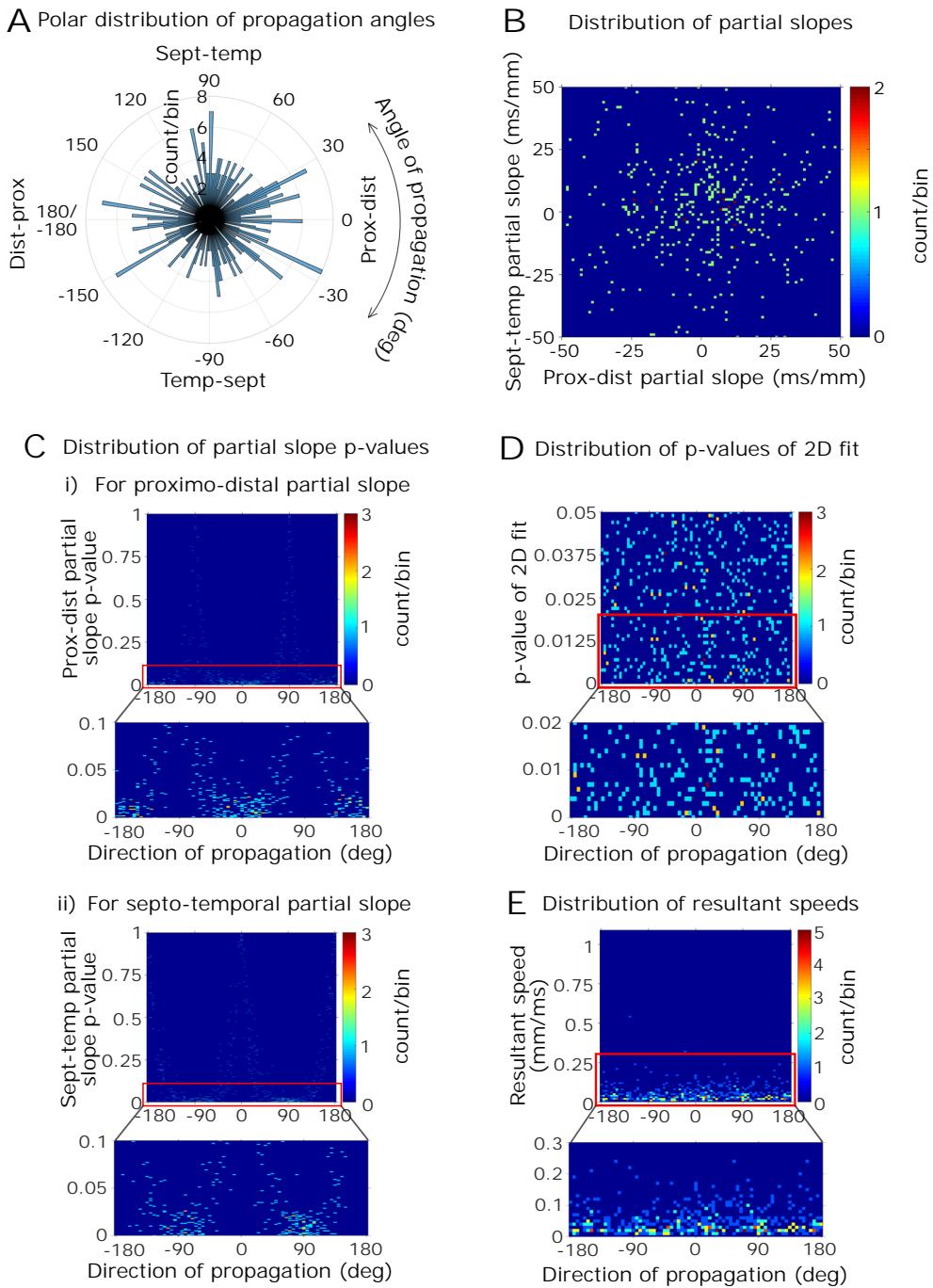
Supplementary Figure 11 Ripple propagation for 2-4 SD.

(A) Polar distribution of the angles of propagation. The following angles correspond to the given directions: proximo-distal direction, 0°; disto-proximal direction, 180° or -180°; septo-temporal direction, 90°; temporo-septal direction, -90°.

(B) Distribution of proximo-distal vs. septo-temporal partial slopes obtained from multiple linear regression analysis of individual propagating events.

(C) Distributions of the p-values of partial slopes vs. direction (angle) of propagation for all propagating events for proximo-distal partial slopes (i) and septo-temporal partial slopes (ii). Note that the p-values are close to 0 about 0°, -180°, and 180° and close to 1 about -90° and 90° in (i), and vice versa for the p-values in (ii).

(D) Distribution of the p-values of the multiple linear regression models vs. direction of propagation for all propagating events.

(E) Distribution of the resultant speed (obtained from vector analysis) vs. direction of propagation for all propagating events.

Supplementary Figure 12

A Polar distribution of propagation angles

B Distribution of partial slopes

C Distribution of partial slope p-values
i) For proximo-distal partial slope

D Distribution of p-values of 2D fit

ii) For septo-temporal partial slope

E Distribution of resultant speeds
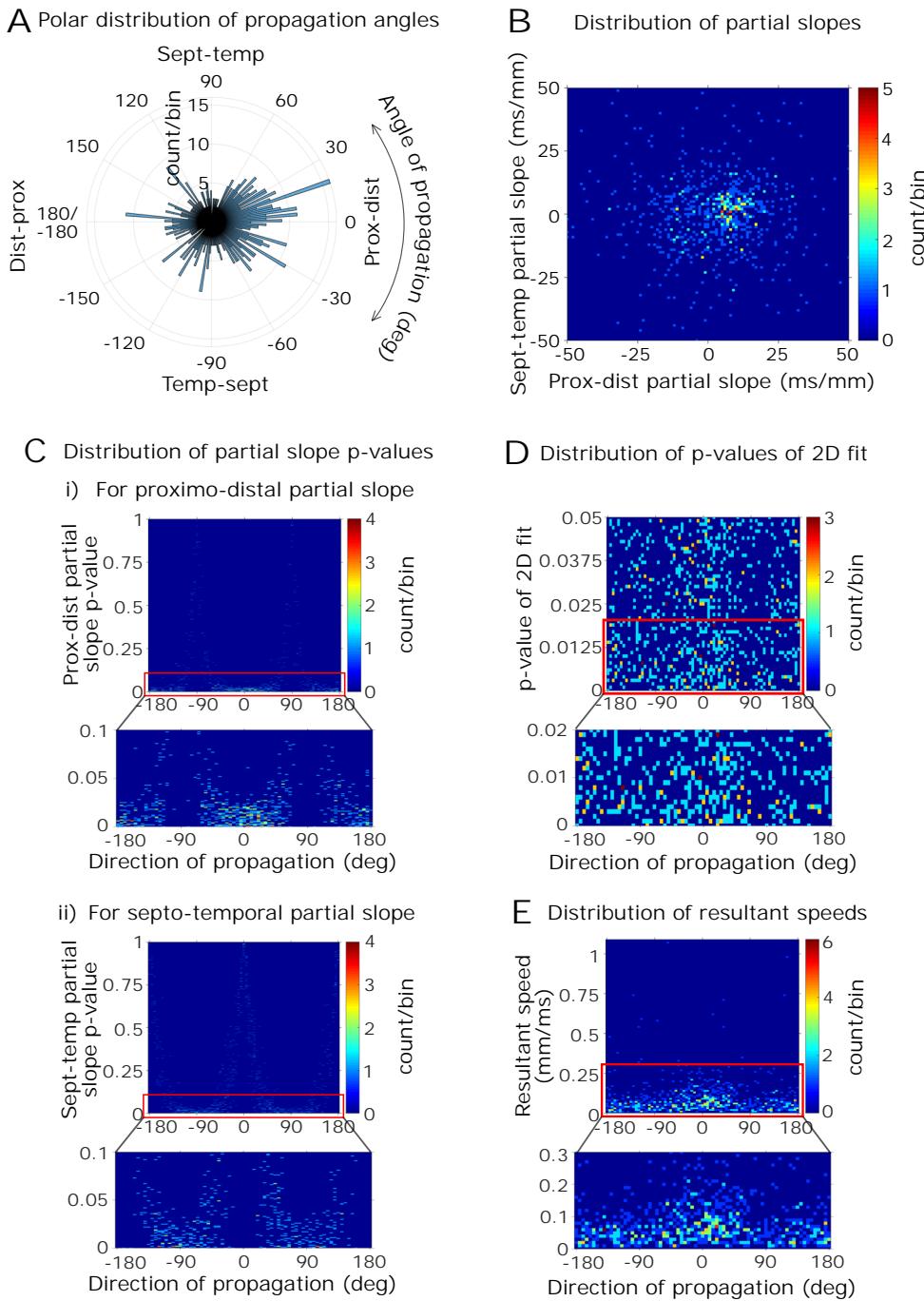
Supplementary Figure 12 Ripple propagation for 4-6 SD.

See Supplementary Figure 11 legend for description.

Supplementary Figure 13

A   Polar distribution of propagation angles

B   Distribution of partial slopes

C   Distribution of partial slope p-values

ia) For proximo-distal partial slope

ib) For septo-temporal partial slope

D Distribution of p-values of 2D fit

iia) For proximo-distal partial slope

iib) For septo-temporal partial slope

E   Distribution of resultant speeds
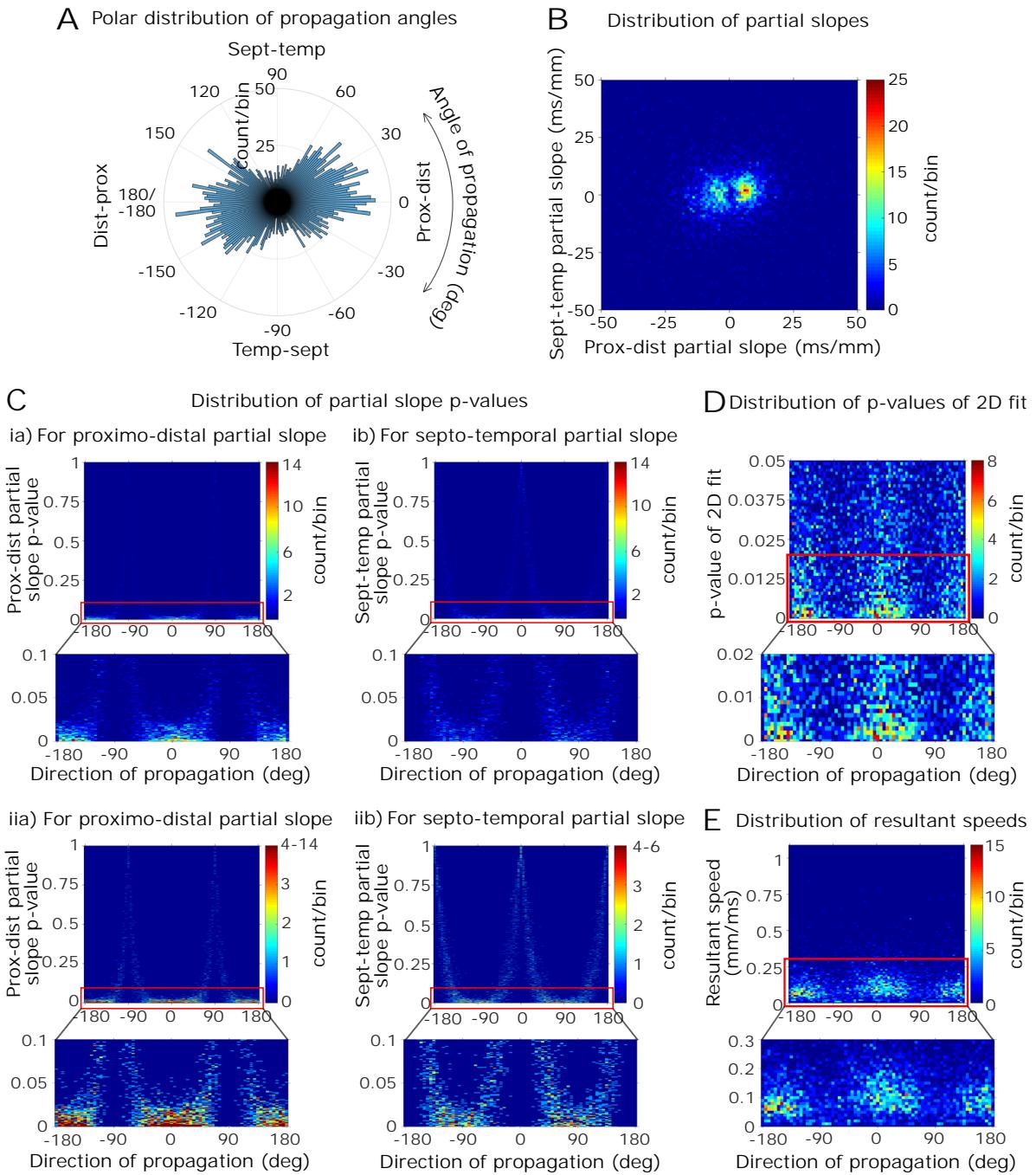
Supplementary Figure 13 Ripple propagation for ≥ 6 SD.

See Supplementary Figure 11 legend for description. Note the clear preference for the proximo-distal axis over the septo-temporal axis in (A). Note the bimodal nature of the distribution of the proximo-distal partial slopes but not the septo-temporal partial slopes in (C). In (D), panels (i) and (ii) are the same plots, however, the color scheme of (ii) has an upper limit of 4 to facilitate visualization of the pattern—note that the p-values are close to 0 about 0°, -180°, and 180° and close to 1 about -90° and 90° in (iia) and vice versa for the p-values in (iib).

Supplementary Figure 14 (see next page for figure legend)
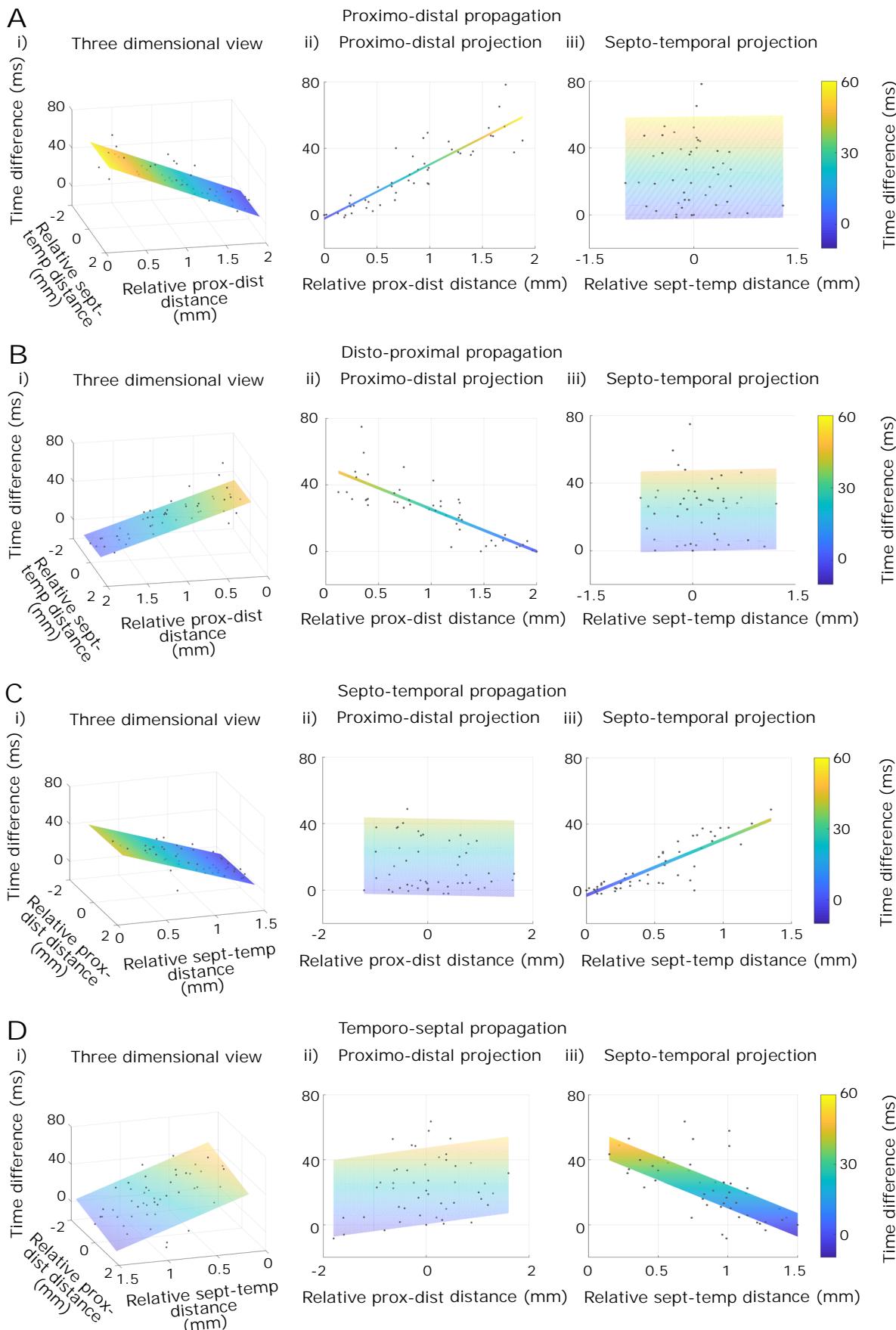
Supplementary Figure 14 Ripple propagation speed for 2-4 SD.

(A)-(D) Distributions of relative time differences vs. relative distances along the proximo-distal and septo-temporal axes after classification of events into the four directions of propagation show clear narrow, linear trends along the expected direction of propagation. Column (i) shows a 3D (X-Y-Z) view, (ii) shows a proximo-distal projection (X-Z view), and (iii) shows a septo-temporal projection (Y-Z view) of column (i). Orientation of plots for propagation along the proximo-distal axis (Ai and Bi) are different from those along the septo-temporal axis (Ci and Di) for visualization purposes.

Supplementary Figure 15 Ripple propagation speed for 4-6 SD.
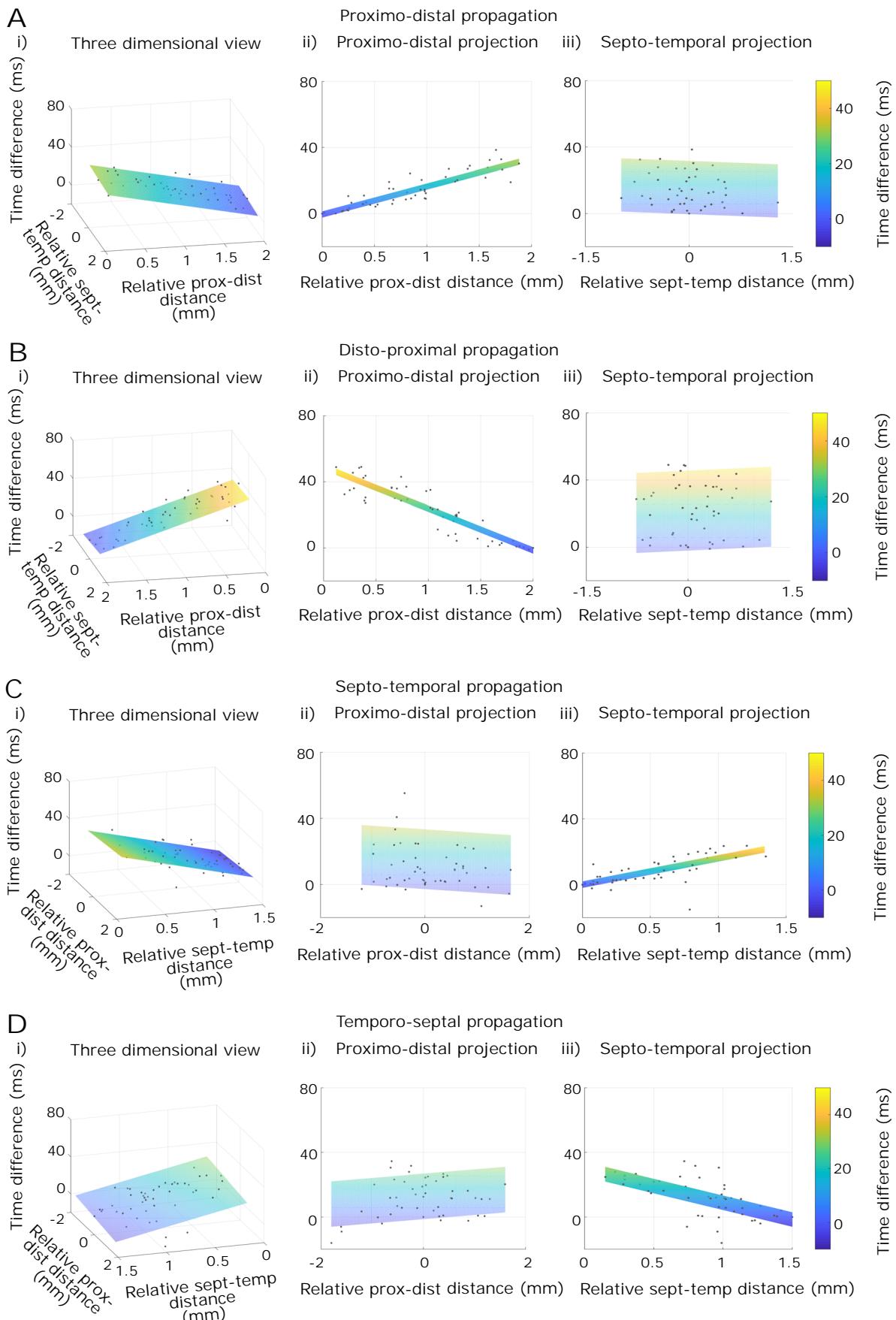
See Supplementary Figure 14 legend for description.

Supplementary Figure 16 (see next page for figure legend)

A Proximo-distal propagation

i) Three dimensional view   ii) Proximo-distal projection   iii) Septo-temporal projection

B Disto-proximal propagation

i) Three dimensional view   ii) Proximo-distal projection   iii) Septo-temporal projection

C Septo-temporal propagation

i) Three dimensional view   ii) Proximo-distal projection   iii) Septo-temporal projection

D Temporo-septal propagation

i) Three dimensional view   ii) Proximo-distal projection   iii) Septo-temporal projection

Supplementary Figure 16 Ripple propagation speed for ≥ 6 SD.

See Supplementary Figure 14 legend for description.

# Supplementary Figure 17 (see next page for figure legend)
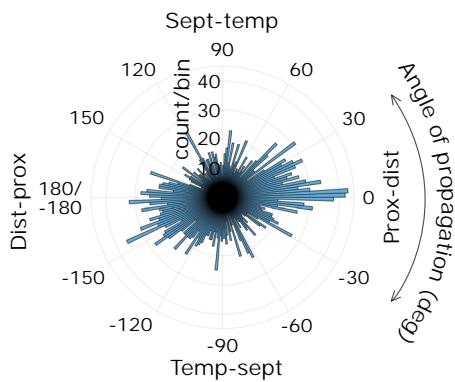
A Polar distribution of propagation angles

B Distribution of partial slopes

C Distribution of partial slope p-values

ia) For proximo-distal partial slope

ib) For septo-temporal partial slope

iia) For proximo-distal partial slope

iib) For septo-temporal partial slope

D Distribution of p-values of 2D fit

E Distribution of resultant speeds
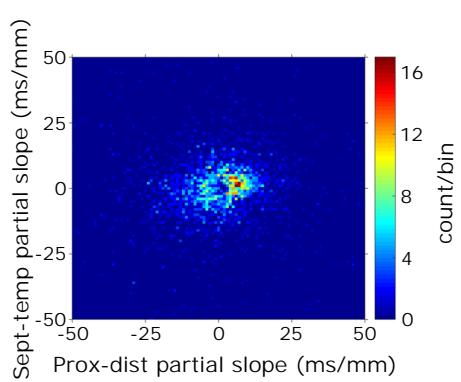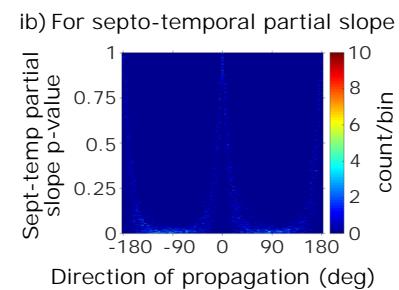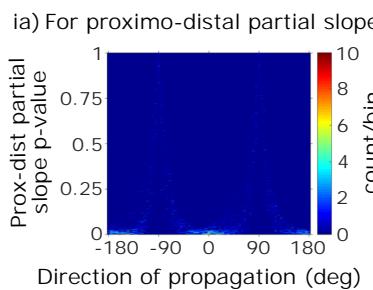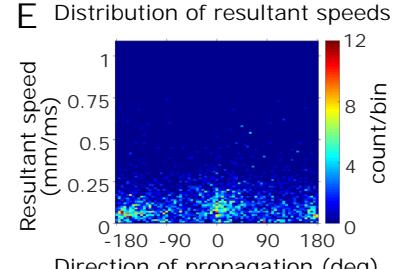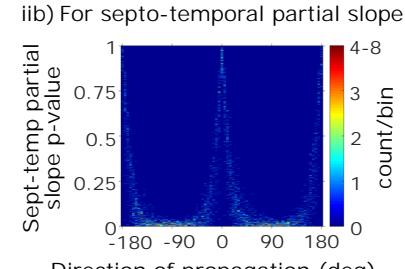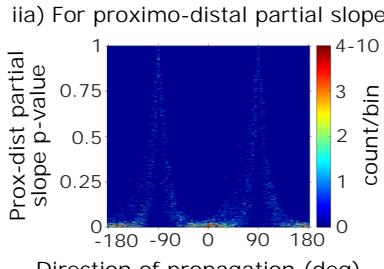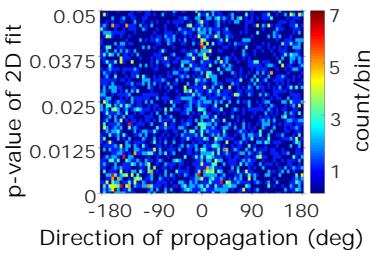
F Ripple propagation
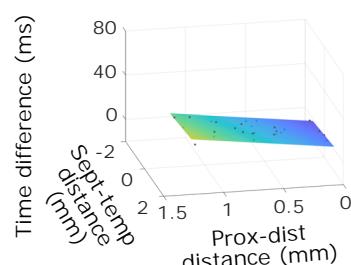
i) Proximo-distal propagation
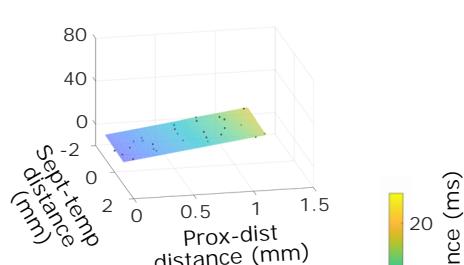
ii) Disto-proximal propagation
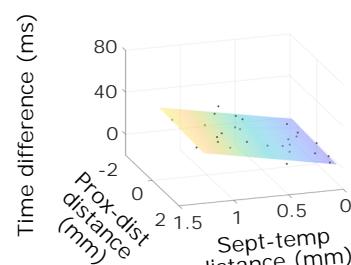
iii) Septo-temporal propagation

iv) Temporo-septal propagation
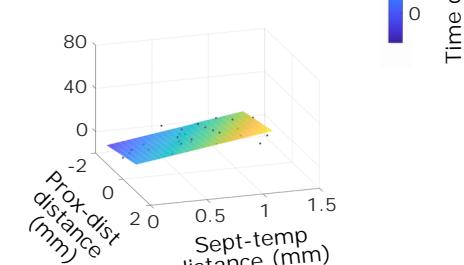
Supplementary Figure 17 Ripple propagation using comparable spatial spreads along the proximo-distal and septo-temporal axes for ≥ 2 SD.

(A) Polar distribution of the angles of propagation. Note the clear preference for the proximo-distal axis.

(B) Distribution of proximo-distal vs. septo-temporal partial slopes obtained from multiple linear regression analysis of individual propagating events. Note the bimodal nature of the distribution of proximo-distal partial slopes but not the septo-temporal partial slopes.

(C) Distributions of the p-values of partial slopes vs. direction (angle) of propagation for all propagating events. Panels (i) and (ii) are the same plots, however, the color scheme of (ii) has an upper limit of 4 to facilitate visualization of the pattern – note that the p-values are close to 0 about 0°, -180°, and 180° and close to 1 about -90° and 90° in (iia), and vice versa for the p-values in (iib). Note the relatively high number of events about 0°, -180°, and 180° in all panels.

(D) Distribution of the p-value of the multiple linear regression models vs. direction (angle) of propagation for all propagating events.

(E) Distribution of the resultant speed (obtained from vector analysis) vs. direction (angle) of propagation for all propagating events.

(F) Distributions of relative time differences vs. relative distances along the proximo-distal and septo-temporal axes after classification of events into the four directions of propagation (i-iv) show clear narrow, linear trends along the expected direction of propagation. Orientation of plots for propagation along the proximo-distal axis (i-ii) are different from those along the septo-temporal axis (iii-iv) for visualization purposes.

Supplementary Figure 18 (see next page for figure legend)
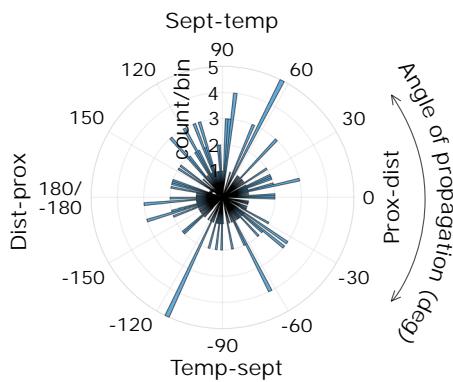
A Polar distribution of propagation angles

B Distribution of partial slopes

C Distribution of partial slope p-values

i) For proximo-distal partial slope

ii) For septo-temporal partial slope

D Distribution of p-values of 2D fit

E Distribution of resultant speeds
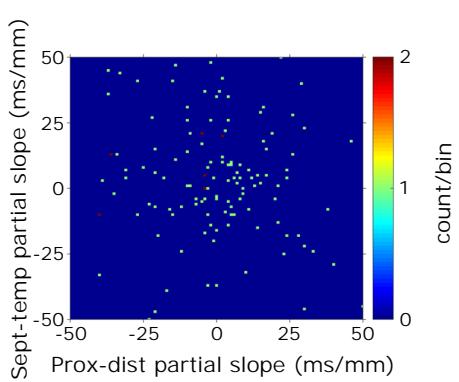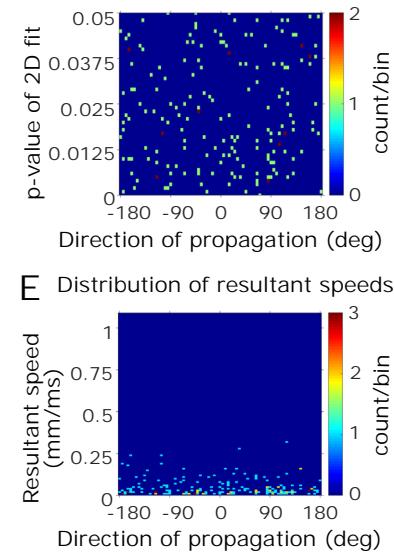
F Ripple propagation

i) Proximo-distal propagation
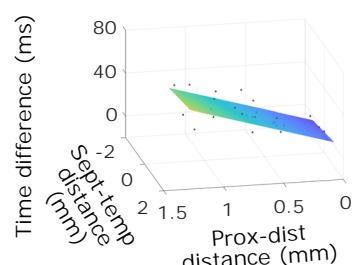
ii) Disto-proximal propagation
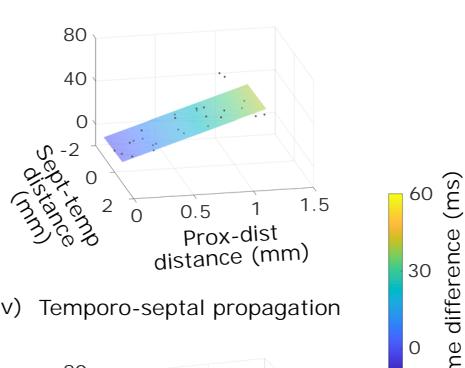
iii) Septo-temporal propagation
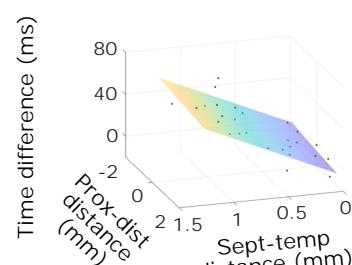
iv) Temporo-septal propagation
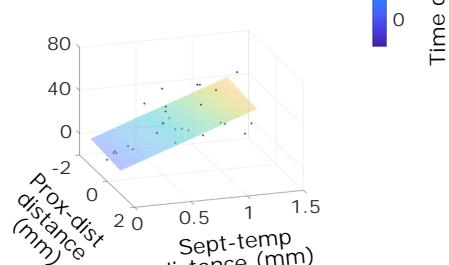
Supplementary Figure 18 Ripple propagation using comparable spatial spreads along the proximo-distal and septo-temporal axes for 2-4 SD.

(A) Polar distribution of the angles of propagation.

(B) Distribution of proximo-distal vs. septo-temporal partial slopes obtained from multiple linear regression analysis of individual propagating events.

(C) Distributions of the p-values of partial slopes vs. direction (angle) of propagation for all propagating events. Note that the p-values are close to 0 about 0°, -180°, and 180° and close to 1 about -90° and 90° in (i), and vice versa for the p-values in (ii).

(D) Distribution of the p-value of the multiple linear regression models vs. direction (angle) of propagation for all propagating events.

(E) Distribution of the resultant speed (obtained from vector analysis) vs. direction (angle) of propagation for all propagating events.

(F) Distributions of relative time differences vs. relative distances along the proximo-distal and septo-temporal axes after classification of events into the four directions of propagation (i-iv) show clear narrow, linear trends along the expected direction of propagation. Orientation of plots for propagation along the proximo-distal axis (i-ii) are different from those along the septo-temporal axis (iii-iv) for visualization purposes.

Supplementary Figure 19 (see next page for figure legend)
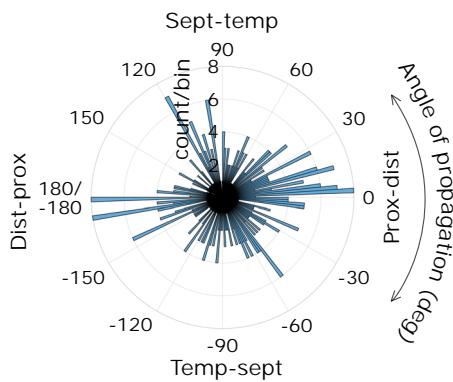
A Polar distribution of propagation angles

B Distribution of partial slopes

C Distribution of partial slope p-values

i) For proximo-distal partial slope

ii) For septo-temporal partial slope

D Distribution of p-values of 2D fit

E Distribution of resultant speeds
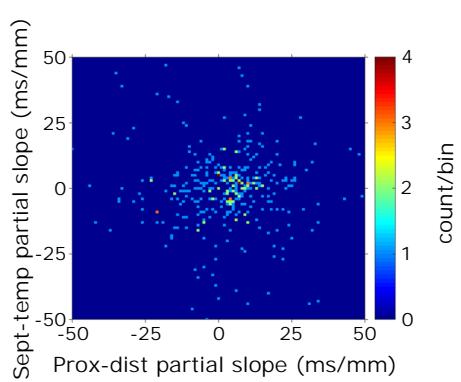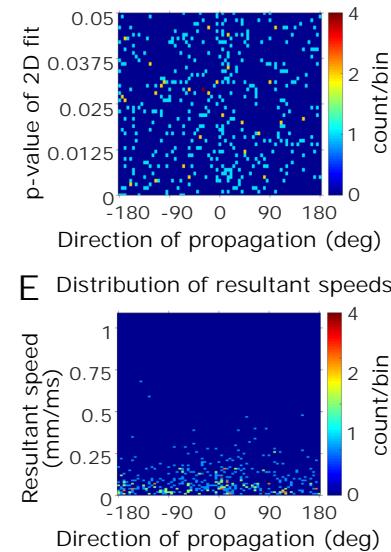
F Ripple propagation

i) Proximo-distal propagation
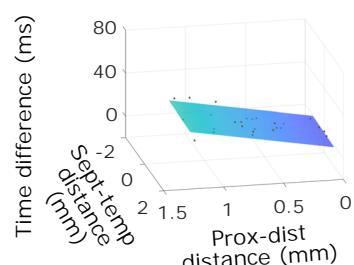
ii) Disto-proximal propagation
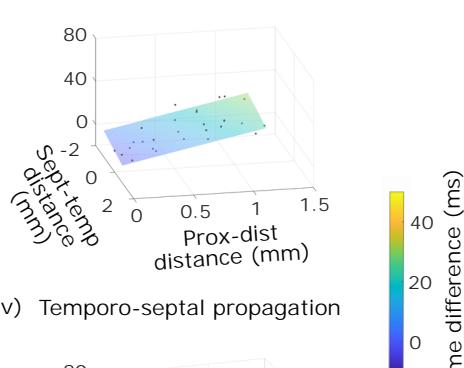
iii) Septo-temporal propagation
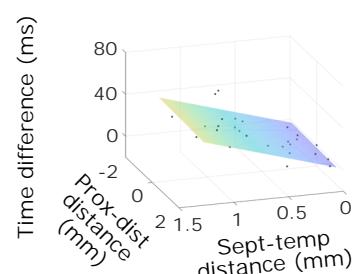
iv) Temporo-septal propagation
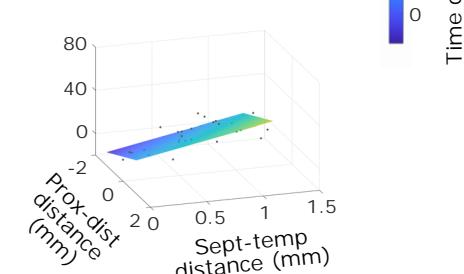
Supplementary Figure 19 Ripple propagation using comparable spatial spreads along the proximo-distal and septo-temporal axes for 4-6 SD.

See Supplementary Figure 18 legend for description.

# Supplementary Figure 20 (see next page for figure legend)
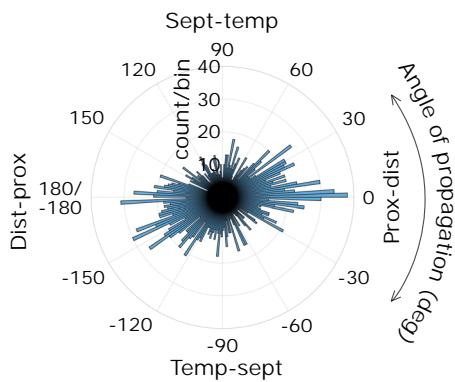
A Polar distribution of propagation angles

B Distribution of partial slopes

C Distribution of partial slope p-values

ia) For proximo-distal partial slope

ib) For septo-temporal partial slope

D Distribution of p-values of 2D fit

iia) For proximo-distal partial slope

iib) For septo-temporal partial slope

E Distribution of resultant speeds
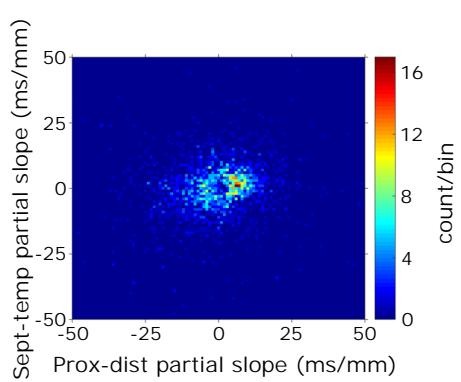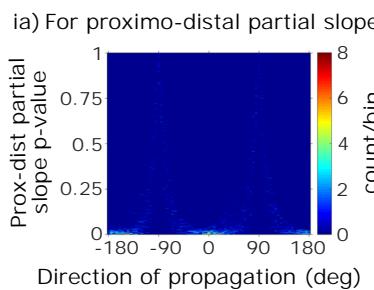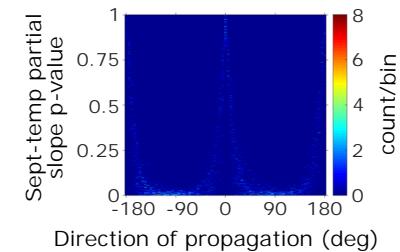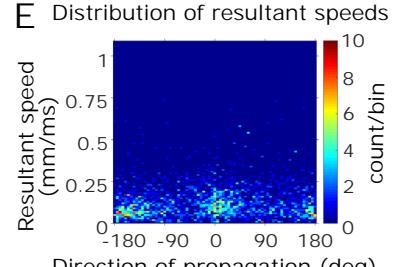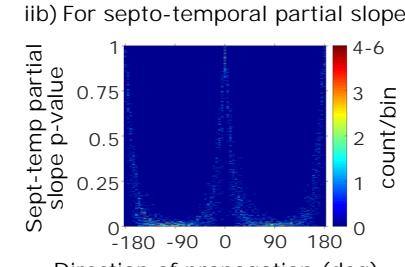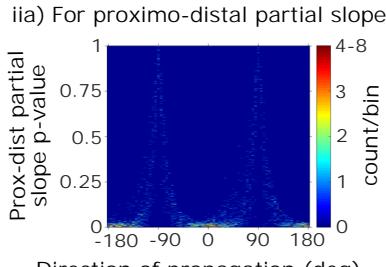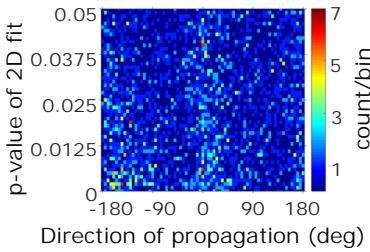
F Ripple propagation
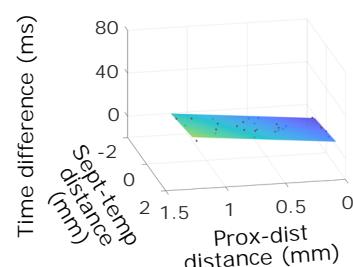
i) Proximo-distal propagation
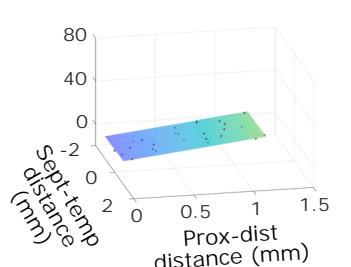
ii) Disto-proximal propagation
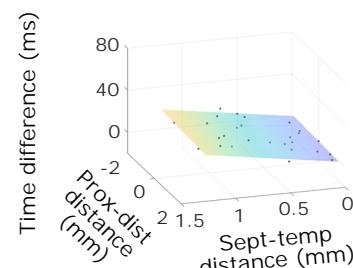
iii) Septo-temporal propagation

iv) Temporo-septal propagation
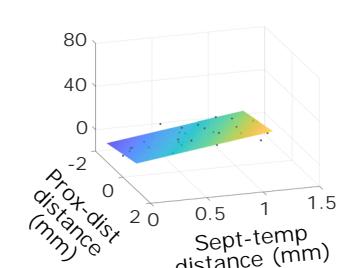
Supplementary Figure 20 Ripple propagation using comparable spatial spreads along the proximo-distal and septo-temporal axes for ≥ 6 SD.

See Supplementary Figure 17 legend for description. Note the clear preference for the proximo-distal axis over the septo-temporal axis in (A). Note the bimodal nature of the distribution of the proximo-distal and septo-temporal partial slopes in (B).

Supplementary Figure 21 (see next page for figure legend)

A Propagating ripples

B Non-propagating ripples

Proximo-distal propagation

Disto-proximal propagation

Septo-temporal propagation

Temporo-septal propagation
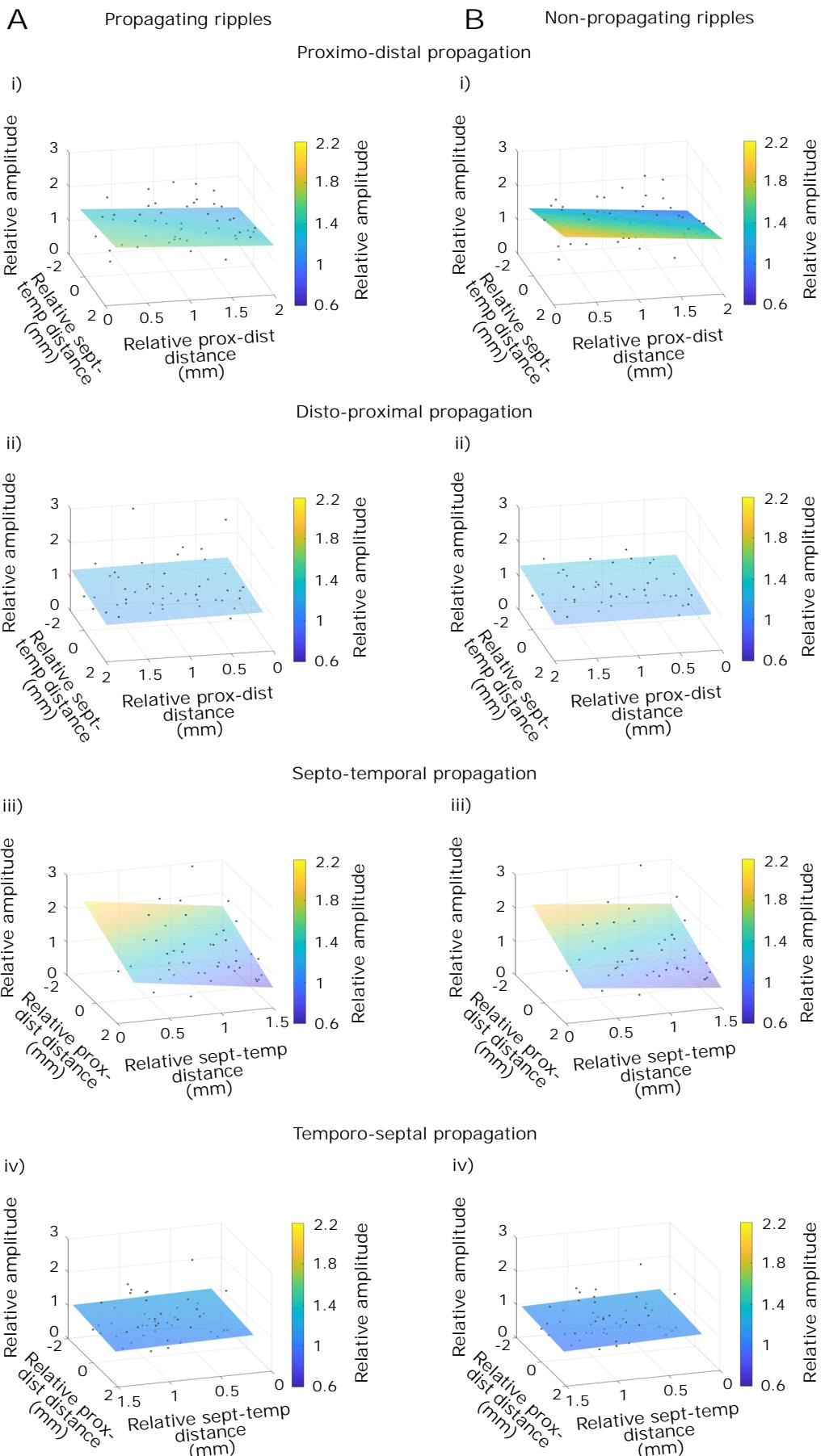
Supplementary Figure 21 Relative ripple amplitude for propagating and non-propagating ripples for ≥ 2 SD.

(A) Relative ripple amplitude after classification of propagating ripples into the four directions of propagation (i) proximo-distal propagation (ii) disto-proximal propagation (iii) septo-temporal propagation (iv) temporo-septal propagation with the 2D fit (plane) obtained from multiple linear regression analysis.

(B) Same as (A) but for a matching number of randomly selected non-propagating ripples for each direction of propagation.

Supplementary Figure 22 (see next page for figure legend)

A   Propagating ripples

B   Non-propagating ripples

Proximo-distal propagation

Disto-proximal propagation

Septo-temporal propagation

Temporo-septal propagation
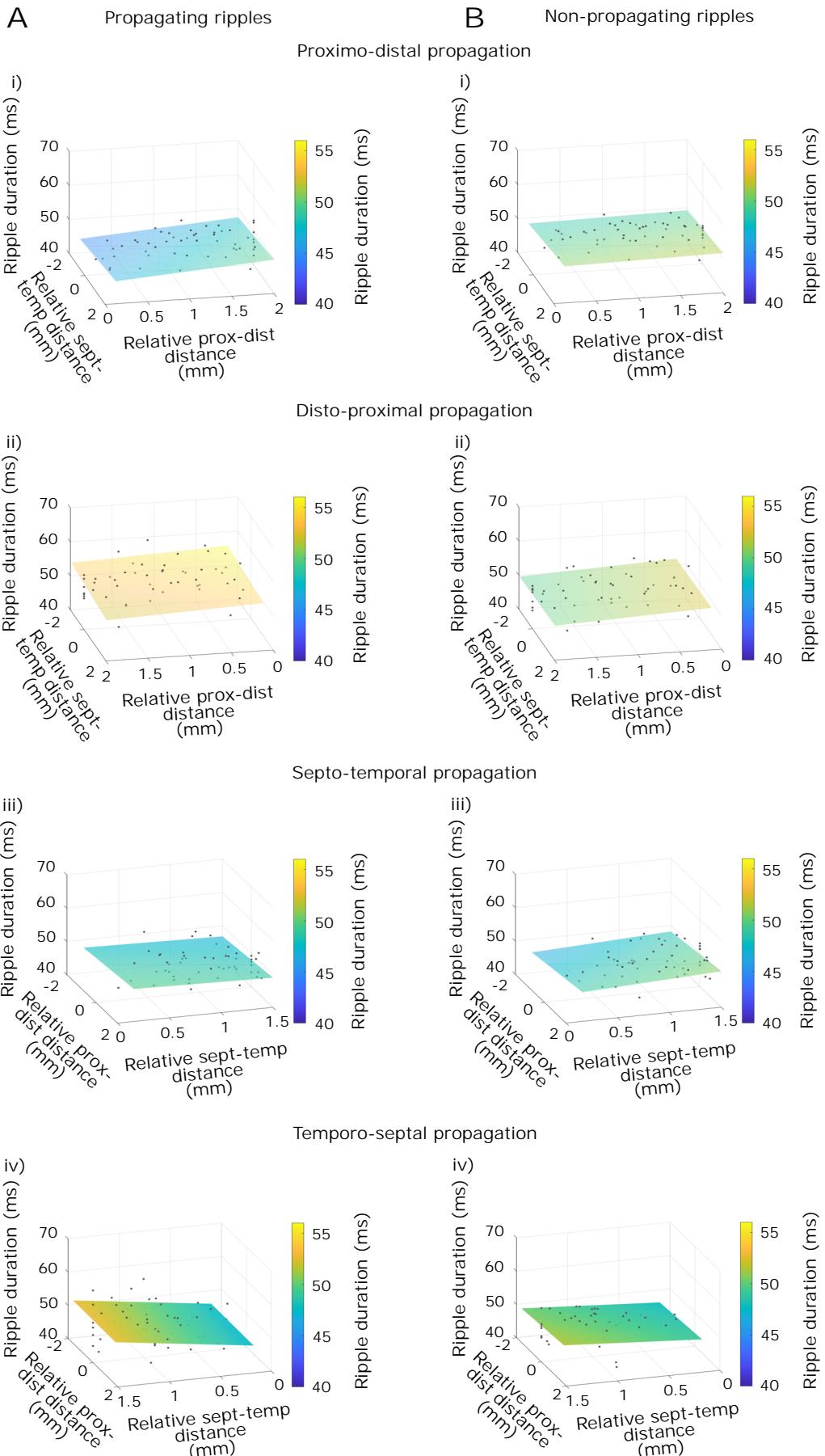
Supplementary Figure 22 Ripple duration for propagating and non-propagating ripples for ≥ 2 SD.

Figure organization is the same as that in Supplementary Figure 21, but for ripple duration.

# Supplementary Figure 23 (see next page for figure legend)

A Propagating ripples

B Non-propagating ripples

Proximo-distal propagation

Disto-proximal propagation

Septo-temporal propagation

Temporo-septal propagation
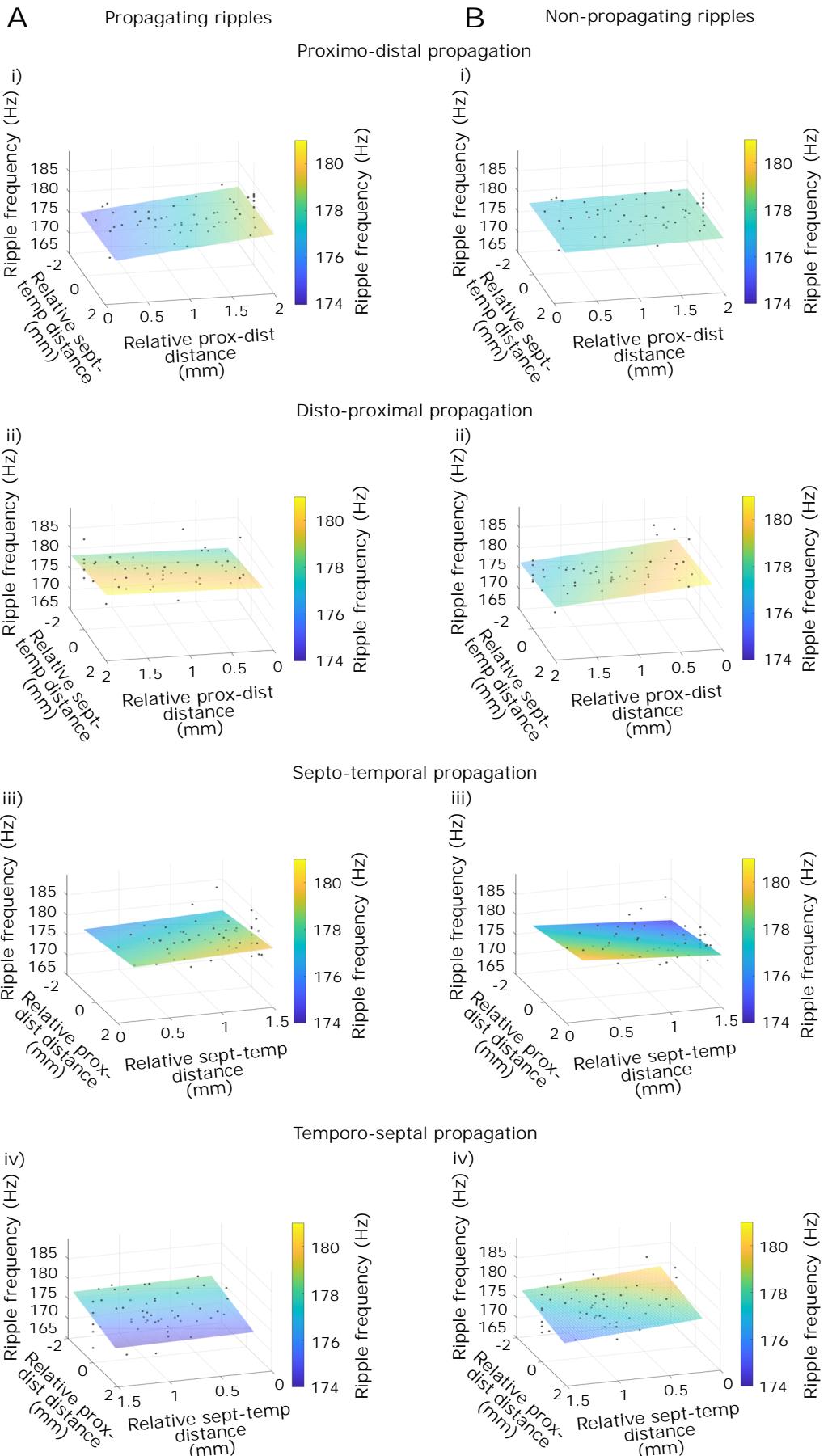
Supplementary Figure 23 Ripple frequency for propagating and non-propagating ripples for ≥ 2 SD.

Figure organization is the same as that in Supplementary Figure 21, but for ripple frequency.

Supplementary Figure 24 (see next page for figure legend)
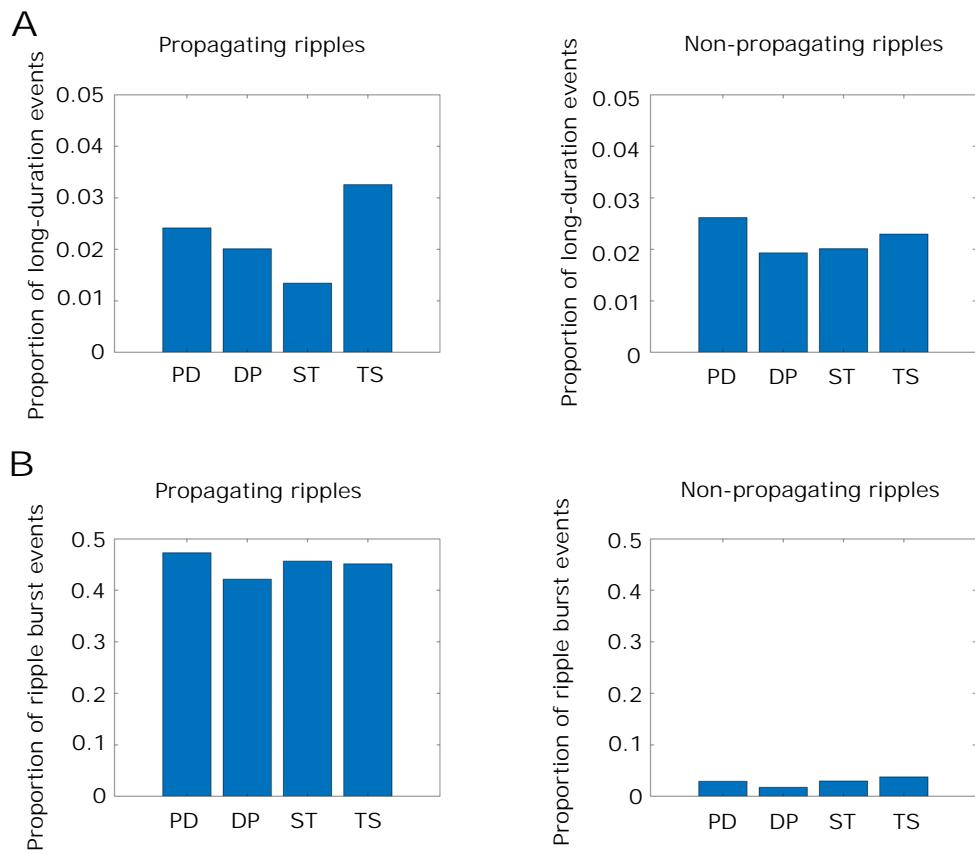
Supplementary Figure 24 Long-duration ripples and ripple bursts for propagating and non-propagating ripples.

(A) Proportion of events with long durations (> 100 ms) on the reference tetrodes for ripples propagating in the four directions (left) and non-propagating ripples (right) for ≥ 2 SD. PD denotes proximo-distal, DP denotes disto-proximal, ST septo-temporal, while TS denotes temporo-septal. No differences were observed in the proportions between proximo-distal and disto-proximal propagating ripples (two-tailed Wilcoxon signed-rank test, signedrank = 13, p = 0.69) or between septo-temporal and temporo-septal propagating ripples (two-tailed Wilcoxon signed-rank test, signedrank = 6, p = 0.22). No differences were observed for non-propagating ripples too, between events assigned to the proximo-distal and disto-proximal categories (two-tailed Wilcoxon signed-rank test, signedrank = 21, p = 0.29) or between events assigned to the septo-temporal and temporo-septal categories (two-tailed Wilcoxon signed-rank test, signedrank = 12, p = 0.81). There was no difference in the proportion of events with long-duration ripples for propagating ripples versus non-propagating ripples for the four directions of propagation collectively (two-tailed Wilcoxon signed-rank test, signedrank = 162, p = 0.35).

(B) Proportion of events with ripple bursts on the reference tetrodes for ripples propagating in the four directions (left) and non-propagating ripples (right) for ≥ 2 SD. No differences were observed in the proportions between proximo-distal and disto-proximal propagating ripples (two-tailed Wilcoxon signed-rank test, signedrank = 22, p = 0.22) or between septo-temporal and temporo-septal propagating ripples (two-tailed Wilcoxon signed-rank test, signedrank = 17, p = 0.69). No differences were observed for non-propagating ripples too, between events assigned to the proximo-distal and disto-proximal categories (two-tailed Wilcoxon signed-rank test, signedrank = 23, p = 0.16) or between events assigned to the septo-temporal and temporo-septal categories (two-tailed Wilcoxon signed-rank test, signedrank = 8, p = 0.37). Note the relatively high proportion of events with ripple bursts for propagating ripples as compared to non-propagating ripples for the four directions of propagation collectively (two-tailed Wilcoxon signed-rank test, signedrank = 406, $p < 10^{-5}$) as well as the relatively high proportion of events with ripple bursts for propagating ripples as compared to events with long-duration ripples for the four directions of propagation collectively (two-tailed Wilcoxon signed-rank test, signedrank = 406, $p < 10^{-5}$). Notice the ten-fold difference in y-axis scale for (A) and (B).

Supplementary Figure 25
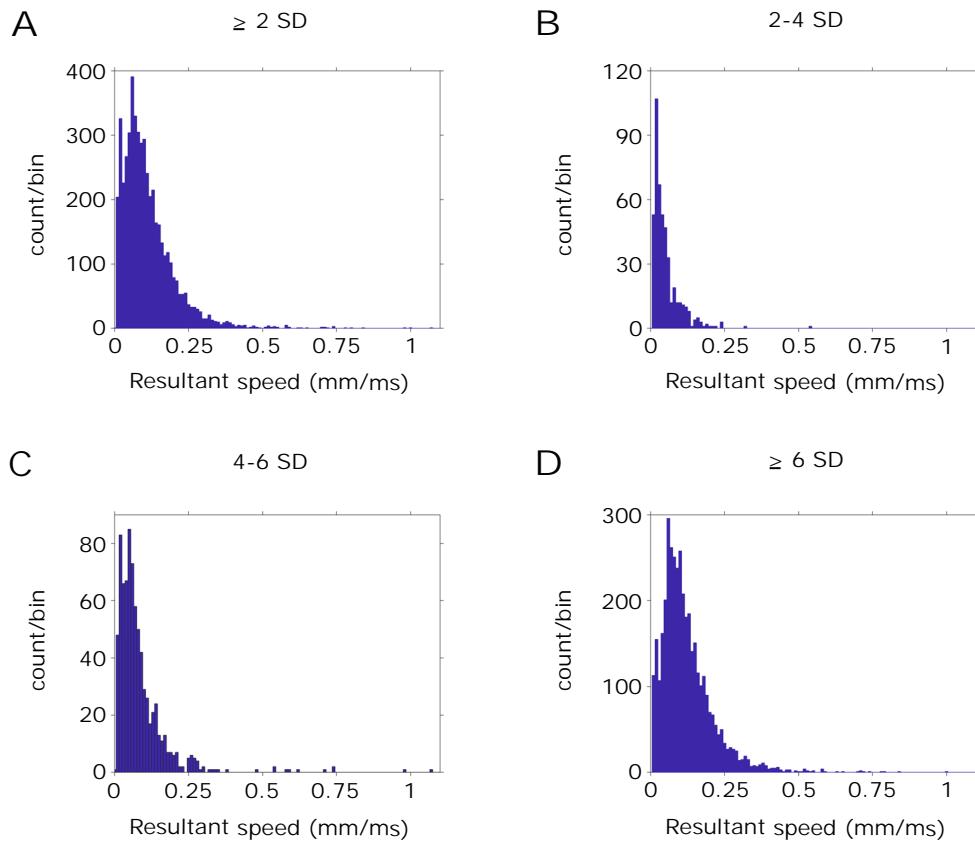
Supplementary Figure 25 Distribution of resultant speeds.

Distribution of resultant speeds of propagation for $\geq$ 2 SD (A), 2-4 SD (B), 4-6 SD (C), and $\geq$ 6 SD (D).
$\geq$ 2 SD: fraction of propagating events with speeds less than 0.2 mm/ms = 0.876
2-4 SD: fraction of propagating events with speeds less than 0.2 mm/ms = 0.983
4-6 SD: fraction of propagating events with speeds less than 0.2 mm/ms = 0.932
$\geq$ 6 SD: fraction of propagating events with speeds less than 0.2 mm/ms = 0.855