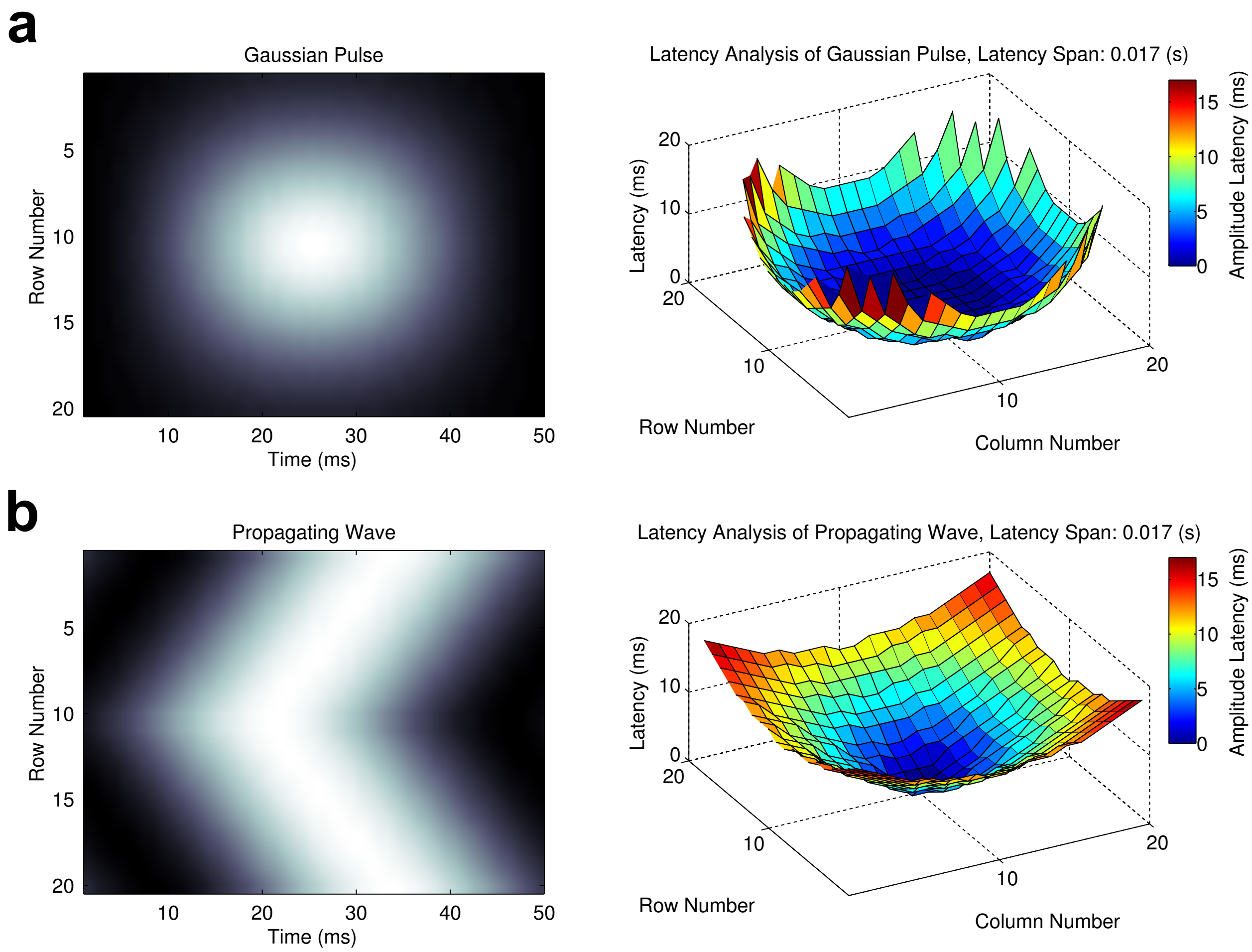
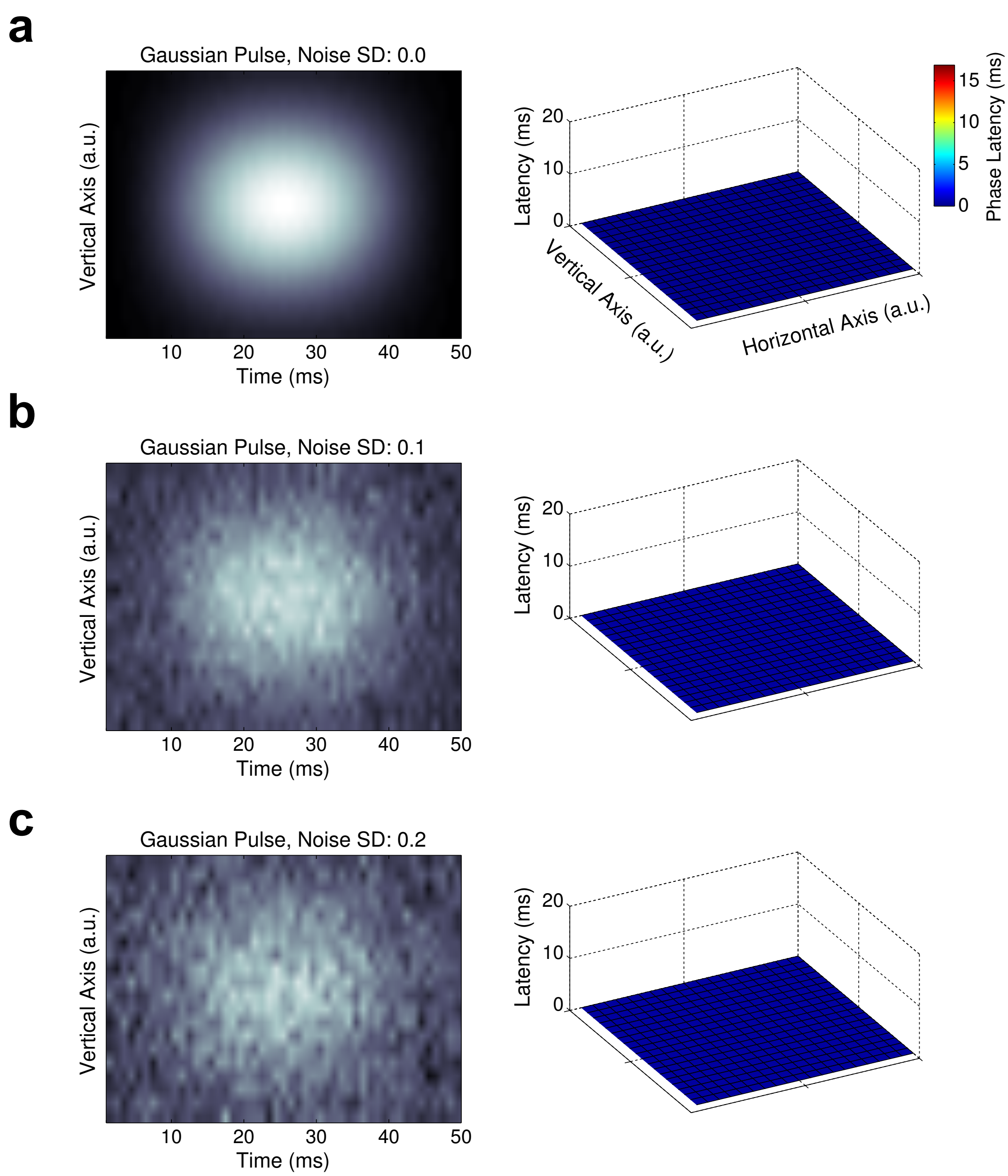


Supplementary Figure 1. Latency Analysis in the Amplitude Domain. Latency analysis in the amplitude domain is unable to distinguish between spatiotemporally separable and inseparable forms. Threshold-crossing latency analysis was conducted on a Gaussian pulse **(a)** and propagating wave **(b)**. Vertical sections of the data through time illustrate the temporal form of the response in both the spatiotemporally separable (Gaussian pulse) and inseparable (propagating wave) case (top panels). Even though the two synthetic datasets display markedly different spatiotemporal behavior, a latency analysis in the amplitude domain registers an increase in latency for each case, confounding the differences between the two. The correlation of latency with distance is strong in both cases (~ .8 - .9). Note that the shape of the latency basin recovered from this analysis depends on the form of the envelope (as illustrated by the difference in latency basin shape for the two models here), and that it is straightforward to specify a spatiotemporally separable model with exactly the same amplitude latency basin as the spatiotemporally inseparable propagating wave model in (b).



Supplementary Figure 2. Phase Latency Analysis Under Noise. To test against the possibility of false positive detections using the phase latency analysis, we started with a Gaussian pulse (with unitary amplitude) and added increasing levels of noise (SD 0, 0.1, 0.2, in panels **a**, **b**, and **c**, left column). The fact that increasing levels of noise have no effect on the phase latency maps extracted from the timecourses illustrates the robustness and applicability of the method for use in noisy multichannel data.

Parameter Class	Parameter	Value (Units)
Cell	τ_m	20.0 ms
	V_{rest}	-65.0 mV
	V_{reset}	-65.0 mV
	V_{thresh}	-50.0 mV
Synaptic	E_e	0.0 mV
	E_i	-70.0 mV
	g_e	1.8 nS
	g_i	18 nS
	τ_e	5.0 ms
	τ_i	5.0 ms
Network	N	1000
	N_e	750
	N_i	250
	p_c	0.1
	L	7.0 mm
	v_c	0.35 m/s
	K	100
	K_{exc}	75
	K_{inh}	25
	σ_c	1.0 mm
ODE	dt	0.1 ms
	T	300 ms

Supplementary Table 1. Parameters for Spiking Network Simulations. Parameters used for the simulations presented in Figures 7 and 8. Values for parameters not listed here can be found in the PyNN documentation (*IF_cond_alpha*).