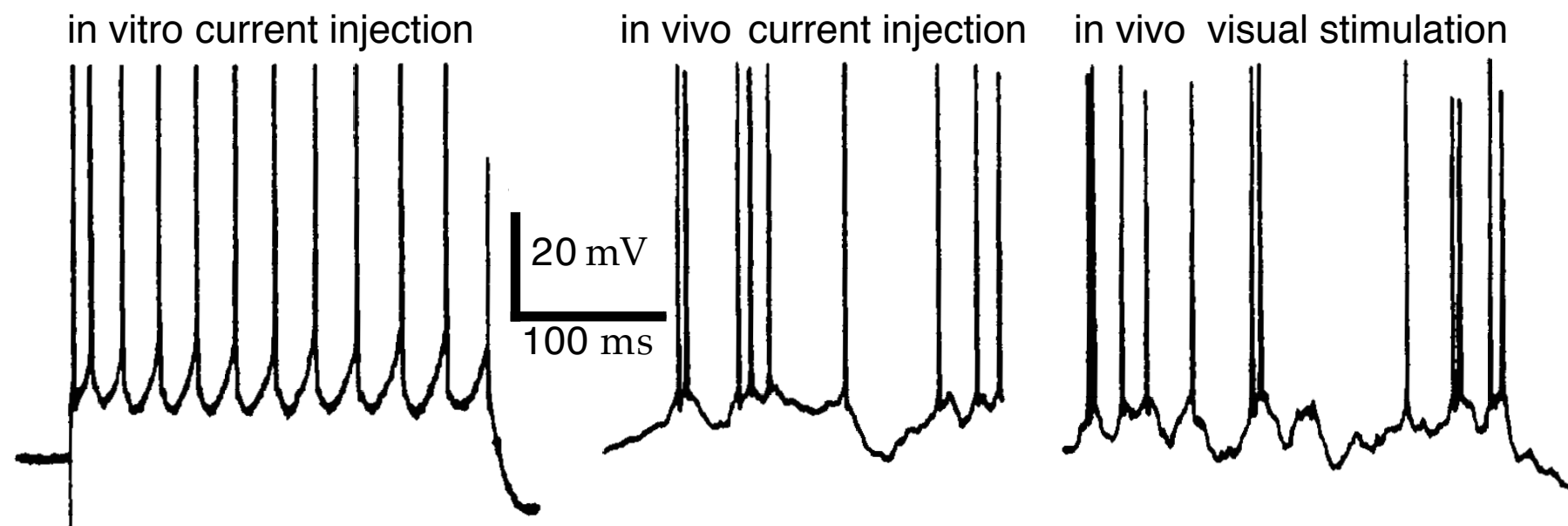
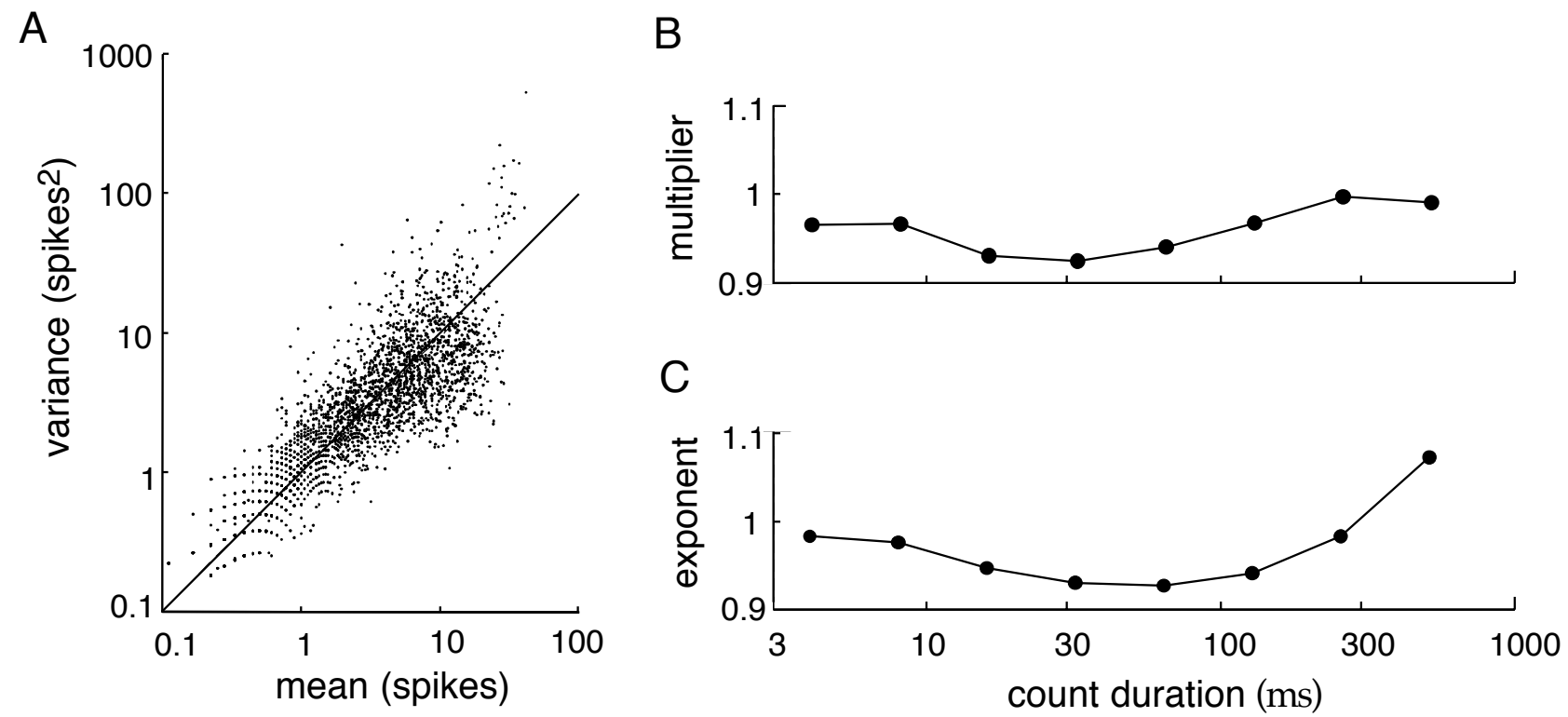


Spike-Train Statistics and Firing-rate model

Testing the Poisson Model



Testing the Poisson Model



Testing the Poisson Model

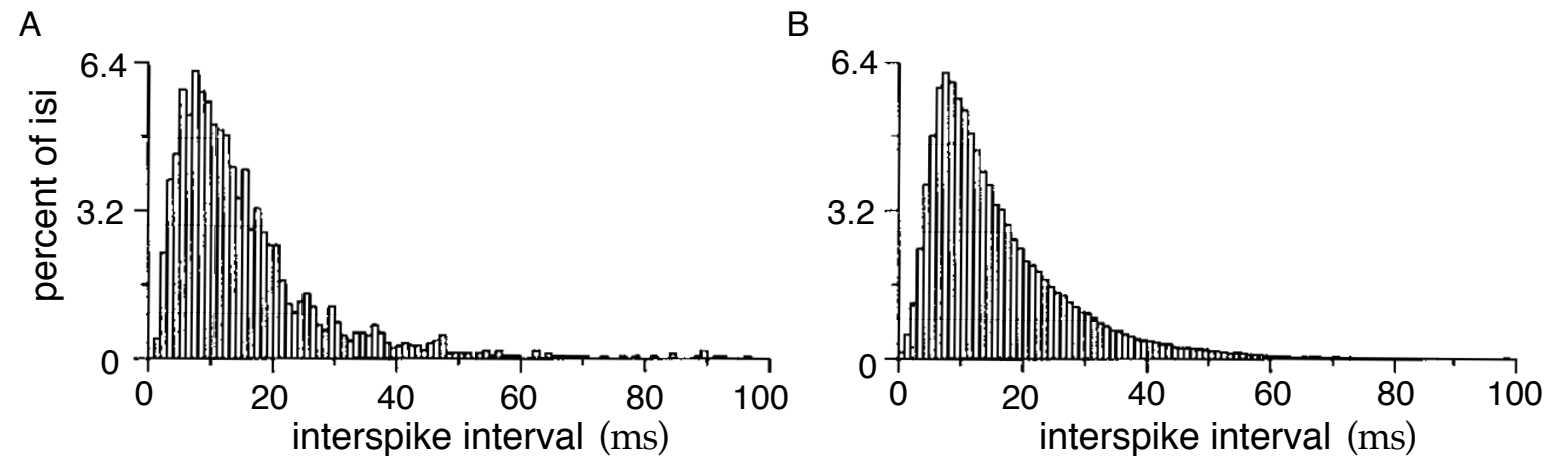
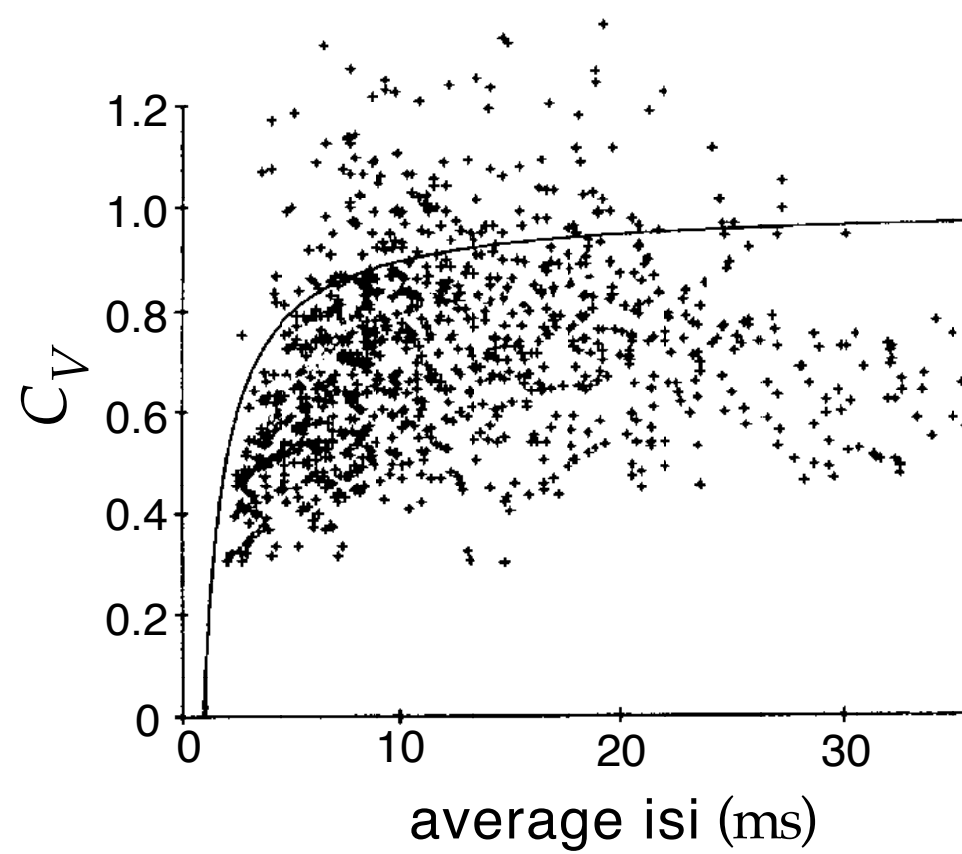


Figure 1.15: (A) Interspike interval distribution from an MT neuron responding to a moving random dot image. The probability of interspike intervals falling into the different bins, expressed as a percentage, is plotted against interspike interval. B) Interspike interval histogram generated from a Poisson model with a stochastic refractory period. (Adapted from Bair et al., 1994.)

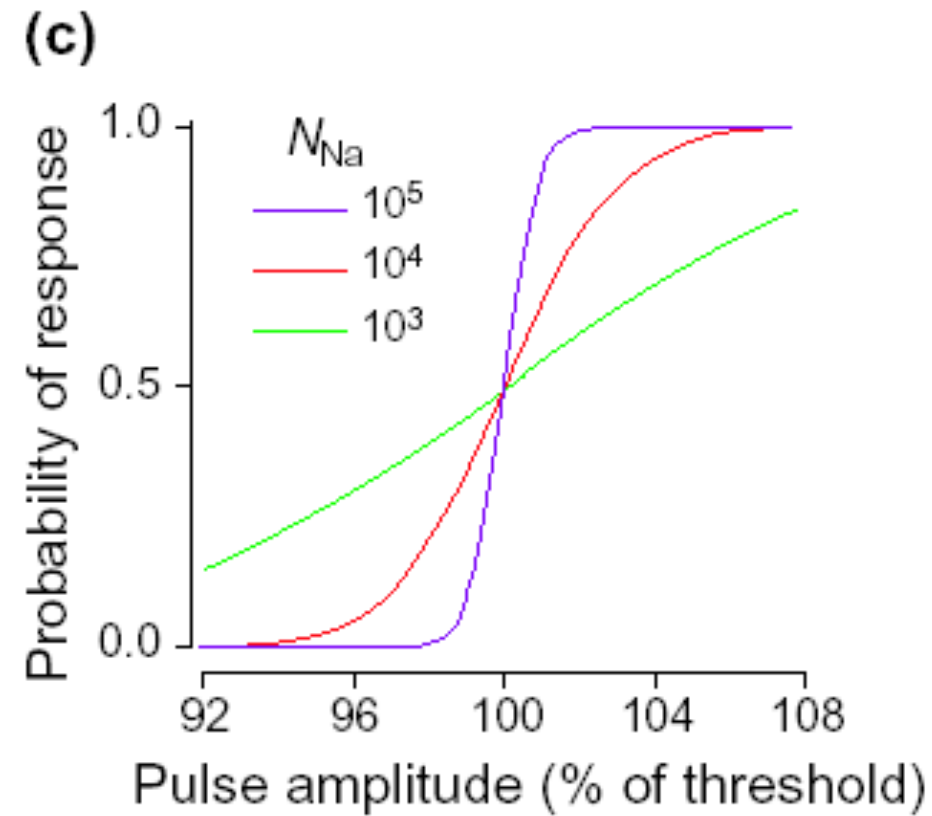
Testing the Poisson Model



Where does the stochasticity come from?

- Channel noise
- Presynaptic sources are noisy

Impact of channel noise on spike generation threshold



Neurons *in vitro* respond reliably to fluctuating stimulus

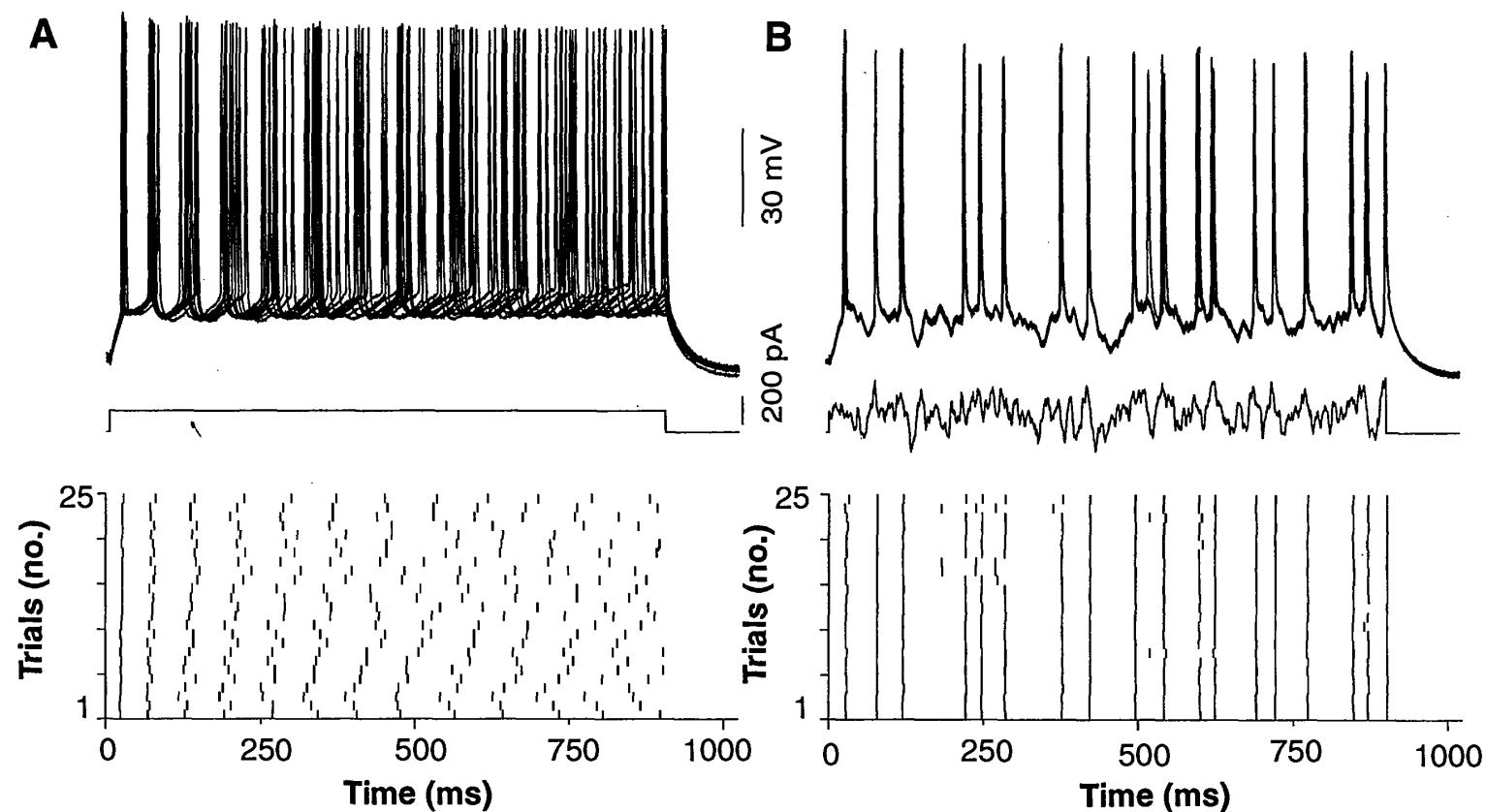
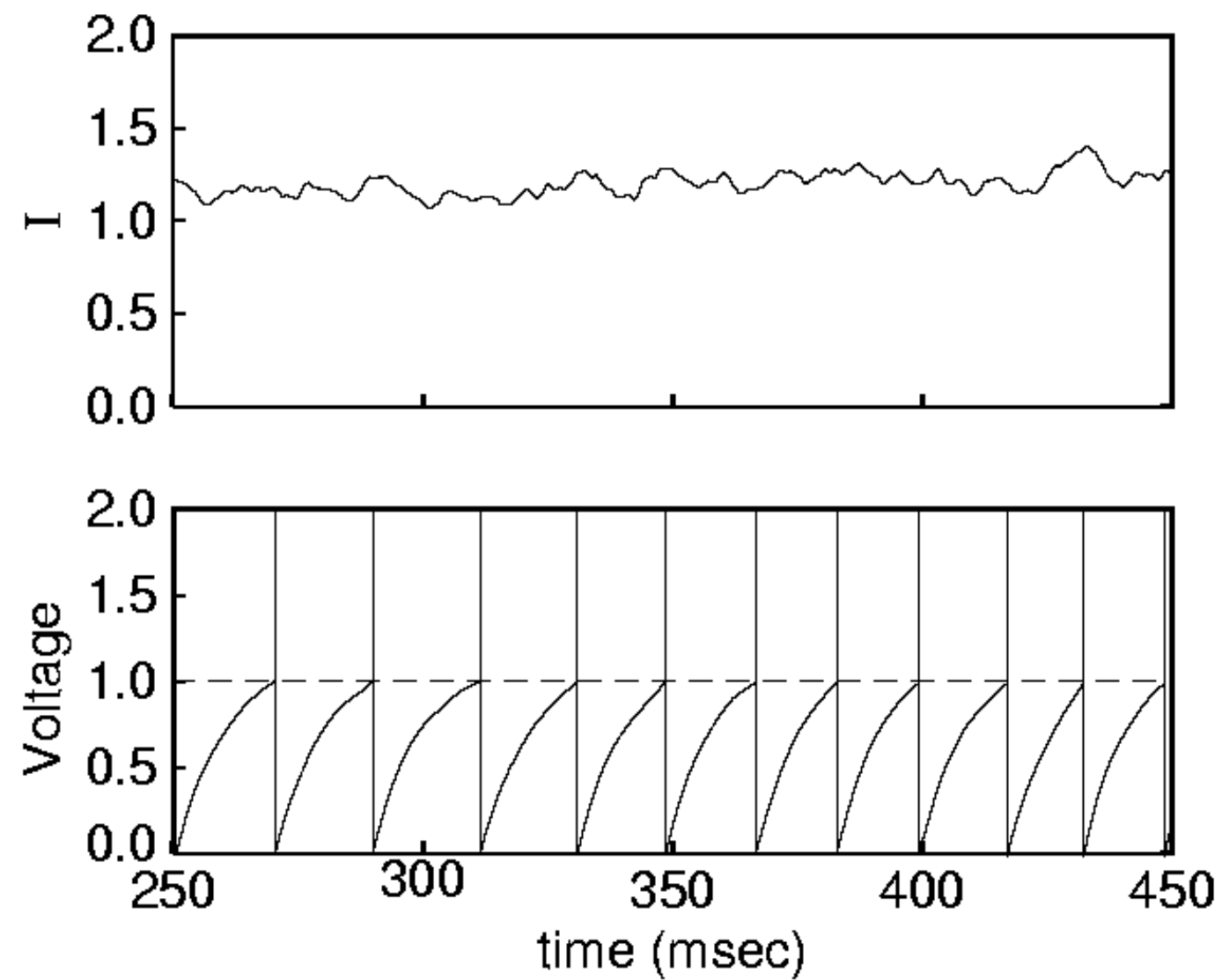


Fig. 1. Reliability of firing patterns of cortical neurons evoked by constant and fluctuating current. **(A)** In this example, a superthreshold dc current pulse (150 pA, 900 ms; middle) evoked trains of action potentials (approximately 14 Hz) in a regular-firing layer-5 neuron. Responses are shown superimposed (first 10 trials, top) and as a raster plot of spike times over spike times (25 consecutive trials, bottom). **(B)** The same cell as in (A) was again stimulated repeatedly, but this time with a fluctuating stimulus [Gaussian white noise, $\mu_s = 150$ pA, $\sigma_s = 100$ pA, $\tau_s = 3$ ms; see (14)].

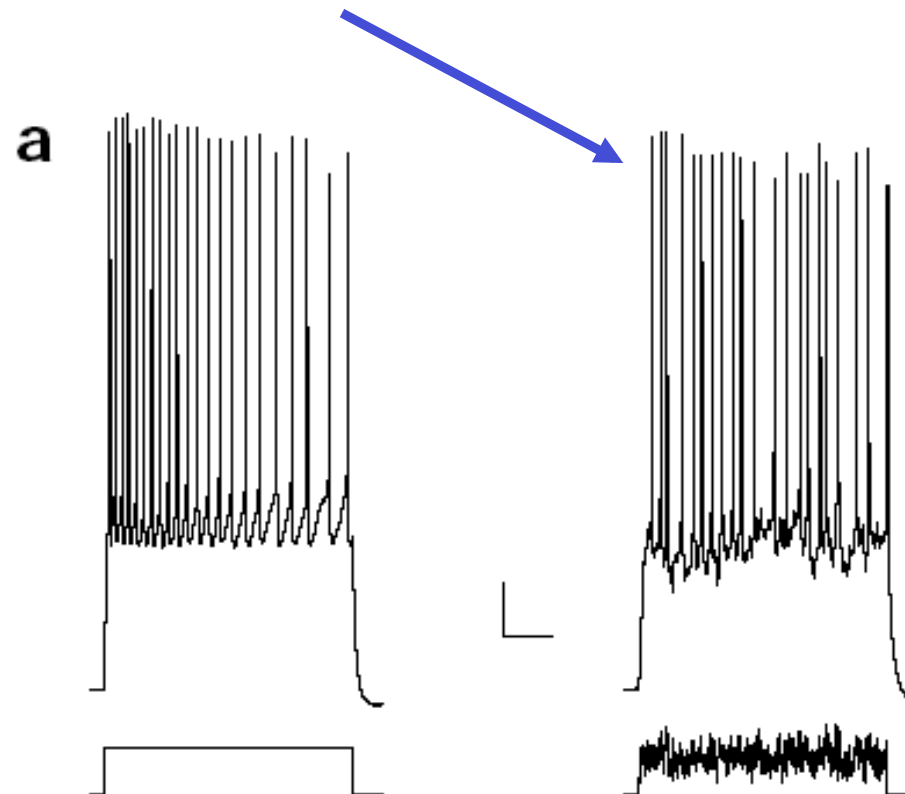
Where does the stochasticity come from?

- Channel noise
- Presynaptic sources are noisy

Integrate and Fire Neuron with $K=1000$ uncorrelated Poisson synaptic inputs



Simulating synaptic inputs in-vitro



$CV=0.28$

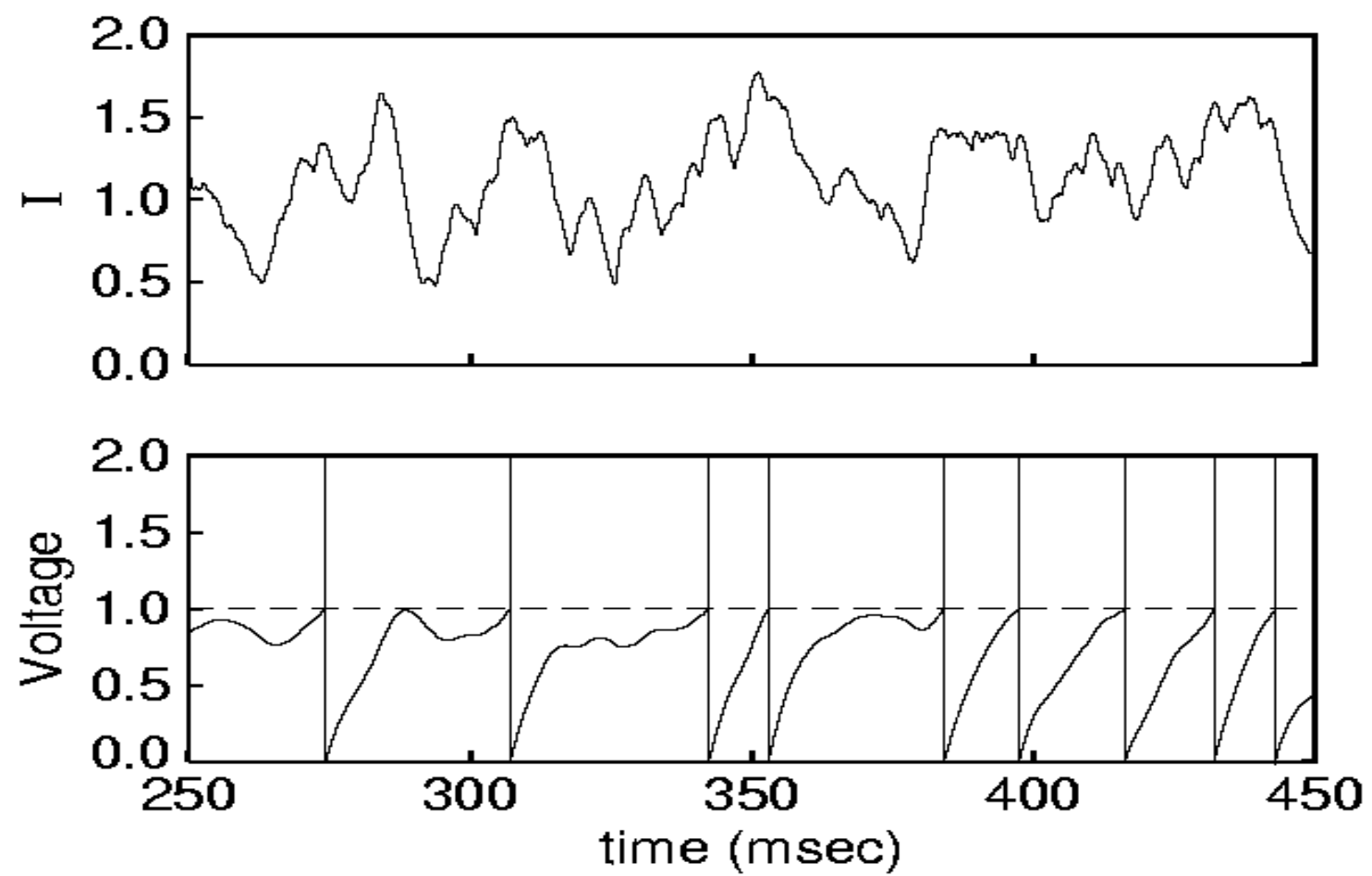
Fano factor=0.06

Two possible solutions

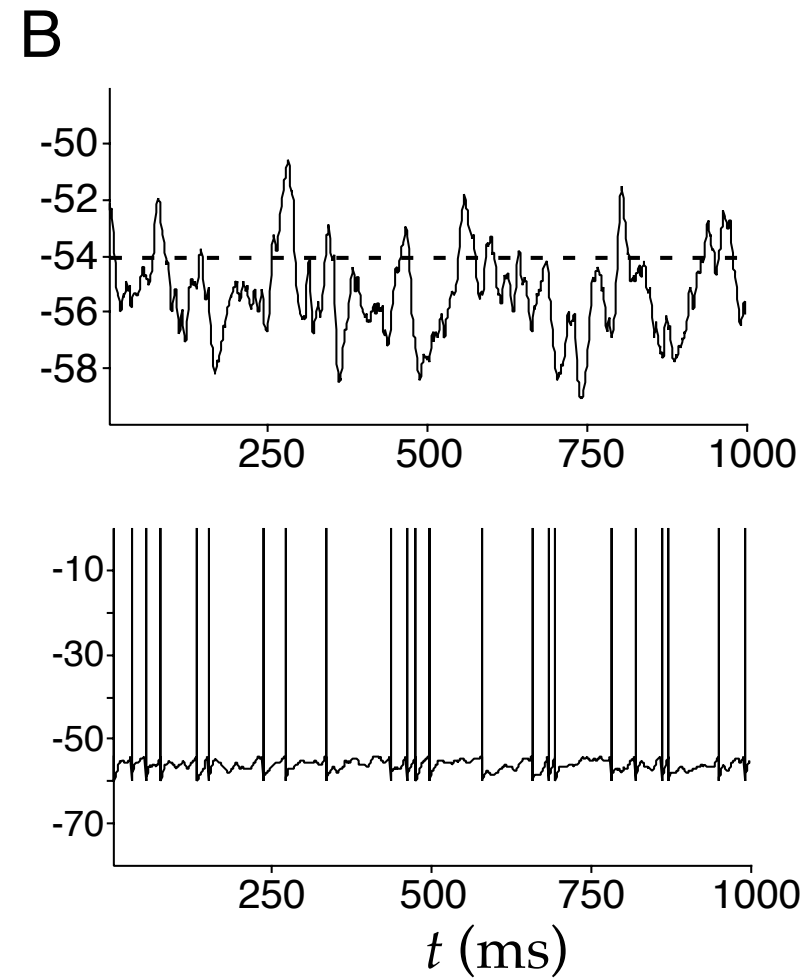
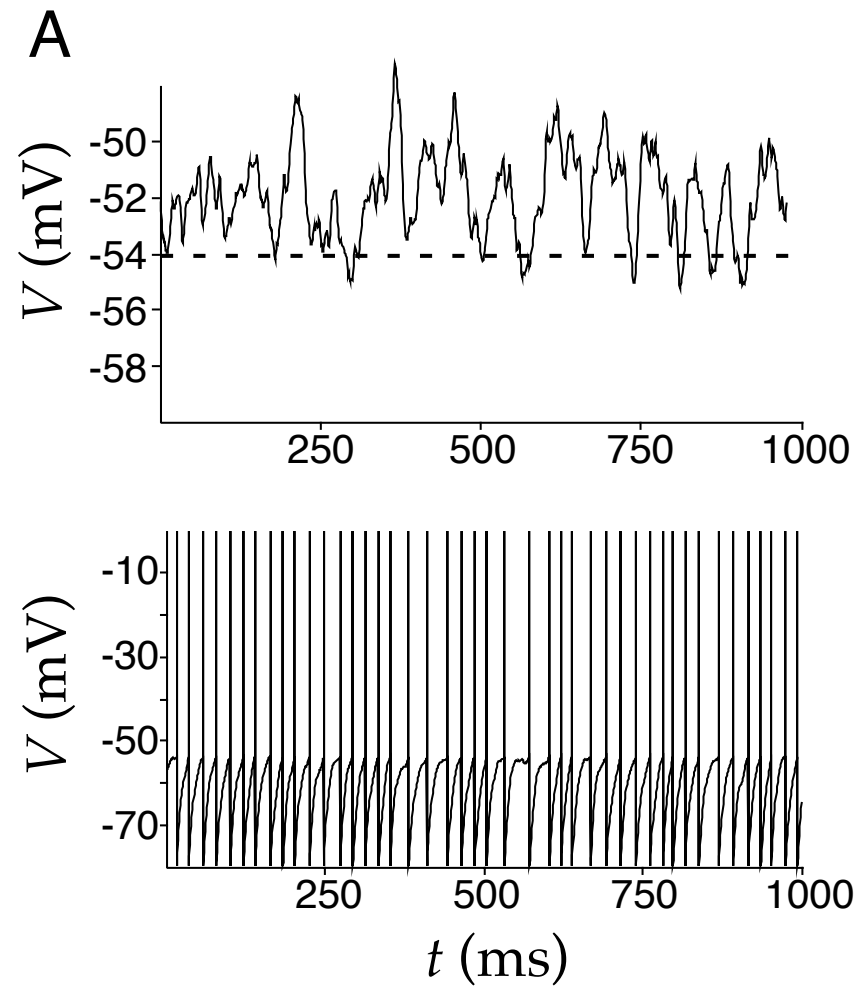
- Correlated Inputs
- Balanced Excitation and Inhibition to push the membrane potential near threshold

Large Fluctuations due to Correlated Inputs

Integrate and Fire Neuron with $K=1000$
Poisson inputs with $c=0.1$ correlations



Membrane potential near threshold



Balanced excitation and inhibition as an autoencoder

