Streams of sound: a synfire sequence detector that performs auditory grouping.

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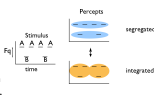
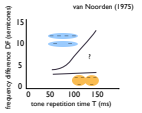
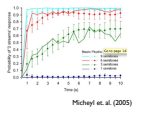
Introduction

To form representations of sound sources in the environment, the auditory system can group incoming sound features across time and frequency. We use a sequence of pure tones in an ABA_ pattern (van Noorden, 1975) for which observers typically report hearing either integration, with the tones grouped into triplets with a galloping rhythm, or segregation, in which the A and B tones are in separate streams with distinct rhythms. Psychophysical studies have shown that the perception of the ABA_ tone sequence depends on the difference in frequency between tones, DF, time between subsequent tones T, and time since the beginning of the sequence presentation. Previous work (Steele et. al., 2012) has shown how buildup in probability of segregation can arise as a consequence of competition between perceptual organizations. Here we propose a mechanistic model of how such organizations could be formed, and how they depend on stimulus parameters.



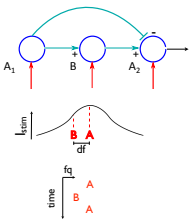




Model Objectives

- capture dependence of integrated percept on stimulus parameters DF and T
- alternations should occur for intermediate DF
- probability of segregation should increase over time in a stimulus-dependent fashion

Synfire sequence detector

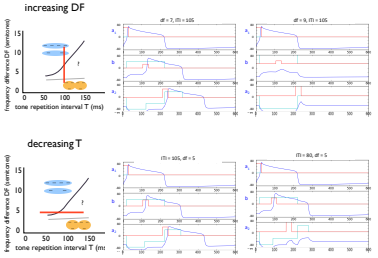


Morris-Lecar units with slow negative feedback

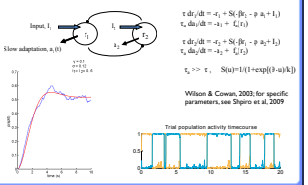
$$C\frac{dV}{dt} = -g_{Ca}m_{ss}(V)(V-V_{Ca}) - g_K W(V-V_K) - g_L(V-V_L) + I_{stim} + I_{syn}$$

$$\frac{dW}{dt} = (W_{ss}(V) - W)/\tau_W(V)$$

Model detection of integrated sequence breaks down at temporal coherence boundary



Competing sequences could produce alternations and buildup



Conclusions

- sequence detector is sensitive to both tone frequency difference and temporal properties
- sustained activity permits detection of tone sequence even across silent gaps
- competition between such sequence detectors performing perceptual organization could produce alternations and buildup

Acknowledgments

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