Recommended

F1000 Factor **3.0**

EndNote
Download citation
Send page by email

Amplitude modulation patterns of local field potentials reveal asynchronous neuronal populations.

Díaz J, Razeto-Barry P, Letelier JC, Caprio J, Bacigalupo J

J Neurosci 2007 Aug 22 **27**(34):9238-45 [**abstract on PubMed**]
[**citations on Google Scholar**] [**related articles**] [**FREE full text**]

Selected by | Rajesh Rao with Erik Edwards NEW
Evaluated 26 Nov 2008
Relevant Sections

Faculty Comments

Faculty Member

Rajesh Rao
with Erik Edwards
University of Washington, United States of America
Neuroscience

Hypothesis
New Finding
Tech Advance

Comments

This article presents a new study of beta-band oscillations in the olfactory epithelium of catfish. The importance of this work is found in the authors' mathematical modeling of the possible origins of the observed oscillations. This work might easily be overlooked by those studying human field potentials or electroencephalograms (EEGs), but the principles revealed here are highly relevant to the larger field of EEG work. A surprising take-home message is that "event-related synchronization" does not necessarily require synchronization.

The dominant theoretical view in EEG today is the synchrony view {1,2} whereby field potential oscillations are assumed to be produced by synchrony (i.e. coherence) across units. This view has dominated EEG and field potential research since it was first proposed by Sir Edgar Adrian in 1934. Changes in power in a frequency band are automatically assumed to be event-related "desynchronization" or "synchronization" {3,4}. However, this view rests on the erroneous assumption, albeit an intuitive one, that a lack of coherence across units would result in summation to zero voltage. That is, the individual contributions should cancel each other out if they are incoherent. In reality, signals with completely random phase in relation to each other are infinitesimally unlikely to exhibit zero coherence. Rather, the chance coherence follows a Rayleigh distribution with mode equal to 1/sqrt(N), where N is the number of units summating to produce the population signal. Thus, utterly incoherent signals still exhibit a non-zero coherence and, therefore, a non-zero amplitude in the population signal (field potential). This insight and empirical observations on the Rayleigh distribution in scalp EEG were first given in the statistical-mechanical theory of Koiti Motokawa {5,6}. This theory was an important challenge to the synchrony theory of Adrian, but was unfortunately forgotten as it was published in German in journals largely unread outside of Japan. This present article has done an important service in reviving this challenge to the synchrony theory for field potentials, and explains how non-coherent units would lead to the (observed) Rayleigh distribution. The authors also show some other statistical consequences of the non-synchrony model, and develop a novel method of introducing varying levels of synchrony into the model such that it can range from utterly incoherent (1/sqrt(N)) to completely coherent (1). Although the authors believe the observed Rayleigh fading phenomena would only apply to local field potentials, analogous modeling may apply even to scalp EEG analyses. In any case, this work deserves careful consideration by a larger audience of field potential and EEG researchers. References: {1} Singer, Annu Rev Physiol 1993, 55:349-74 [PMID:8466179]. {2} Buzsáki G, Temporal coding in the brain. Berlin, New York: Springer-Verlag. {3} Pfurtscheller and Aranibar, Electroencephalogr Clin Neurophysiol 1977, 42:817-826 [PMID:67933]. {4} Pfurtscheller and Neuper, Neuroreport 1992, 3:1057-1060. {5} Motokawa K, Eine statistisch-mechanische Theorie über das Elektrenkephalogramm. Tohoku journal of experimental medicine 1943, 45:278-96. {6} Motokawa and Mita, Das Wahrscheinlichkeitsprinzip über die gehirnelektrischen Erscheinungen des Menschen. Japanese journal of medical sciences III Biophysics 1942, 8:63-77.

Competing interests: None declared
Evaluated 26 Nov 2008 NEW

How to cite this evaluation

Faculty Comments

How to cite the Faculty of 1000 Biology evaluation(s) for this paper

1) To cite all the evaluations for this article:

Faculty of 1000 Biology: evaluations for Díaz J et al *J Neurosci* 2007 Aug 22 27 (34) :9238-45
http://www.f1000biology.com/article/id/1127024/evaluation

2) To cite an evaluation by a specific Faculty member:

Rajesh Rao: Faculty of 1000 Biology, 26 Nov 2008 http://www.f1000biology.com/article/id/1127024/evaluation