Choosing the best oscillatory power asymmetry metric - results from simulations

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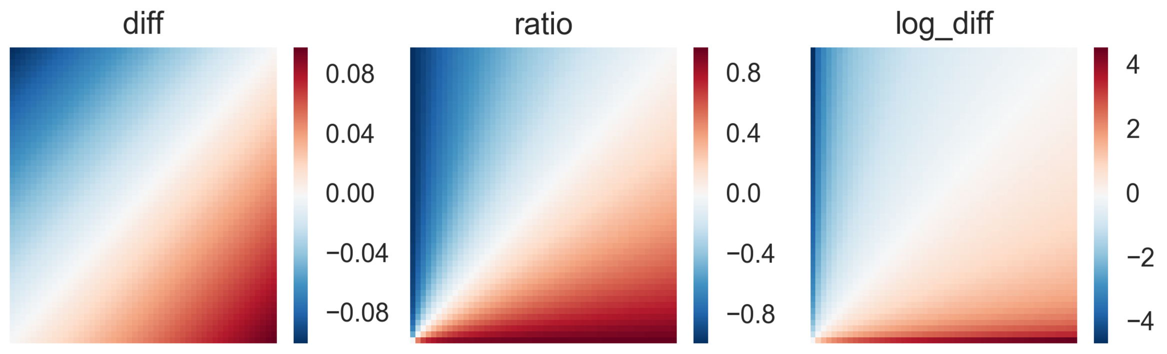
BACKGROUND

Asymmetry in power of given oscillatory band (often alpha) is a commonly used measure. There are at least three asymmetry metrics used in the literature but guidelines as to which should be preferred in what cases are lacking [1,2,3,5,6,7]. The lack of such guidelines is especially relevant given the fact that single-trial power values do not come from a normal but gamma distribution, which is often ignored. We present results of simulations comparing most popular measures of asymmetry.

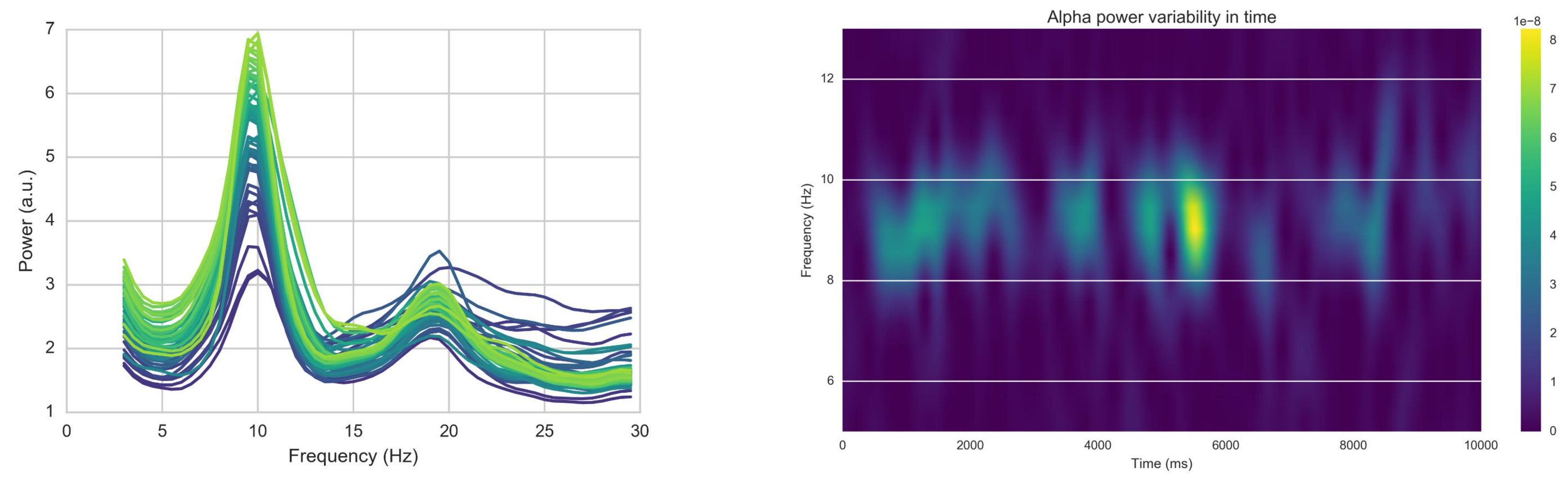
$R - L$ $\qquad \frac{R - L}{R + L}$ $\qquad \log R - \log L$



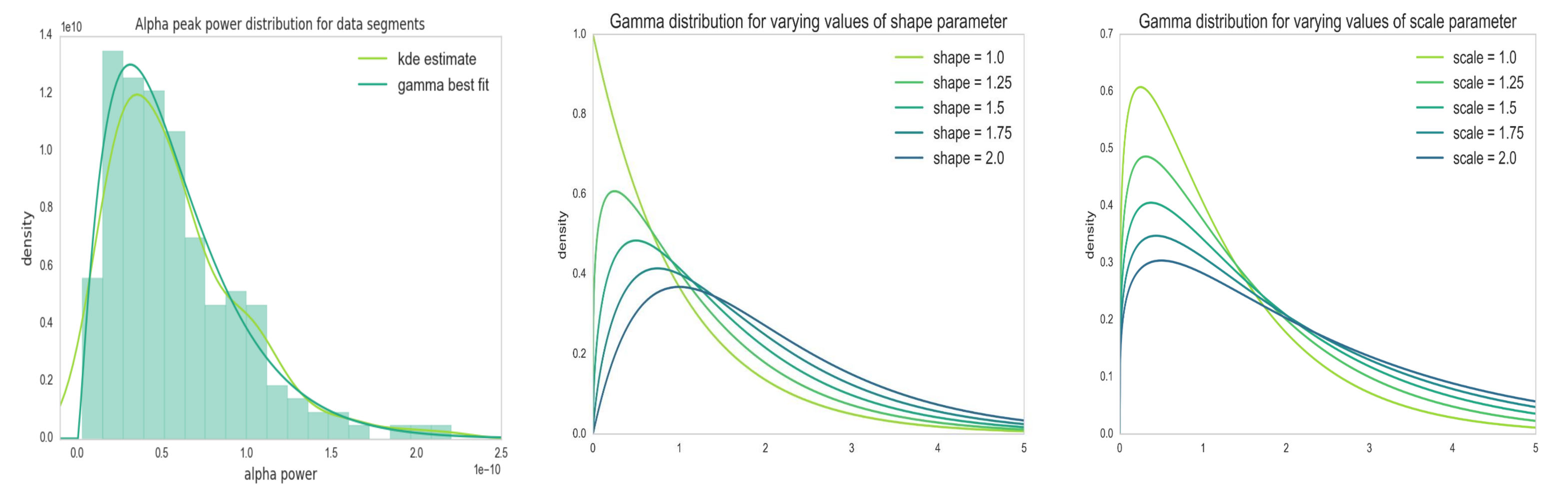
SIMULATIONS

We performed two types of simulations, where effects were simulated and tested: 1) on single trials (within a single subject); 2) on multiple subjects, where each subject's trials are averaged. Both types of simulations consisted in random sampling from gamma distributions with same shape parameter. For each subject two types of trials were simulated: 1) without asymmetry effect, when values for left and right hemispheres were drawn from the same gamma distribution; 2) with asymmetry effect, when values for left and right hemispheres were drawn from distributions that differed in scale parameter. Both types of trials were contrasted with dependent t-test within subjects. A range of gamma scale differences, number of subjects and number of trials were tested - each simulation was run 1000 times and probability of detecting simulated effects depending on used asymmetry metric was calculated.

Alpha power is variable across time and space



Single-trial alpha power comes from gamma distribution

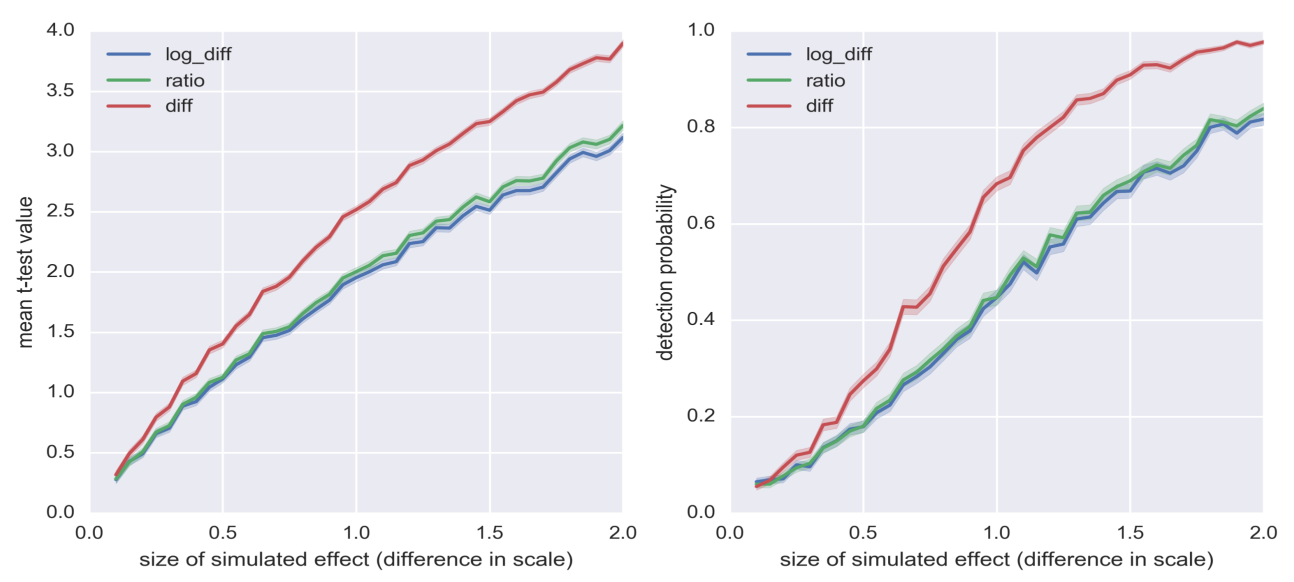


For each trial and each subject values are drawn from gamma distribution in following way:

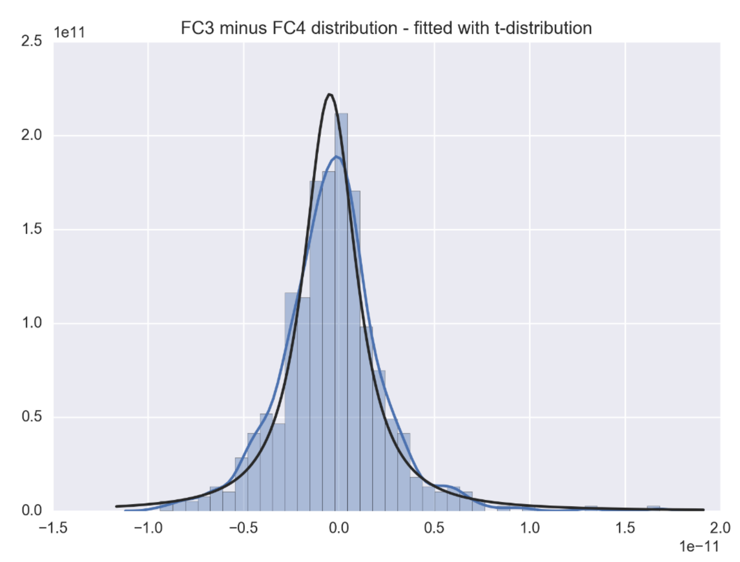
Subject **without** the asymmetry effect $\qquad$ Subject **with** the asymmetry effect

RESULTS

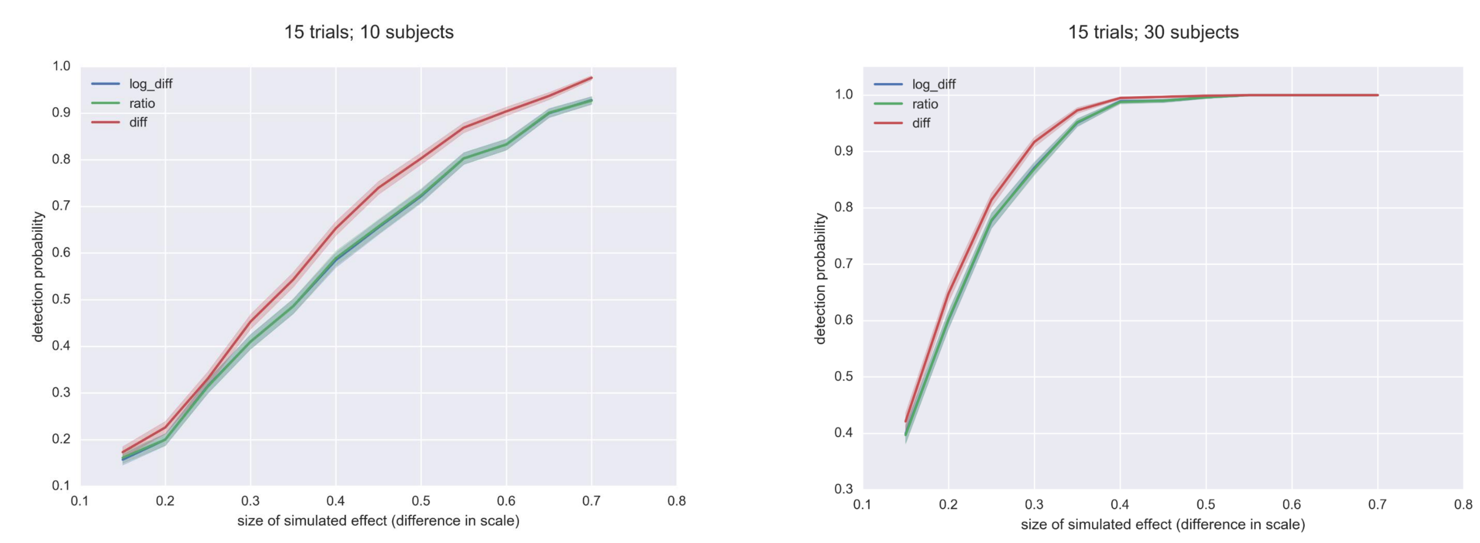
For single-trial analyses difference metric performs best

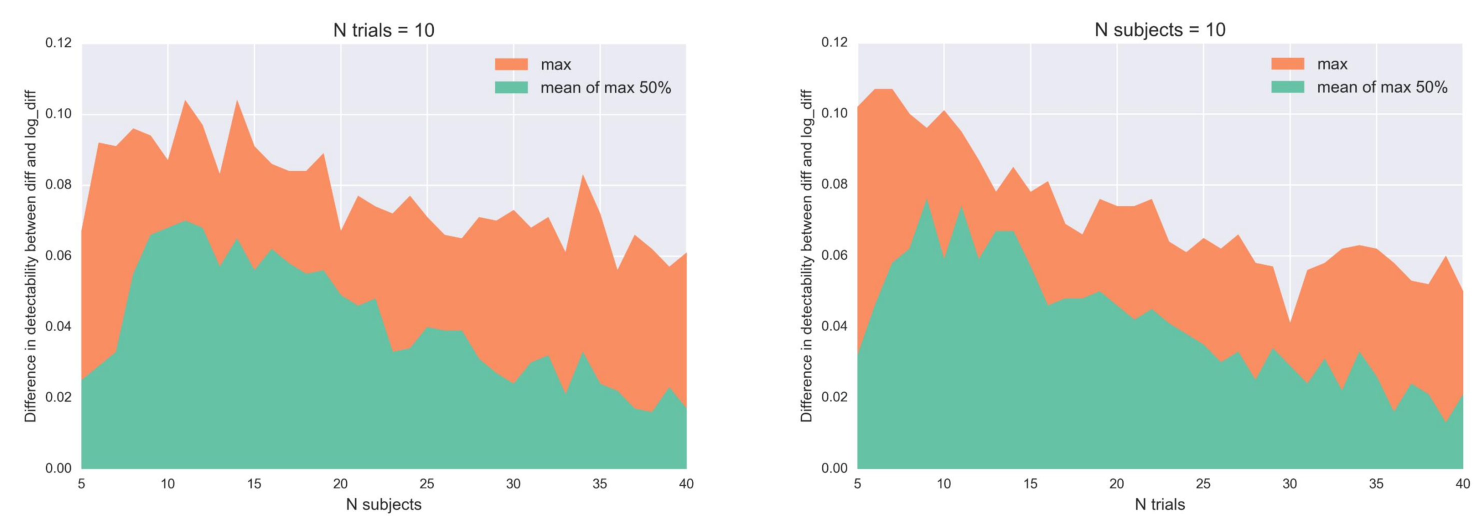


All of these simulations point to simple difference being the best measure (having lowest probability of type II error). The advantage of difference is most striking for single-trial designs, mostly due to the fact that difference of gamma distributions resembles t test distribution (and single-trial approaches are most affected by the fact that the original distribution is gamma-shaped).



For group-level analyses difference is also better





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WANT MORE INFO?

Download the poster from GitHub repository:

https://github.com/mmagnuski/AoN2016-poster

Powered by open-source solutions: python MNE [4]

Founding: Ministry of Science and Higher Education, Republic of Poland; National Science Centre Poland