restingIAF: A RELIABLE, AUTOMATED METHOD FOR QUANTIFYING INDIVIDUAL ALPHA FREQUENCY

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INTRODUCTION

IAF is a fundamental property of brain processing relating to individual differences across various domains:

- perception[1,2]
- memory[3] & attention[4]
- language[5]
- general intelligence[6]

IAF might also help improve the precision of frequency band analysis.[7]

THE PROBLEM

IAF is typically indexed by a dominant spectral peak elicited during eyes-closed resting-state M/EEG. However, a subset of individuals do not demonstrate any clear alpha peak.

– **Visual identification** of spectral peaks in such cases is inefficient, prone to bias, and difficult to replicate.

– **Automated strategies** may solve these problems, but are themselves subject to various limitations.

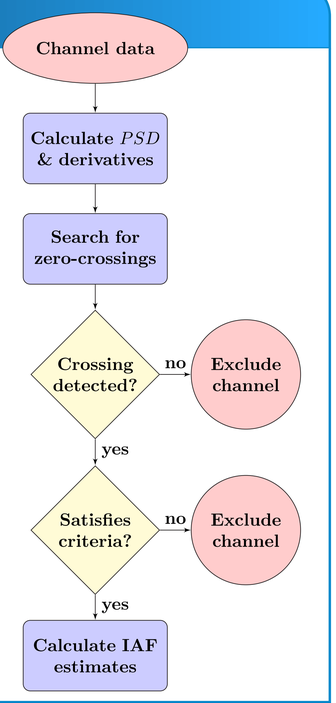
THE IDEA

We devised an automated routine that estimates **peak alpha frequency (PAF)** from the 1st and 2nd derivatives of **Savitzky-Golay (S-G) filtered** power spectra.
S-G filtering smoothes noisy fluctuations while preserving peak characteristics.[8]
We also extended this approach to derive **centre of gravity (CoG)** estimates of IAF.

METHOD & ANALYSIS

ALGORITHM

The routine is summarised in the flow diagram opposite.
To register as a PAF, peaks must exceed a background spectral noise threshold and a secondary peak threshold. Number of estimates for averaging can also be thresholded.
restingIAF has MATLAB and Python implementations.



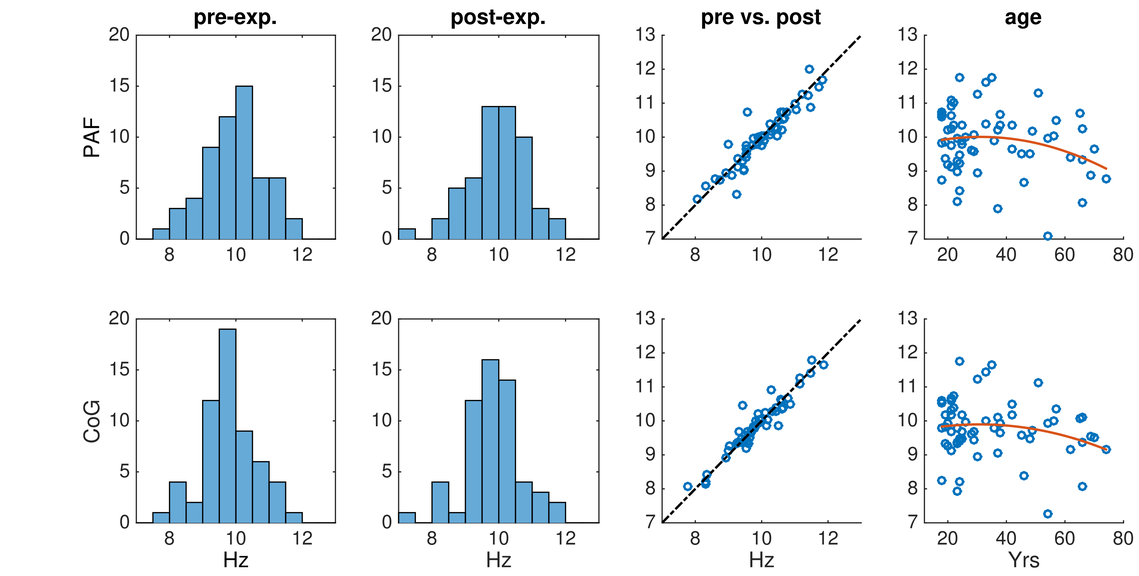
EMPIRICAL DATA

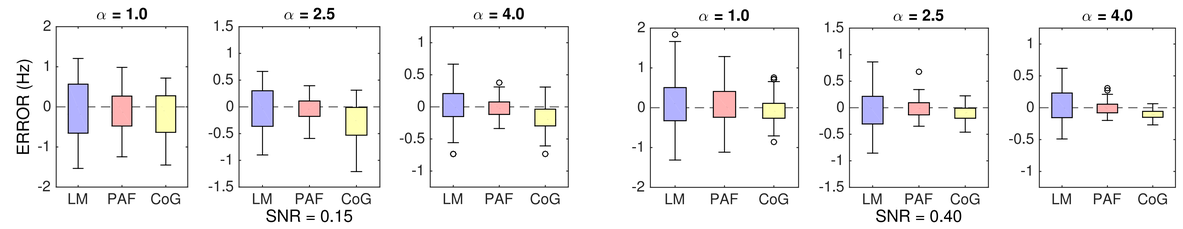
63 healthy adults (42 females; age range: 18–74 yrs).
2 min eyes-closed EEG recorded pre/post experiment.
PAF/CoG distributions and correlations analysed.

SIMULATION DATA

Gaussian-distributed alpha components synthesised and embedded within a pink noise signal. Component dispersal (α) and signal-to-noise ratio (**SNR**) parametrically varied.
PAF/CoG compared to **local maximum (LM)** detection.

KEY FINDINGS





CONCLUSIONS

– S-G filtering aids accurate, automated extraction of target alpha components.
– Empirical data show similar characteristics to previous large *n* studies.
– *restingIAF* may help improve reliability and rigour of future IAF research.

FUTURE WORK

☐ **SOON:**
- GitHub release
- Assess performance in children

☐ **LATER:**
- Develop GUI for EEGLAB
- Automate S-G filter settings

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