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

Andrew W. Corcoran[a,b] Phillip M. Alday[c,b] Matthias Schlesewsky[b] Ina Bornkessel-Schlesewsky[b]

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 (peak) frequency elicited during eyes-closed resting-state M/EEG. However, a subset of individuals do not demonstrate a clear alpha peak.
Further, visual identification of peak frequency from channel spectra is time-consuming and prone to bias.
Automated strategies may solve these problems, but also introduce new sources of error.

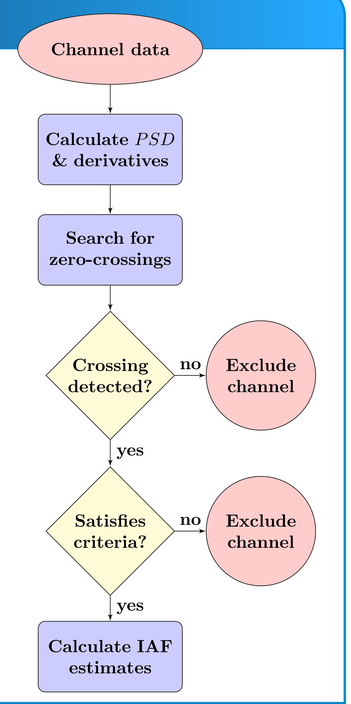
THE IDEA

We devised an automated routine that estimates **peak alpha frequency (PAF)** from the 1st derivative of Savitzky-Golay filtered 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 EEGLAB and Python implementations.



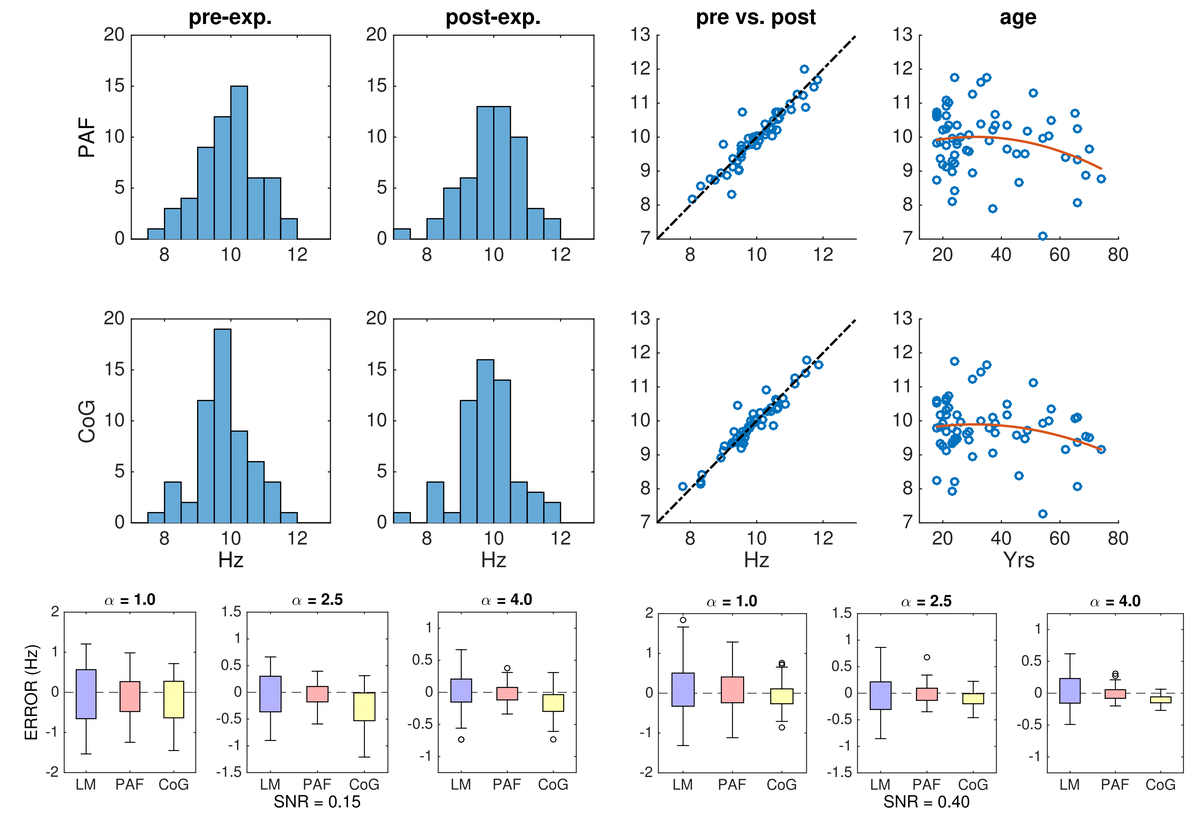
EMPIRICAL DATA

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

SIMULATION DATA

Gaussian-distributed alpha components synthesised and embedded within 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 parameter settings

AFFILIATIONS & REFERENCES

[a]Cognition & Philosophy Laboratory, Monash University. [b]Cognitive Neuroscience Laboratory, University of South Australia. [c]Max Planck Institute for Psycholinguistics, Nijmegen. **CONTACT: andrew.corcoran1@monash.edu**

[1] Cecere et al. *Curr. Biol.* **2015**, *25*, 231. [2] Samaha & Postle. *Curr. Biol.* **2015**, *25*, 2985. [3] Klimesch. *Brain Res. Rev.* **1999**, *29*, 169. [4] MacLean et al. *Brain Cogn.* **2012**, *78*, 218. [5] Bornkessel et al. *Exp. Psychol.* **2004**, *51*, 279. [6] Grandy et al. *NeuroImage.* **2013**, *79*, 10. [7] Klimesch. *TICS.* **2012**, *16*, 606. [8] Zeigler. *Appl. Spectrosc.* **1981**, *35*, 88.