Magnetoencefalografía

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Resumen

La Magnetoencefalografía (MEG) permite obtener imagenes de la electrofisiología subyacente del cerebro humano, a través de la medición de los campos magnéticos generados por las corrientes neuronales (potenciales de acción).

La evolución de las técnicas MEG desde sus primeros registros en la década de los 70s ha permitido situarla como una herramienta eficaz de investigación y diagnóstico en el estudio no invasivo de la actividad cerebral.

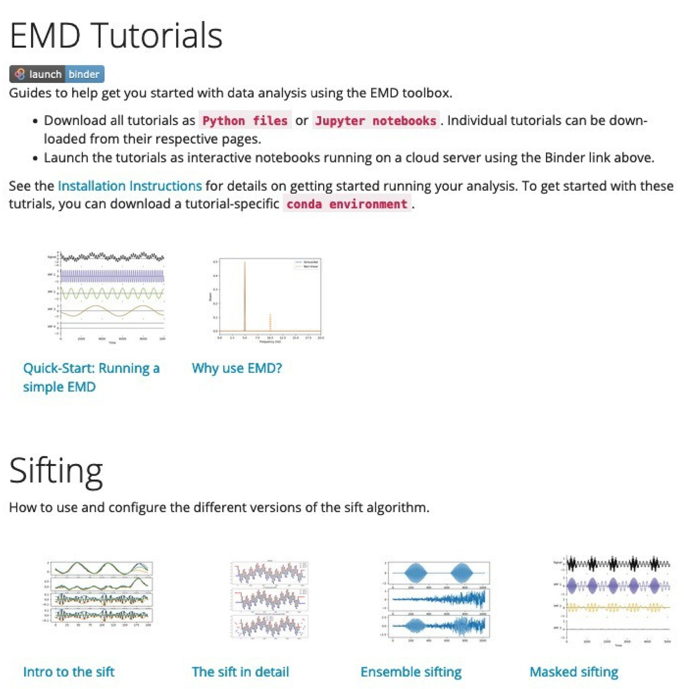
Principios y fundamentos

All analyses are carried out in the python 3.7 in usingthepythonEMD toolbox. Software installation and documentation can be found online at:

https://emd.readthedocs.io

Click on the'Binder'link to run the tutorials in an interactive web-notebook -no install required!

Campos (bio) eléctricos y magnéticos


EMD Tutorials

launch binder

Guides to help get you started with data analysis using the EMD toolbox.

- Download all tutorials as `Python files` or `Jupyter notebooks`. Individual tutorials can be downloaded from their respective pages.
- Launch the tutorials as interactive notebooks running on a cloud server using the Binder link above.

See the Installation Instructions for details on getting started running your analysis. To get started with these tutrials, you can download a tutorial-specific `conda environment`.

Quick-Start: Running a simple EMD

Why use EMD?

Sifting

How to use and configure the different versions of the sift algorithm.

Intro to the sift

The sift in detail

Ensemble sifting

Masked sifting

Campos (bio) eléctricos y magnéticos

Aplicaciones clínicas en el diagnóstico

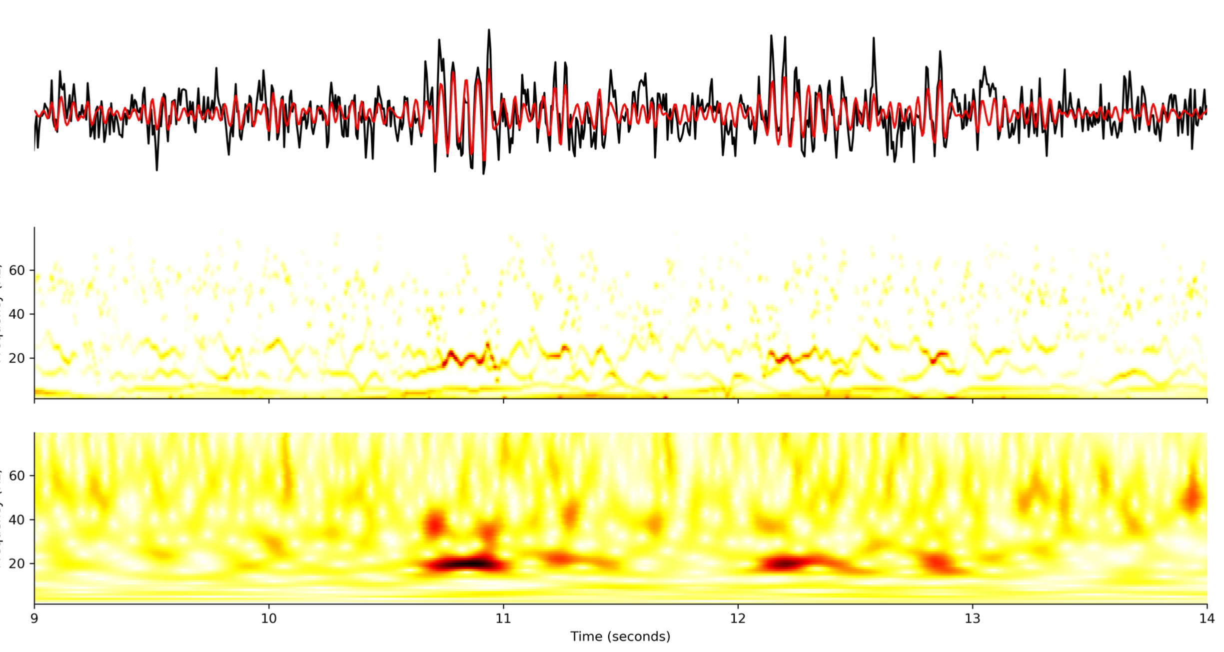
A segment of MEG data reconstructed at an occipital source can be seen below (A). The IMFs identified by mask EMD are shown (B) and red in (A) which clearly isolate a prominent alpha rhythm in IMF-3. The Hilbert-Huang transform represents the distributionofpowerintheseIMFsas a function of time and instantaneous frequency (C). This is much higher resolution than standard approaches such as MorletWavelets (D).

A

B

C

D



Memoria y Epilepsia

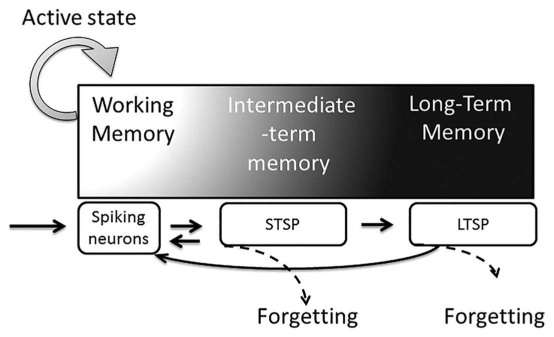
A segment of sensor space MEG data from a sensorimotor channel recorded during a finger-tapping task. The raw trace and second IMF show prominent beta oscillations (A). As with the alpha signal the Hilbert-Huang transform (B) provides a higher resolution time-frequency transform than a standard wavelet approach C)

A

Tratamiento hipotalámico
estimulación cortical LTM
(Long Term Memory)

Planificación
quirúrgica
cerebral

B



C

Enfermedades neurodegenerativas que afectan a la consciencia: Alzheimer, demencia senil, neuropatías?

Lenguaje

investigar la emergencia de habilidades cognitivas complejas, como el lenguaje, en bebés y niños pequeños . En ancianos y pacientes con traumas que afectan zonas de procesamiento del lenguaje (Wernicke y Brocka)

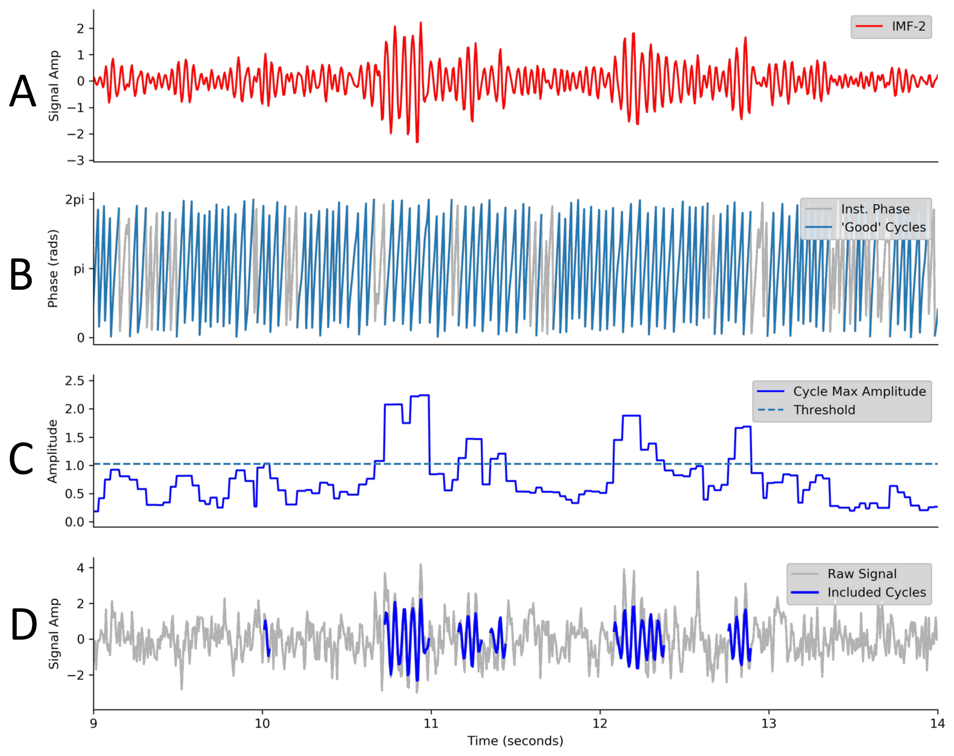
Procesamiento de la información sensorial

Activación motora

procesamiento de la información sensorial

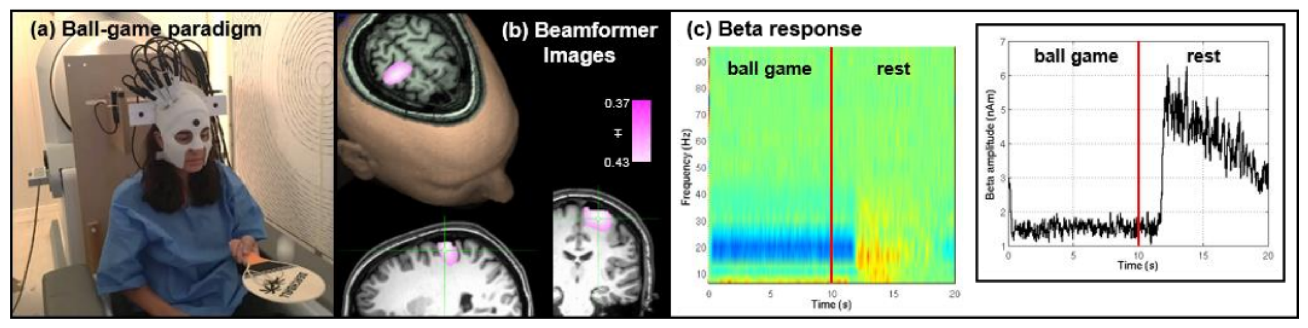
MEG vs EEG

The IMFs identified by EMD make a good basis for single cycle analyses. The beta IMF (A) is used for cycle selection here. First the Hilbert transform is used to identify the instantaneous phase (B). Cycles with incomplete or distorted phases are discarded. Secondly, the maximum instantaneous amplitude of each cycle is computed and thresholdedby a percentile to remove small cycles C). These criteria are combined to identify events in which high amplitude bursts of clear oscillatory activity occur (D)



Mayor Resolución espacial... y ¿temporal?

¡Acceso a zonas profundas, sin cirugía!

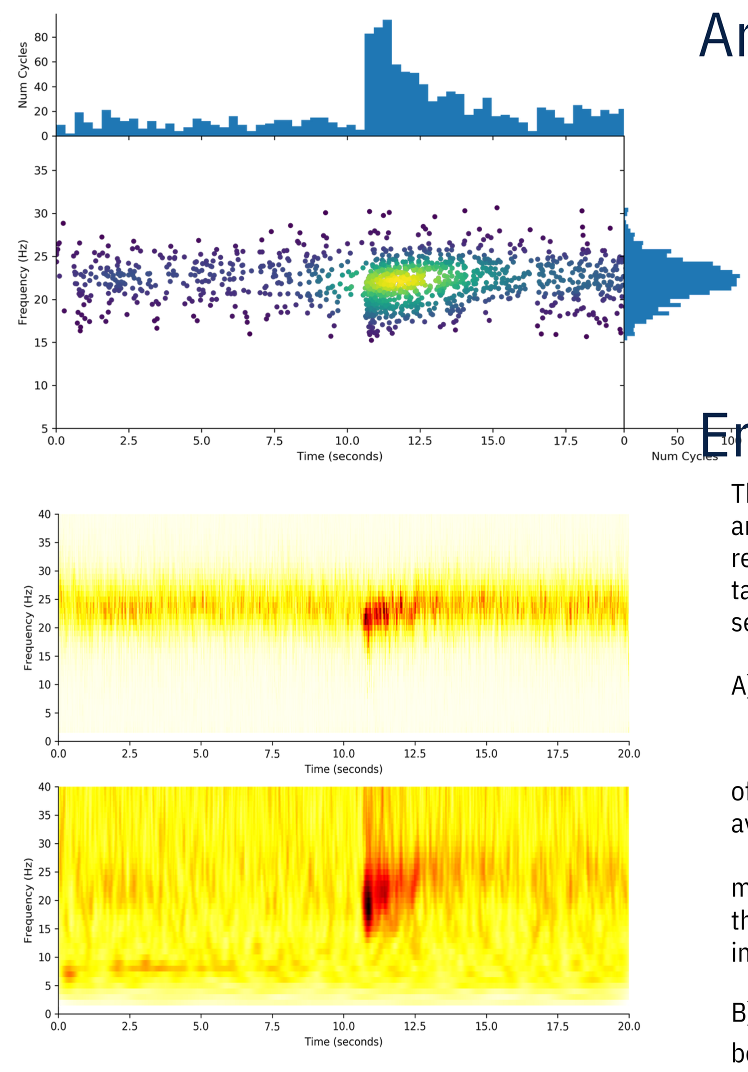


Decodificación avanzada

A

B

C



Análisis temporal mediante FFT

Fourier transform for time-series analysis
Laplace

Osciloscopios y análisis de la frecuencia para diferenciar entre alpha, beta, gamma, delta

Empirical Mode Decomposition is a data-driven algorithm which splits an oscillatory signal into as set of Intrinsic Mode Functions with minimal distortion to non-linear and non-stationary properties.

Here we apply a masked EMD analysis to MEG recordings of Occipital Alpha at rest and Sensorimotor Beta during a finger tapping task (data taken from the SAILS toolbox example data: Añadir un poco de texto)

Enfoque cualitativo de respuesta

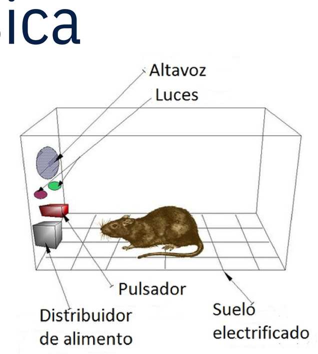
These single cycles can then form the basis for further analysis, in this case we look at a post- movement beta rebound response averaged over 30 trials. The participant taps their finger for 10 seconds before resting for 10 seconds.

A)Ascatter plot indicating the timing and frequency of each identified cycle over the 30 trials. Hotter coloursindicate a greater density of cycles. The top histogram indicates the average timingofcycles,showingaclear increase in number around 1 second after movement stops. The right histogram shows the distribution of cycles frequencies - indicating an average of around 22Hz.

B)The averaged Hilbert-Huang transform of the beta IMF across 30 trials.

C)The averagedwavelettransformacrossthe30 trials.

input and output O: sin que el sujeto pueda evitarlo diferencia con EEG. Requiere colocación física



Caja de Skinner

Condicionamiento operante con MEG? Sustituir suelo electrificado por MEG de alta impedancia

Conclusiones

Referencias

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Estado del arte y últimos avances

A segment of sensor space MEG data from a sensorimotor channel recorded during a finger-tapping task. The raw trace and second IMF show prominent beta oscillations (A). As with the alpha signal the Hilbert-Huang transform (B) provides a higher resolution time-frequency transform than a standard wavelet approach C)

A

B

C

neurociencia en biología del desarrollo: organización cortical de la visión temprana en humanos [1], y para investigar la representación neuronal de la voz en el cerebro [2]