Structural and Functional Correlates of Oscillatory Dynamics in Sensorimotor System

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Introduction

Neural oscillations are fundamental to brain function, coordinating communication across neuronal populations. Among these, **beta-band oscillations** (12–30 Hz) play a crucial role in motor control and executive processes. Traditionally spectral analysis methods, such as Fourier transform, assume oscillatory activity is continuous and stationary. However, emerging evidence suggests that beta activity occurs in **transient bursts rather than as a continuous rhythm** [1].

Beta bursts are short-lived, high-amplitude events that dynamically regulate executive and motor functions. Previous studies focus mainly on burst features such as amplitude, duration, rate, central frequency and frequency span [2]. There is few studies about the **shape of beta bursts** [3,4]. The shape of bursts have a huge variability, potentially encoding distinct functional roles. However, the specific mechanisms underlying these waveform variations remain poorly understood.

We will investigate the **functional roles of beta bursts,** their relationship with **cortical myelination**. By integrating magnetoencephalography (MEG) and structural magnetic resonance imaging (MRI), we aim to uncover the structural and functional correlates of beta burst dynamics in the sensorimotor system.

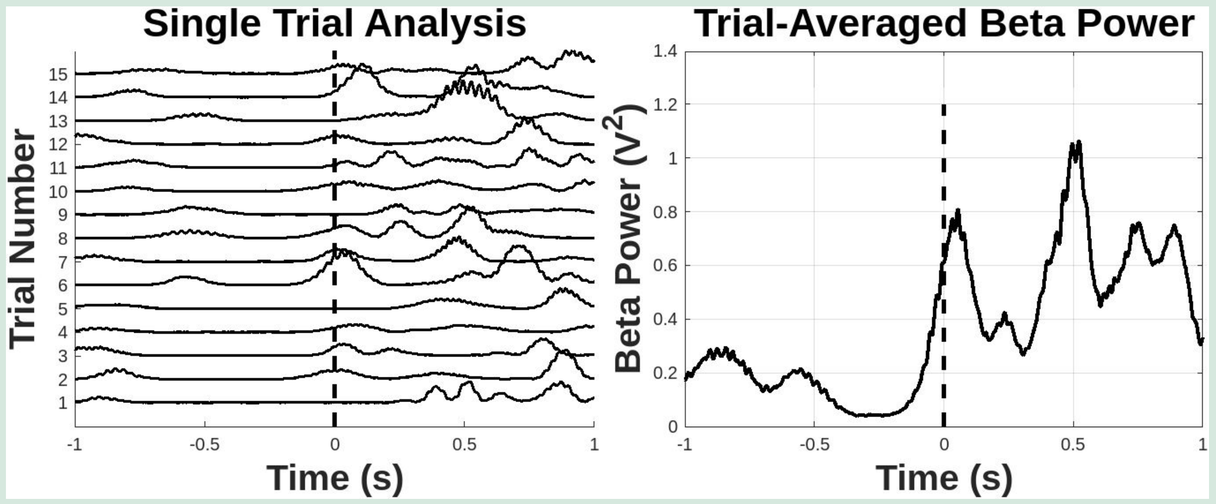
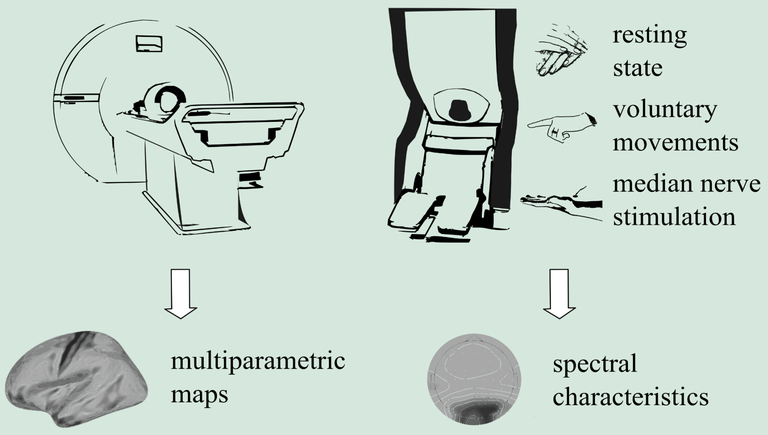
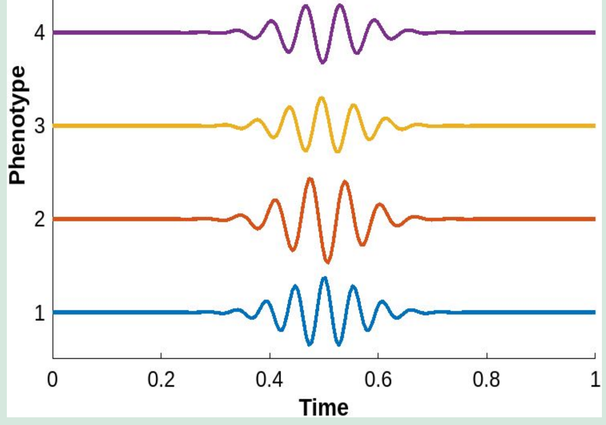
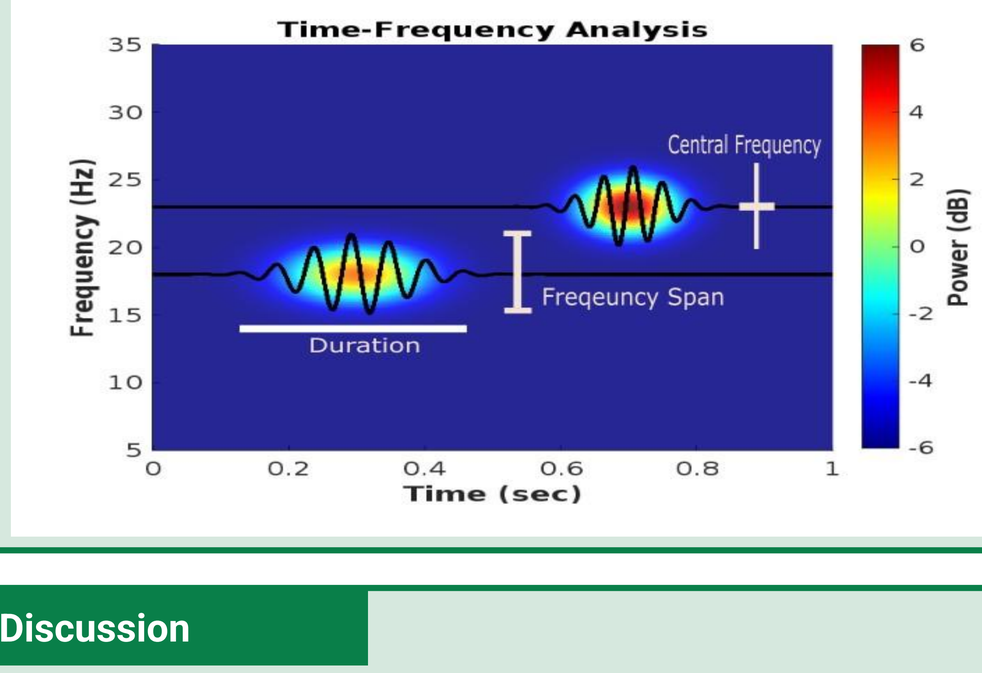


Fig 1. Schematic explanation of transient nature of beta activity from simulated data

Methods







Research Questions

Project 1

- **How beta oscillatory power is modulated by beta bursts?**
- **Are there different types of beta bursts that have distinct functional roles?**
- **What are the characteristics of beta bursts in sensorimotor regions in different tasks?**

Project 2

- **Does myelin content correlate with beta burst features in sensorimotor areas?**
- **Does myelin content in deeper and superficial layers contribute to beta burst shapes?**

Discussion

- We will explore the **transient nature of beta bursts** and their **functional significance** in the sensorimotor region.
- By analyzing **burst waveform variability** and other features, we aim to identify **distinct functional roles** that traditional analyses may have overlooked.
- We will investigate the **relationship between cortical myelination and beta burst dynamics** to understand how structural properties influence oscillatory activity.
- These insights could help determine how beta burst features change in Parkinson's disease (PD) and assess their potential as biomarkers for PD.

References

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