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What is the exact relationship between beta band activity and hand motor imagery?

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Motivation

Brain-Computer Interface features typically rely on band power modulations in the mu and beta frequency bands.

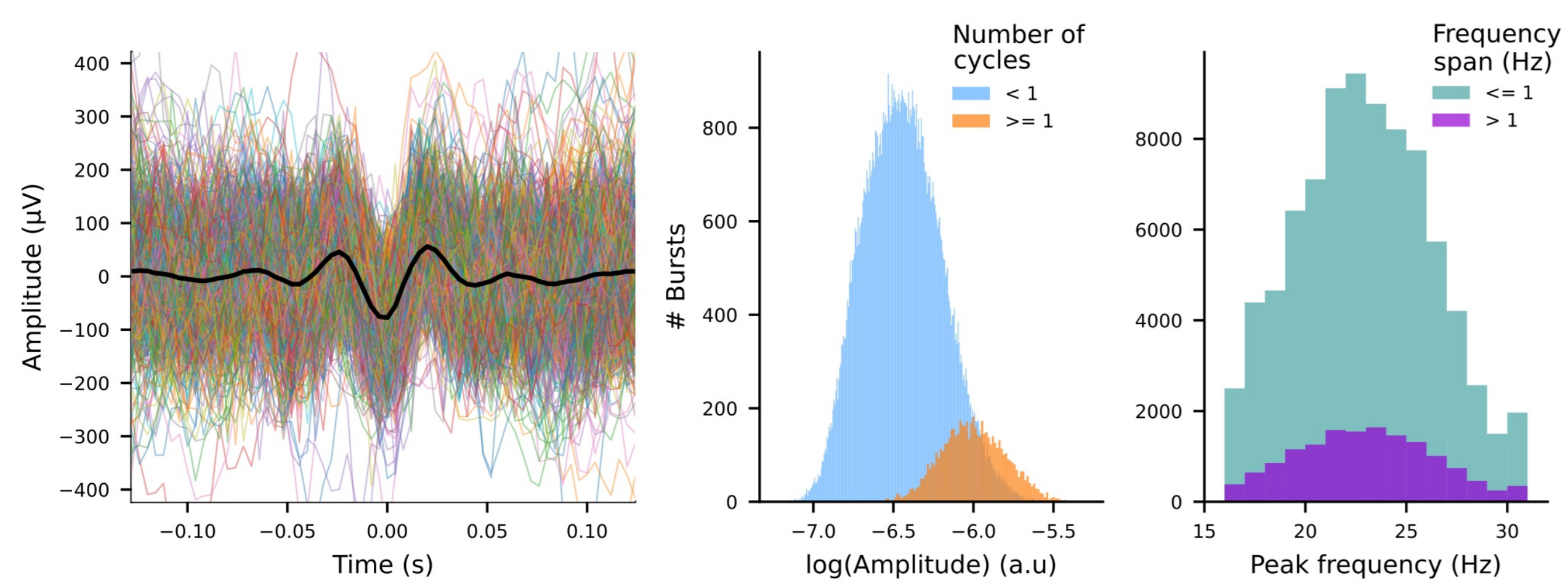
However, beta band activity has been shown to occur as **bursts** rather than sustained oscillations.

Therefore, alternative representations of beta band activity could improve decoding results.

Pre-processing

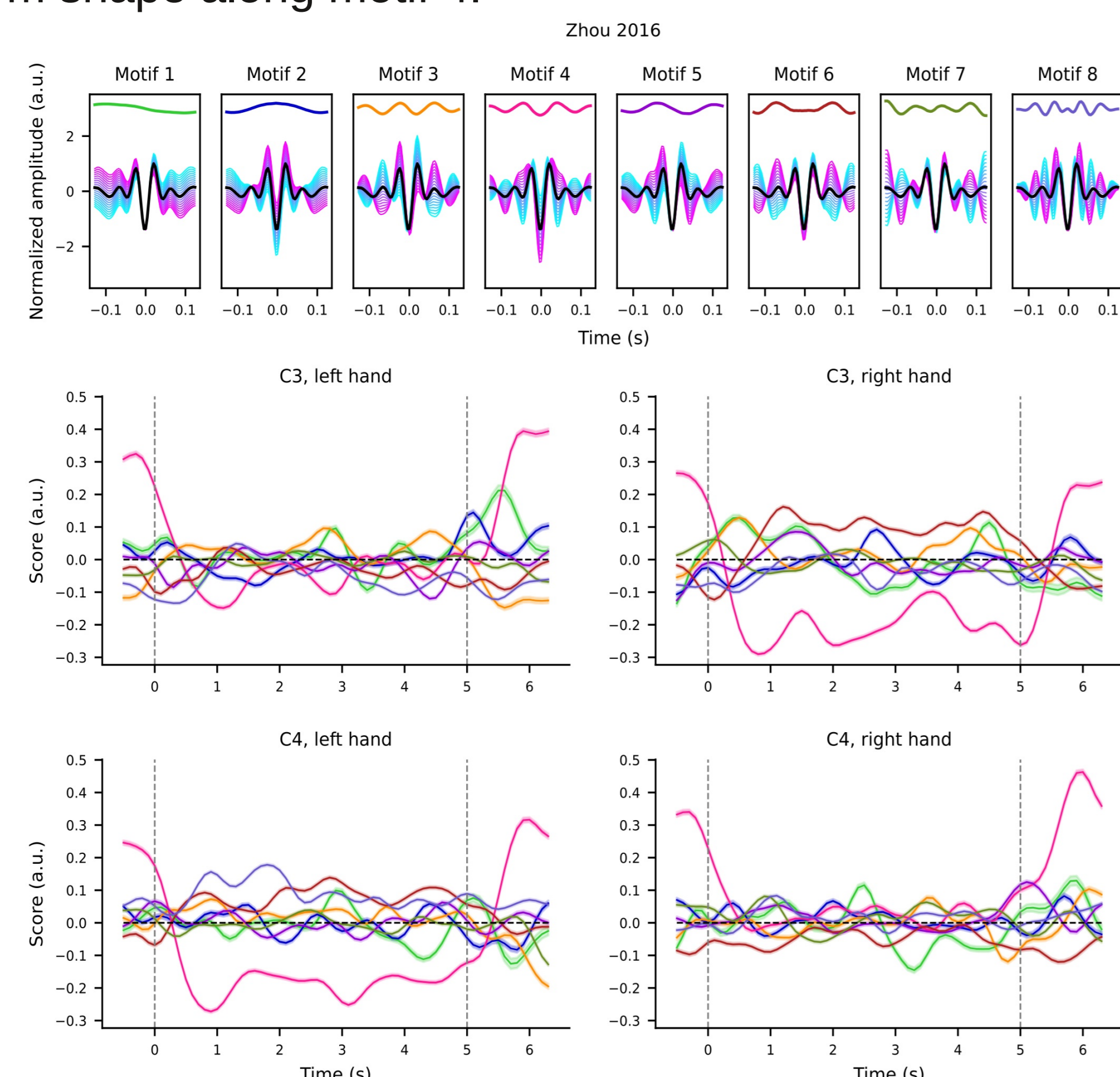
Beta burst detection and alignment in a **burst dictionary**.

Variability in beta bursts raw signal is reflected in the **waveform shape**.



The waveform shape can be analyzed into distinct **motifs** using PCA.

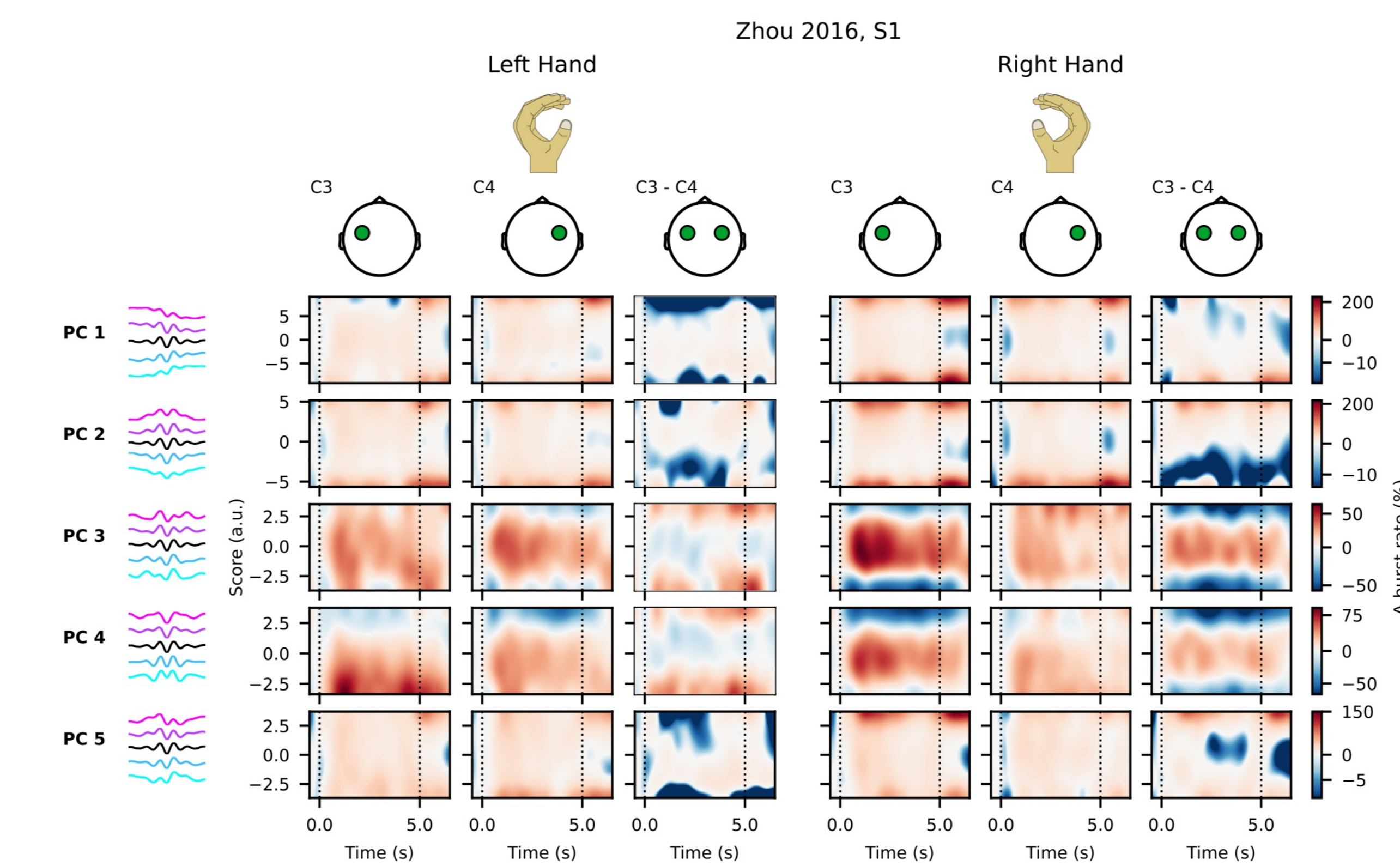
Each motif is modulated differently depending on the recording channel and task condition, e.g. **pronounced contralateral modulation** of waveform shape along motif 4.



Feature extraction based on rate modulations of bursts with different waveforms

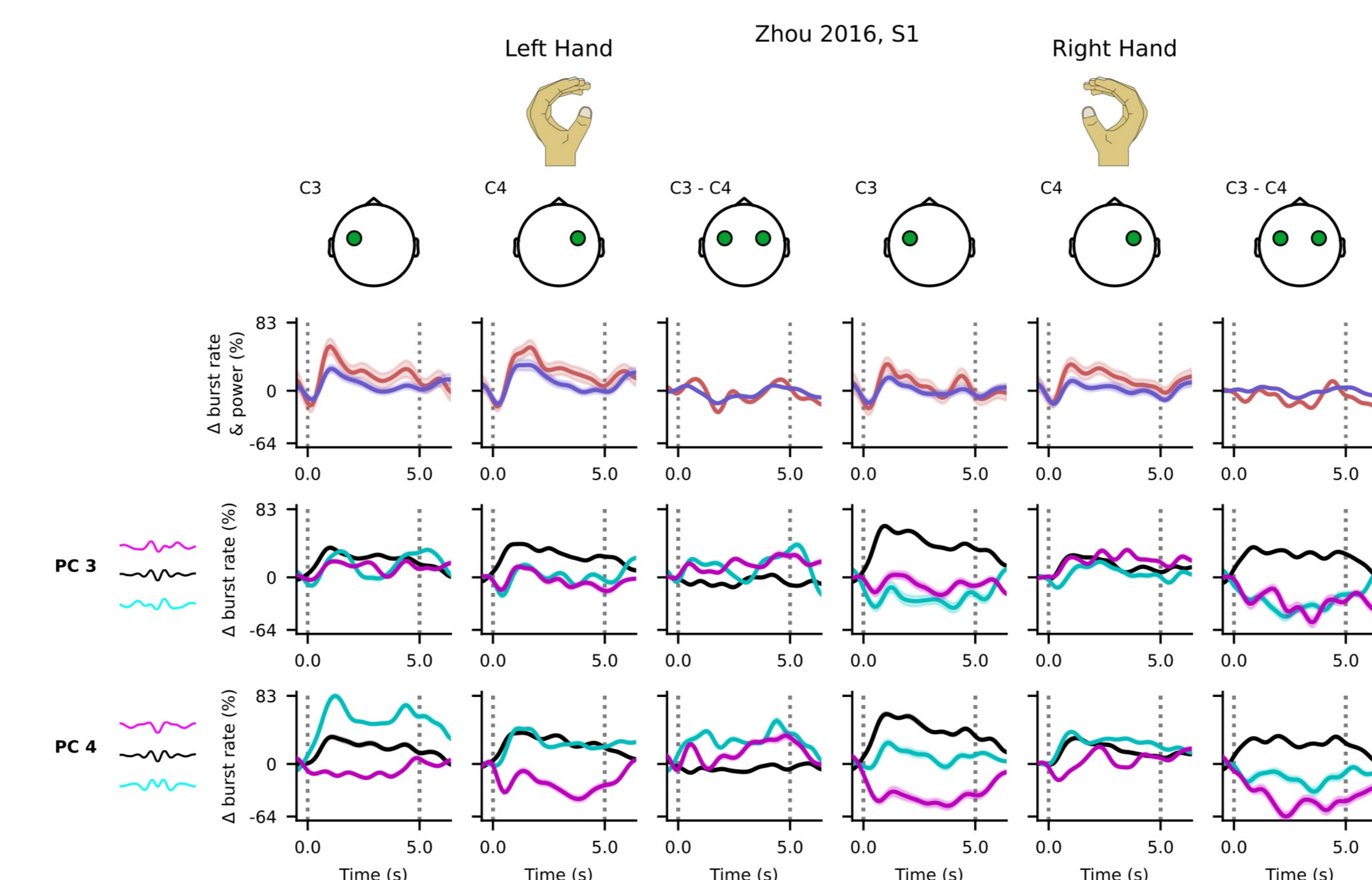
Burst rate modulation varies across each motif, depending on the exact waveform, recording channel and task condition.

This view reveals more detailed task-related burst rate changes across different motifs.



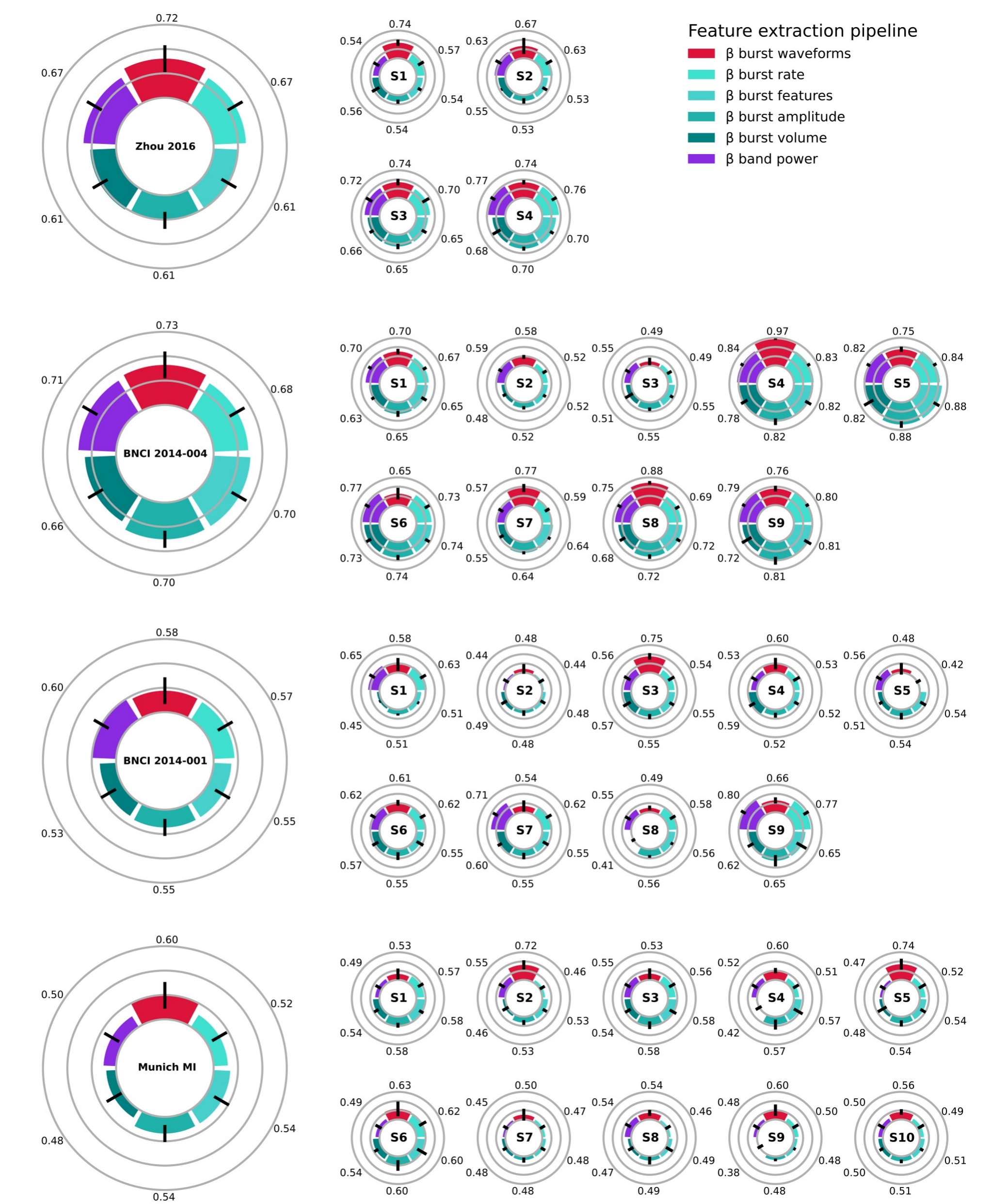
Power modulation closely matches overall burst rate modulation.

Along specific motifs, the differential rate modulation of bursts with distinct waveforms can serve as **informative feature** for classification.



Results

The waveform-based burst rate representation of beta activity yields the **best decoding results** in a binary classification task.



Future directions

Incorporation of multiple recording channels.

Identification of optimal waveforms' subspace for class separation.

Inclusion of mu frequency band bursts.

References

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Acknowledgments

