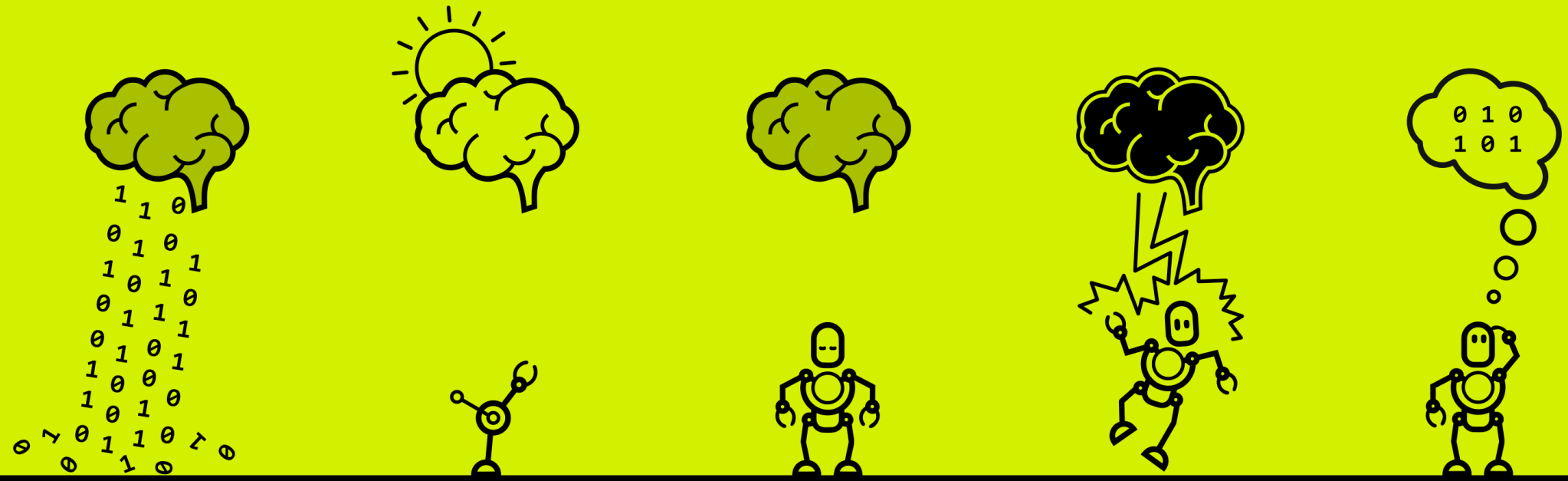

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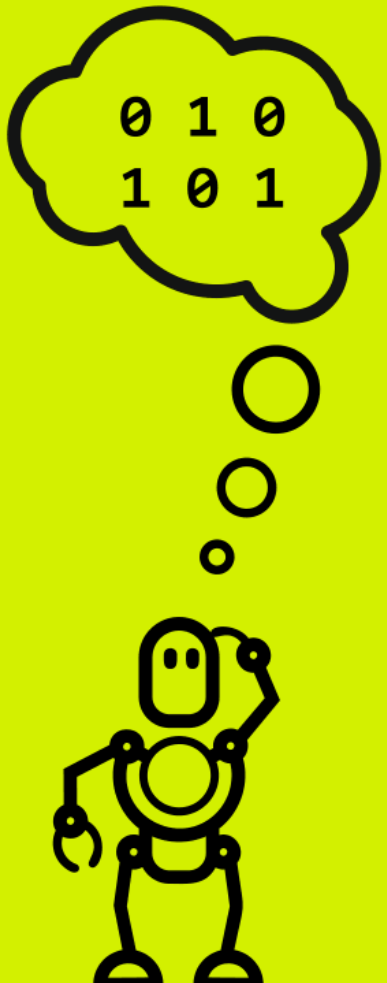

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Unlocking High-Accuracy Motor Imagery Decoding in Stroke EEG

Umair Arshad

The Challenge: Decoding Brain Signals for Stroke Rehab

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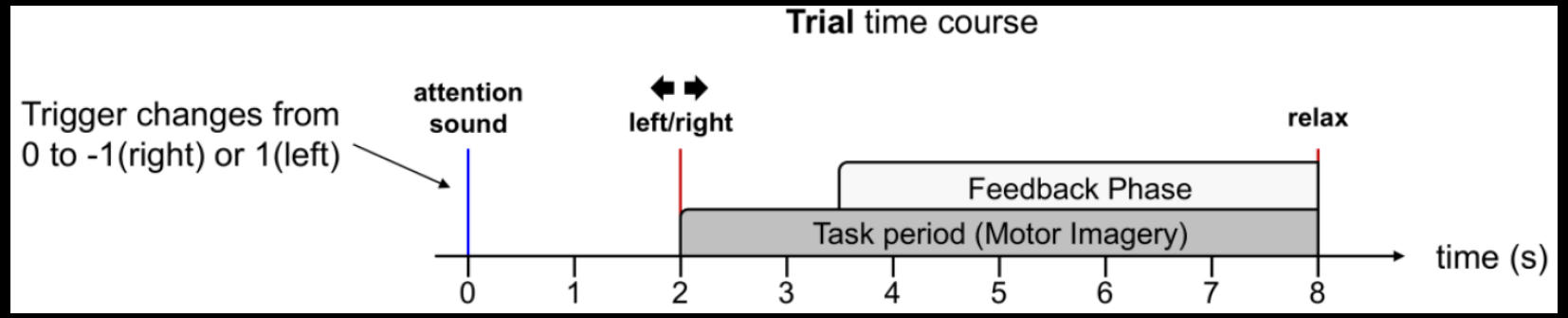
- Stroke often impairs movement; BCI-FES therapy aims to help by linking brain signals (Motor Imagery - MI) to feedback.
- Problem: Decoding MI from noisy EEG in stroke patients is difficult. How can we find the best method & see if therapy improves the brain signal itself?
- Data: Analysed EEG from 3 stroke patients (Pre & Post 25 BCI-FES sessions) performing Left/Right hand MI.



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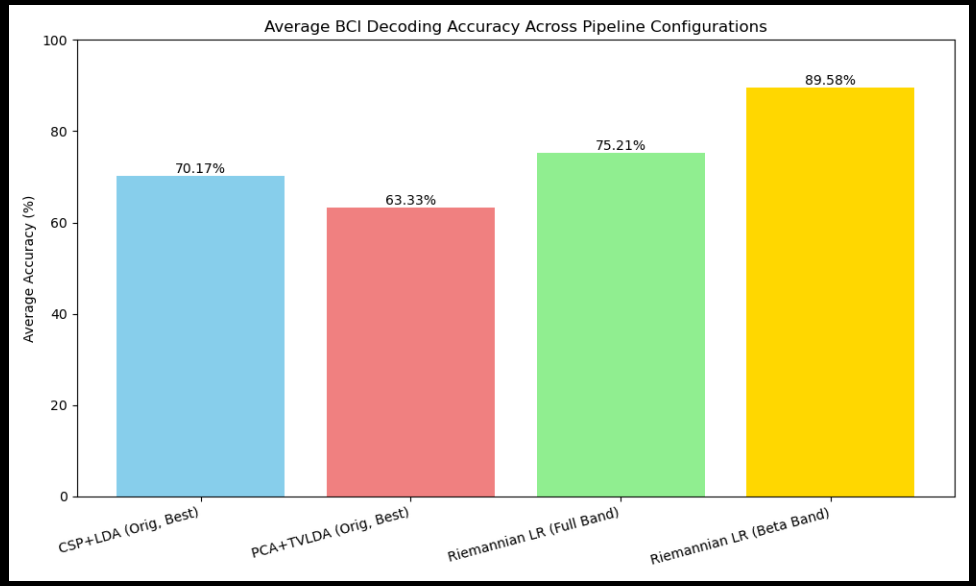
Advanced Algorithms & Targeted Analysis

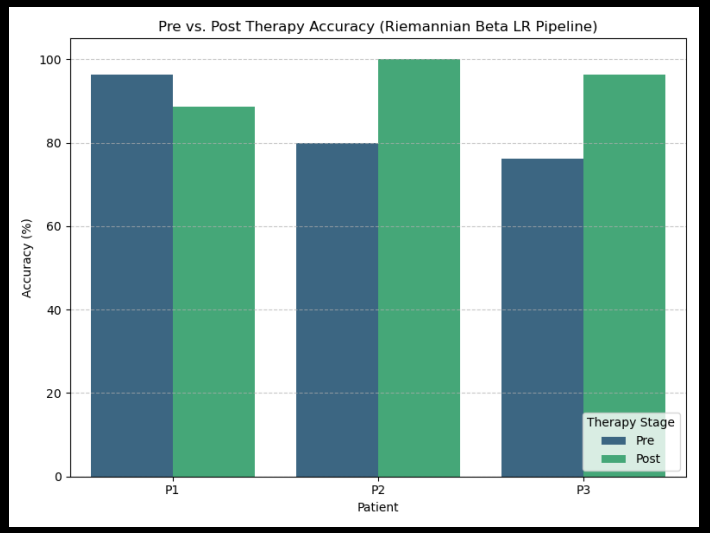
- Systematically compare BCI decoding pipelines (standard vs. state-of-the-art) to find the optimal approach for this data.
- Focused on advanced Riemannian Geometry methods, which use signal covariance, and optimized analysis by isolating the critical Beta frequency band (13-30Hz).
- Assessed accuracy for each patient before and after therapy using the best identified pipeline.

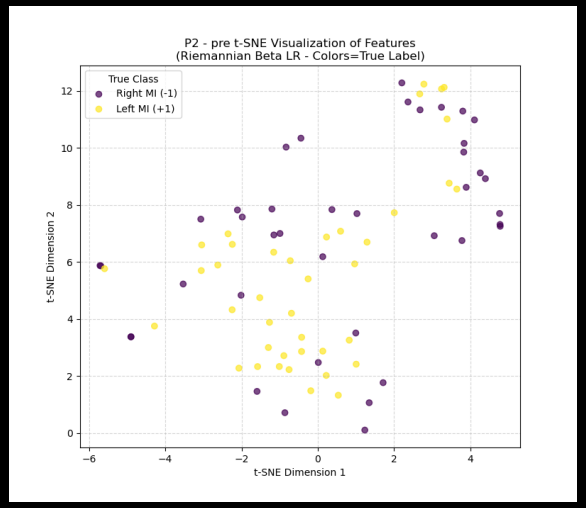
Building the Best Pipeline

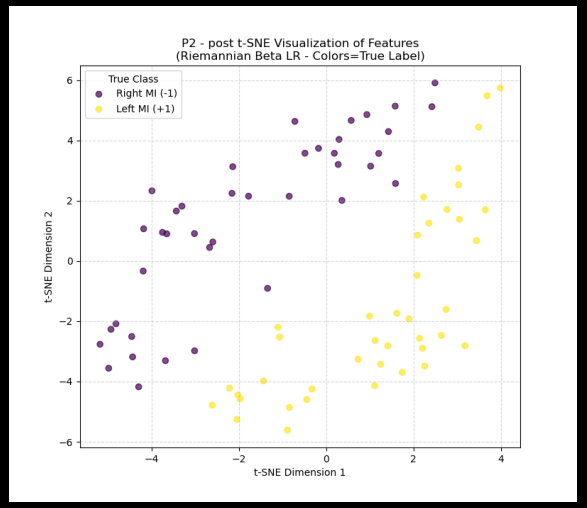
- Loaded EEG -> Filtered to Beta Band (13-30Hz) -> Calculated Covariance Matrices per trial -> Projected to Tangent Space -> Classified with Logistic Regression.
- Tested against standard CSP+LDA and other variations (like TVLDA, whitening - which proved less effective here).
- Used classification accuracy (Left vs Right MI) on unseen test data.

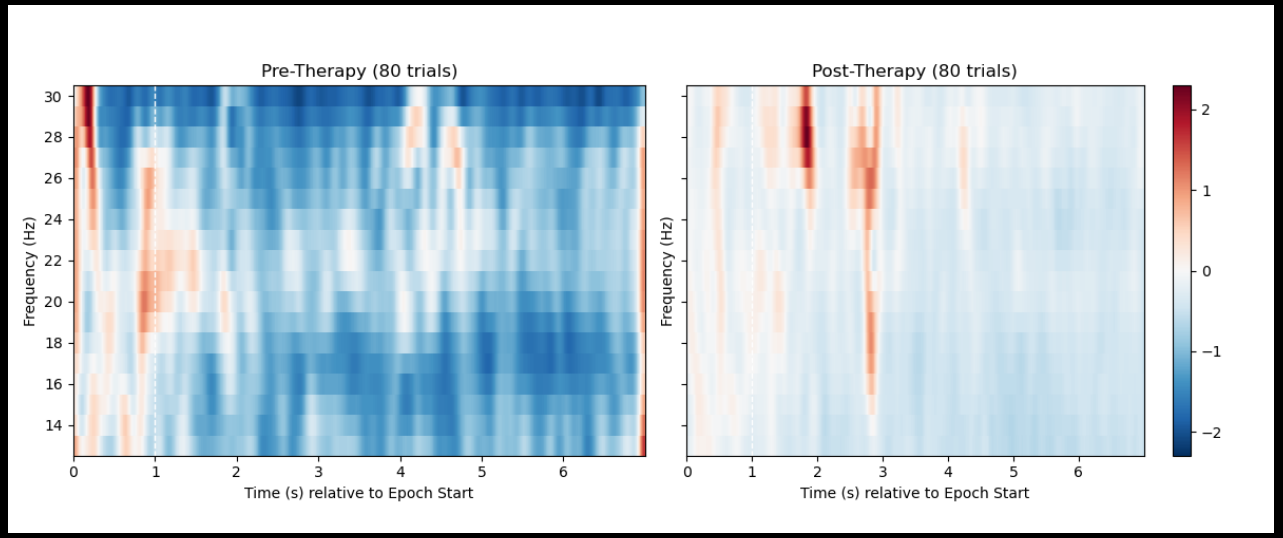


High Accuracy Achieved & Therapy Impact Revealed









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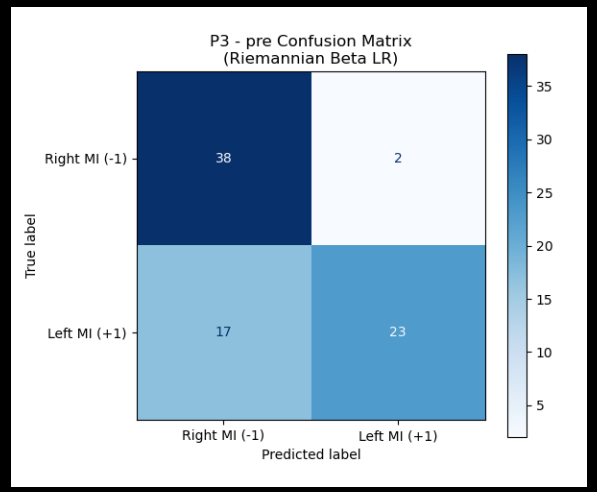
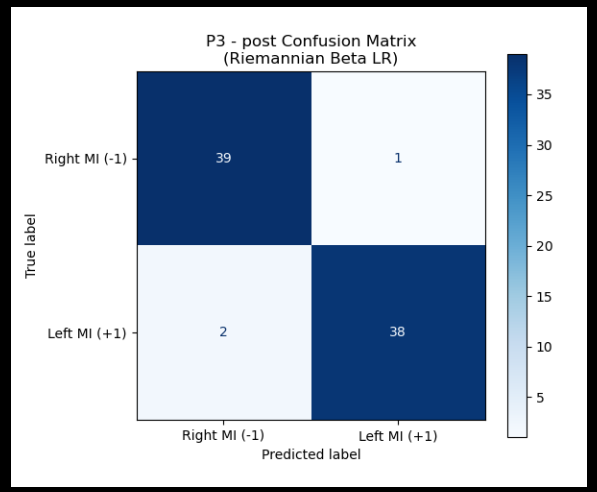
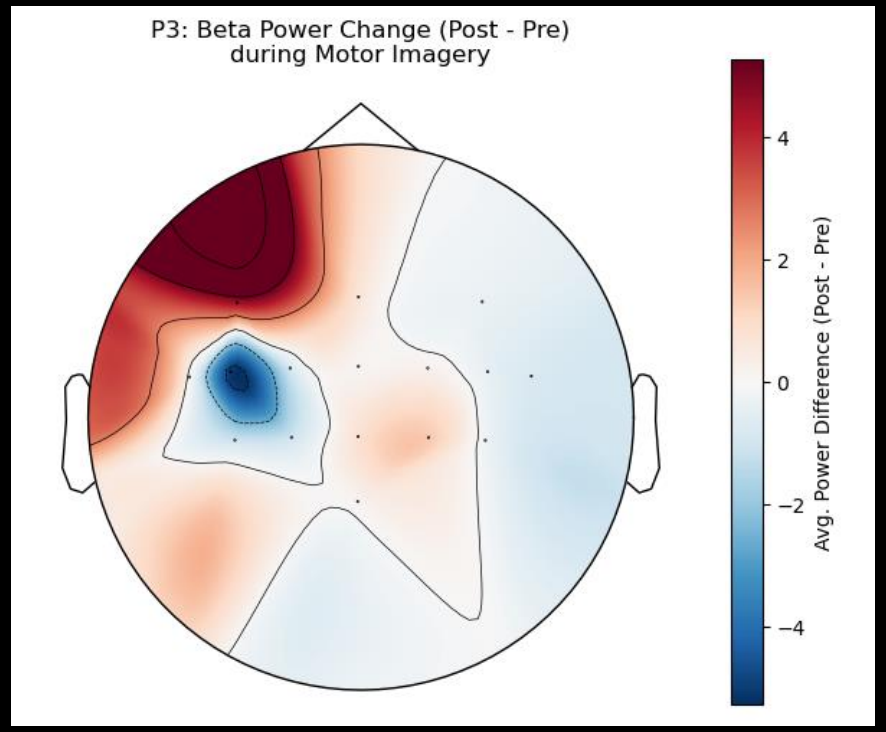
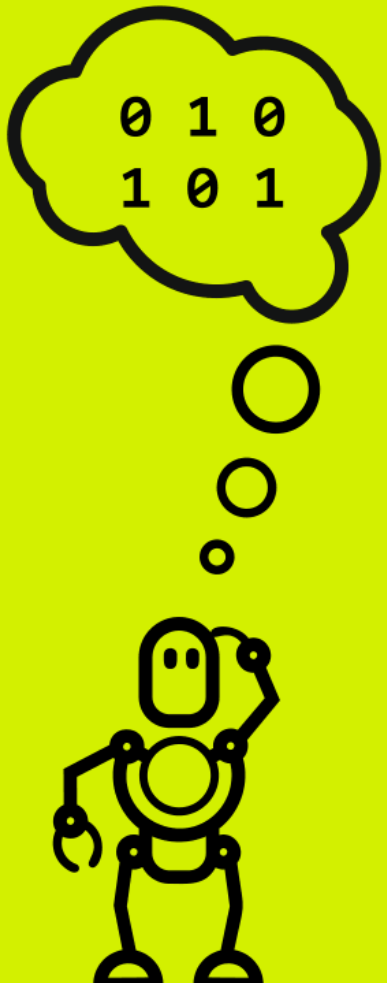






Key Findings & Future Steps

- Riemannian Geometry on Beta band is highly effective for stroke MI EEG.
- BCI-FES therapy *can* measurably enhance MI signals, supporting its potential.
- Future: Validate on more patients, explore real-time application.



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