

Ensemble learning based on functional connectivity and Riemannian geometry for workload estimation

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BACKGROUND:

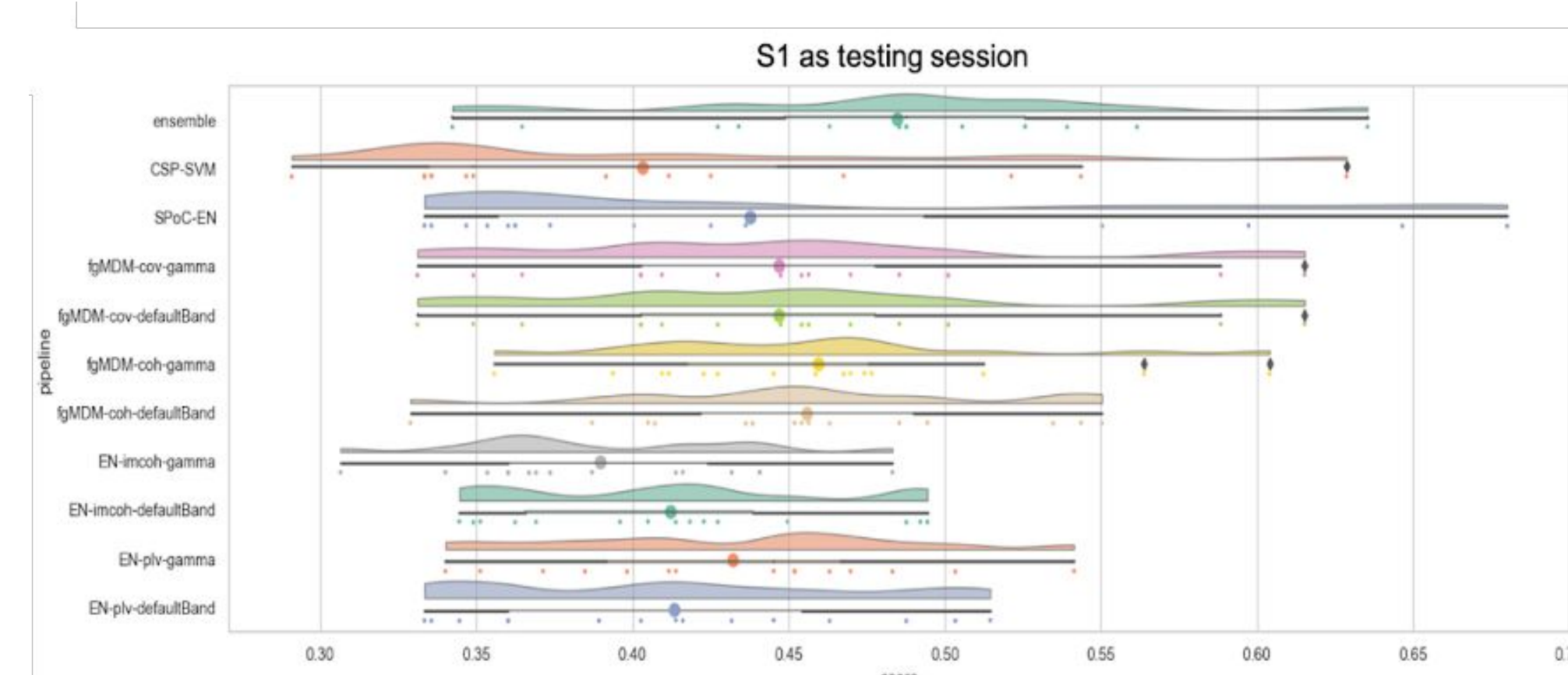
- Passive BCI (pBCI) presents important intra- and inter-subject variabilities.
- Riemannian geometry (RG) has raised a growing interest in BCI, essentially applied on spatial covariances matrices
- Matrices based on functional connectivity (FC) could enhance workload estimation

METHODS

pBCI hackathon dataset - 15 subjects, 3 sessions (2 as training sets), 3 difficulty levels to be discriminated.

RG+FC & Ensemble learning - ridge classification on the best classifiers: Common Spatial Patterns + Support Vector Machine (CSP+SVM), Source Power Comodulation + ElasticNet (SPoC+EN), geodesic filtering MDM (fgMDM) on covariance (Cov) for α - β band, fgMDM on Cov for low- γ band, fgMDM on Coherence (Coh) for α - β band, fgMDM on Coh for low- γ band, ElasticNet in tangent space (EN) for the imaginary coherence (ImCoh), in α - β band, EN for ImCoh in low- γ band, EN for the phase-locking value (PLV) in α - β band and EN for PLV.

RESULTS

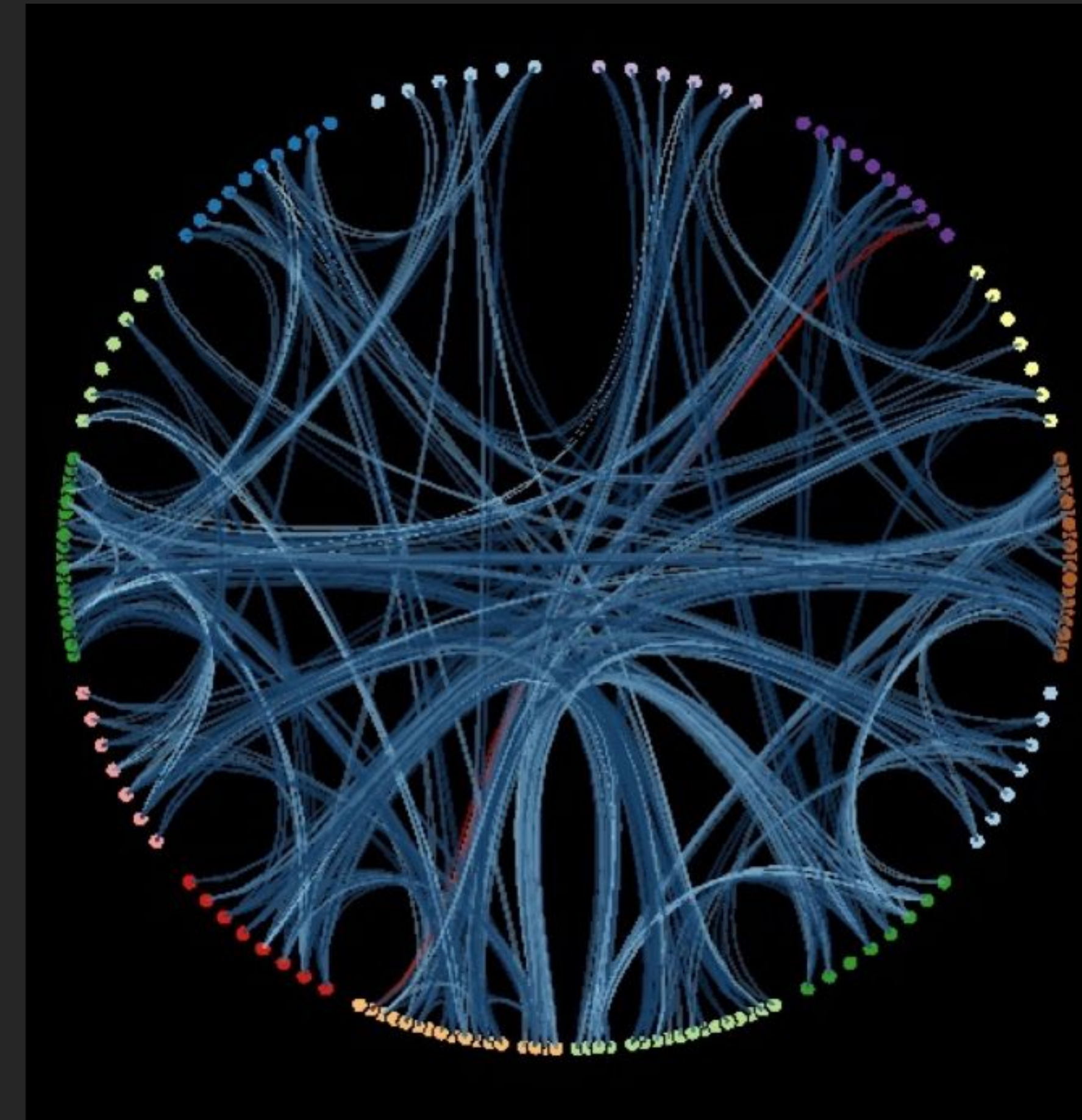


Group-level results associated with all the tested classifier.

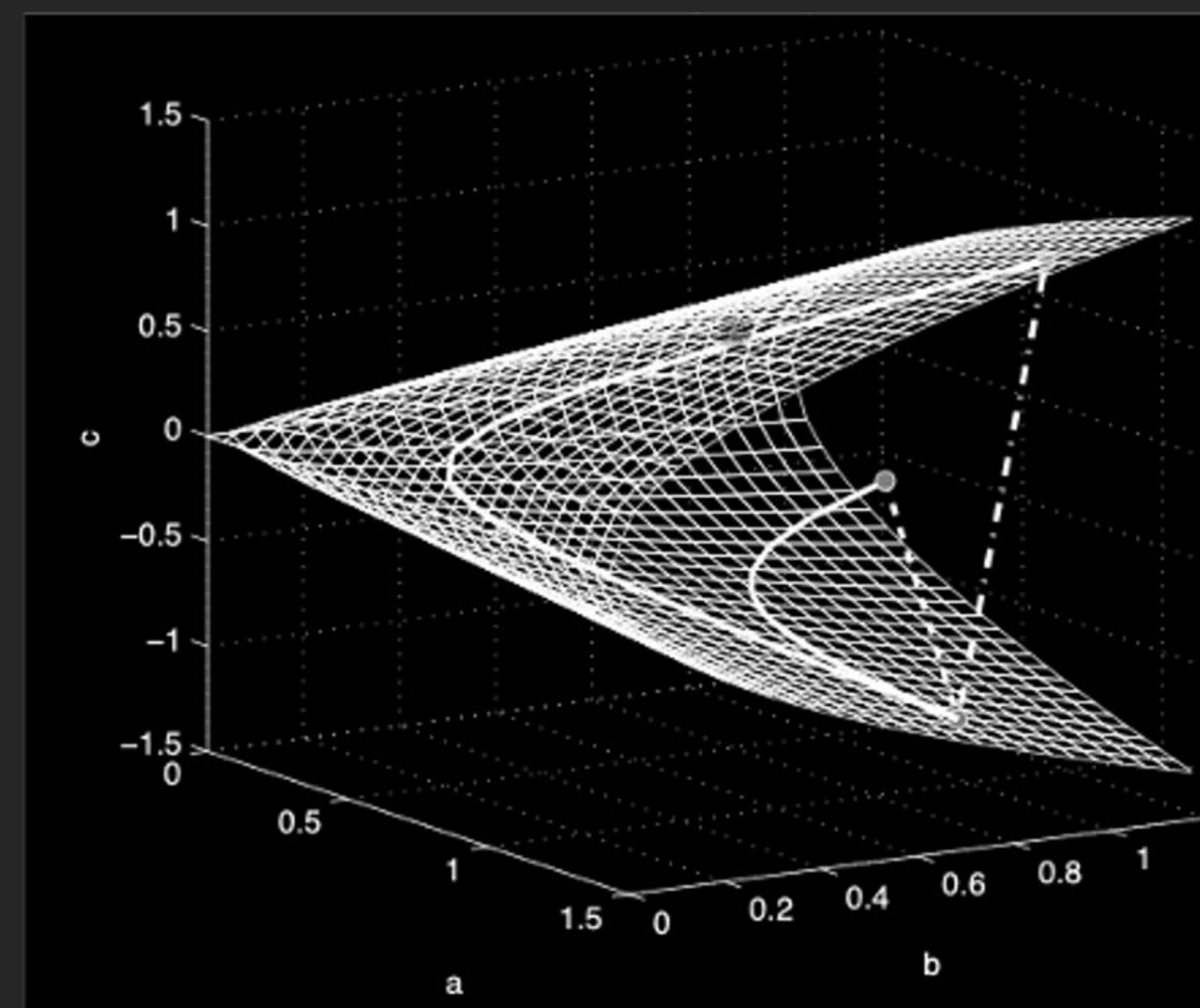
LIMITATIONS

Contrarily to other BCI paradigms, the best features to discriminate workload states remain unknown. A further work will consist in implementing methods to select the most reliable subset of features based on neurophysiological criteria.

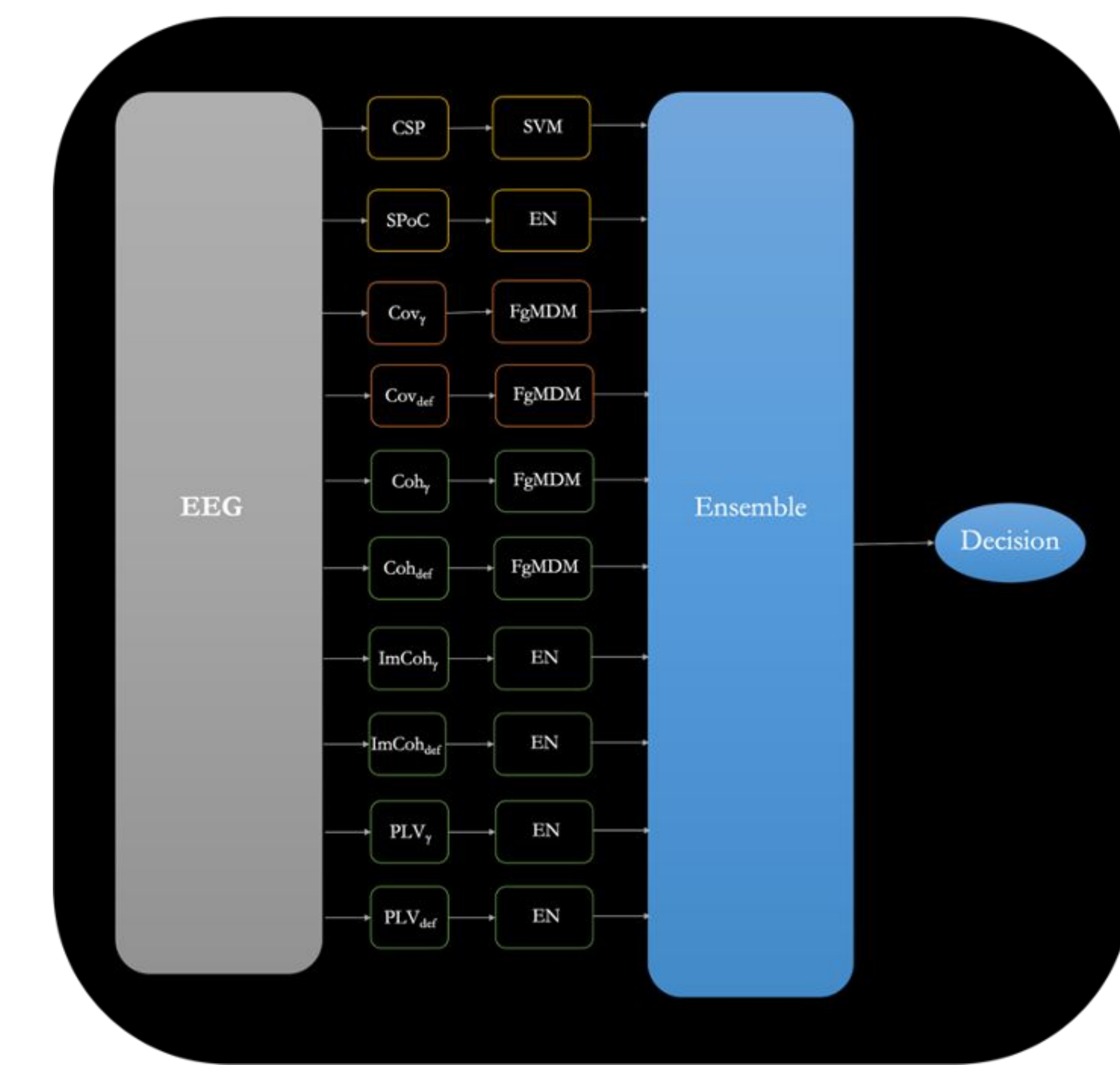
Combining functional connectivity



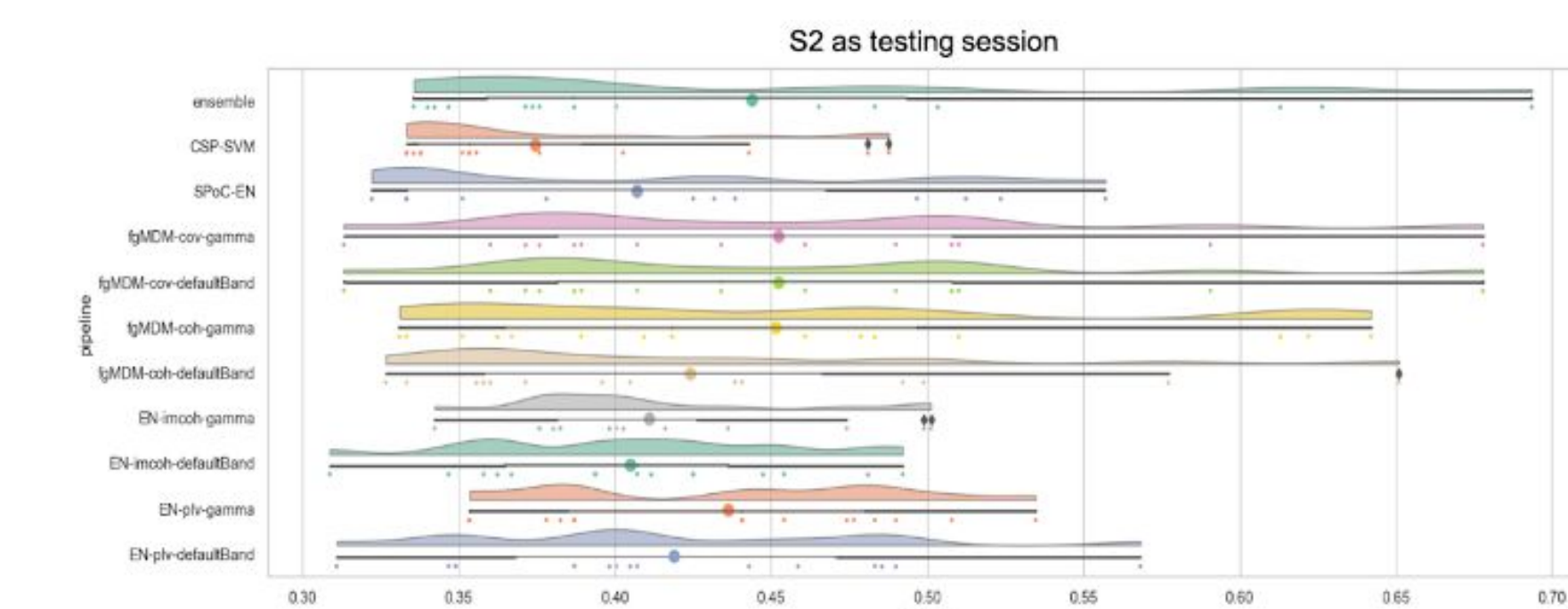
and Riemannian geometry yields



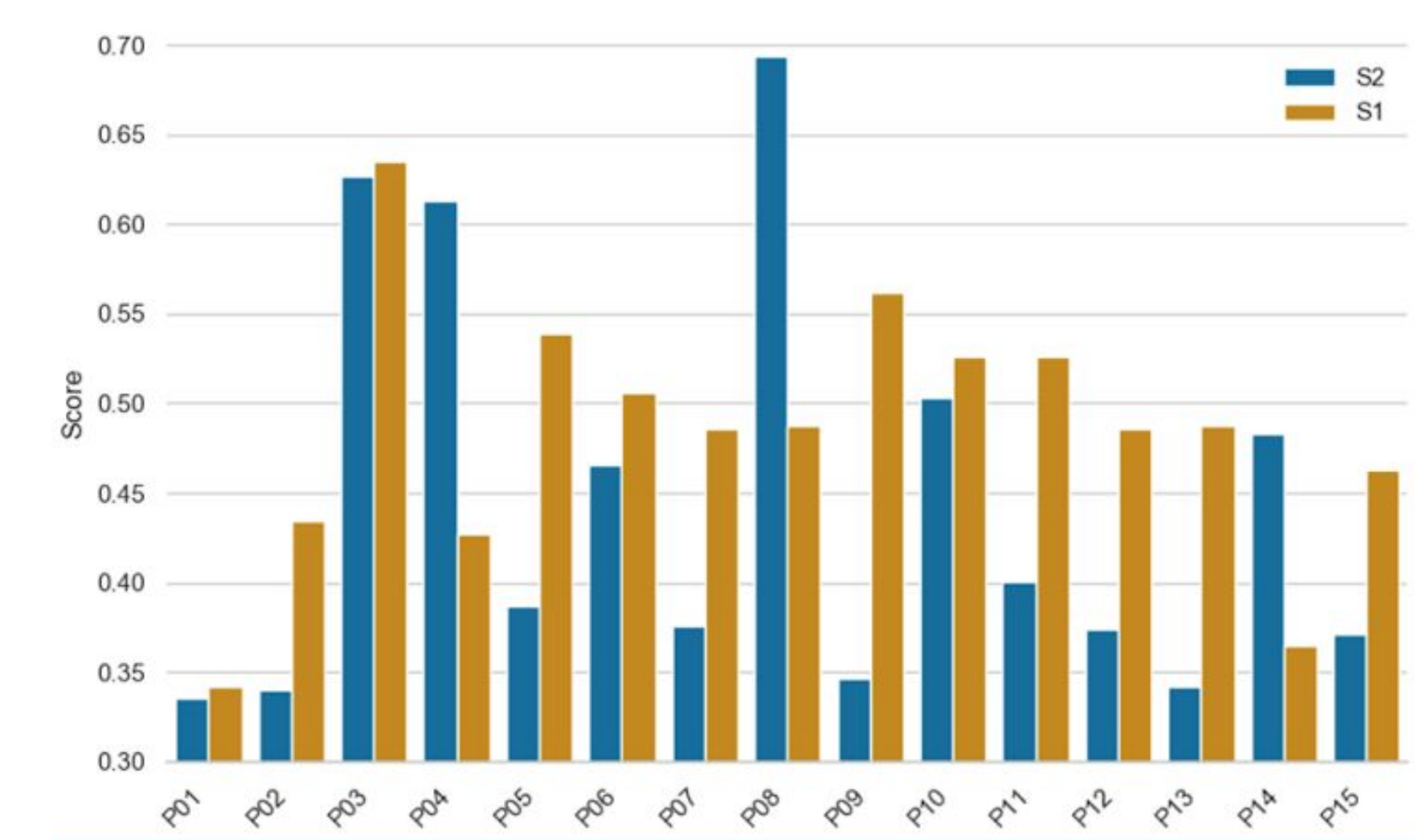
more robust workload estimation



Proposed architecture for ensemble learning.



Group-level results associated with S1 as training set.



Individual-level results from the ensemble classifier.

[passive-bcchy-hackathon](https://github.com/passive-bcchy-hackathon)

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