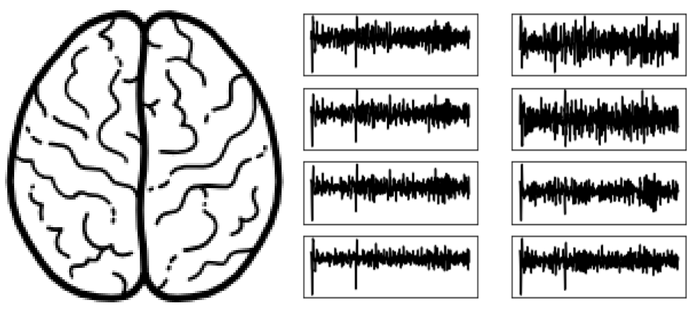
EEG-BASED VIDEO IDENTIFICATION USING GRAPH SIGNAL MODELING AND GRAPH CONVOLUTIONAL NEURAL NETWORK

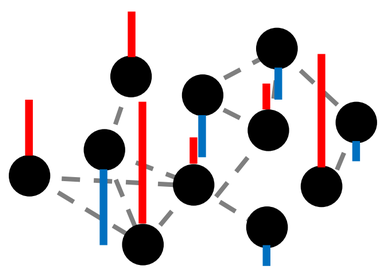
Introduction

EEG signals



Low spatial resolution

Difficult to obtain rich graph signal representation



- **Expanding graph to overcome low spatial resolution of EEG**
- **Application of graph signal modeling and graph convolutional neural network for EEG signals**

Graph Signal Modeling

Bands

δ $\quad$ β_{low}

θ $\quad$ β_{mid}

α_{low} $\quad$ β_{high}

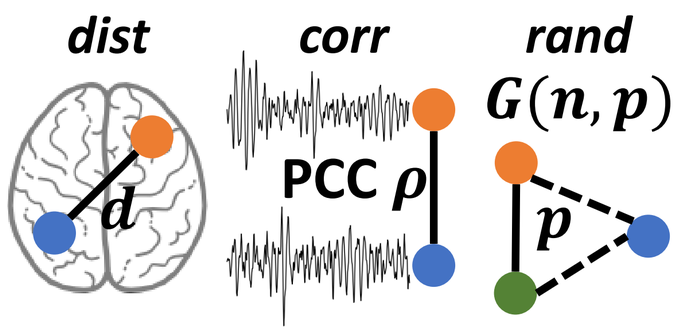
α_{high} $\quad$ γ

Signal

Power

Entropy

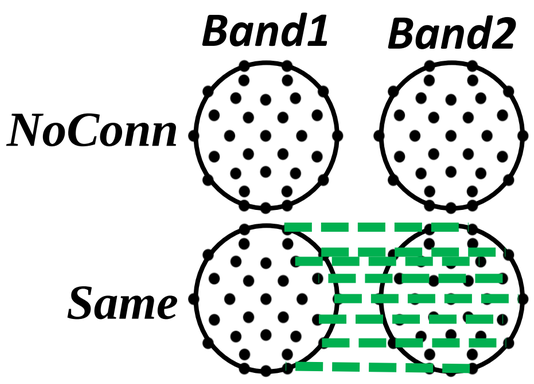
Intra-band



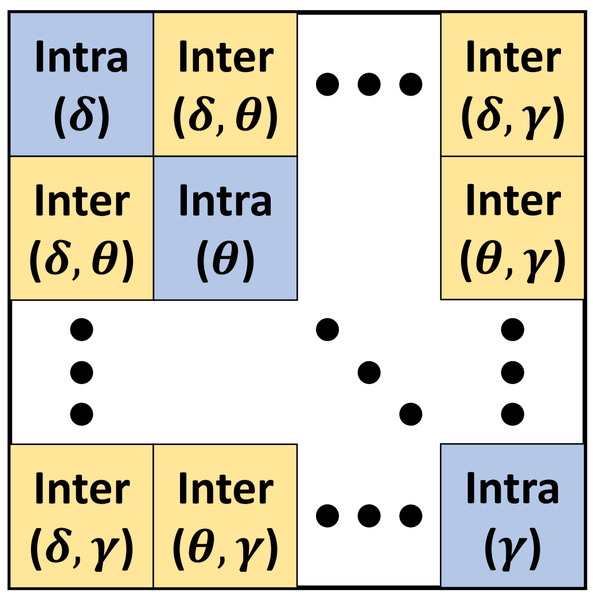
Sparsity control

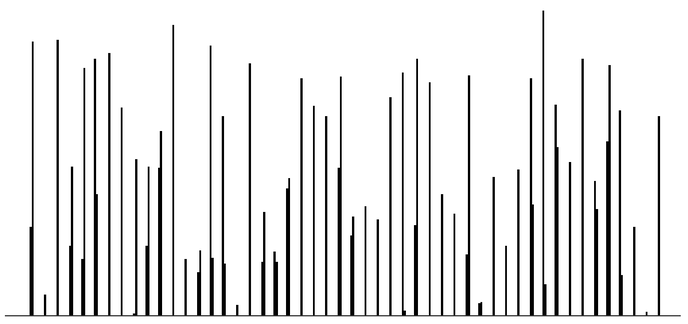
- ***dist*, *corr*: top-k** $(k = 4,8,12)$
- ***rand*: edge prob.** $(p = 0.3,0.5,0.7)$

Inter-band



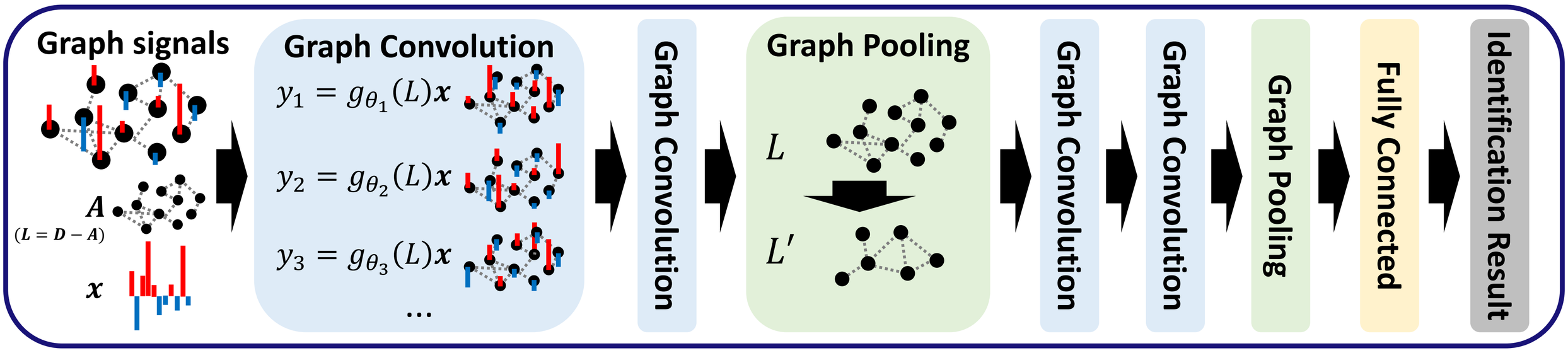
Merged graph & signal





$$x = [x_0^\delta \dots x_{31}^\delta x_0^\theta \dots x_{31}^\gamma]$$

Graph Convolutional Neural Network[1]



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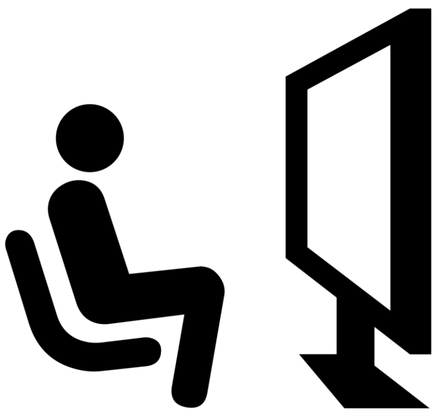
Experiments & Results

Experiment

DEAP dataset[2]



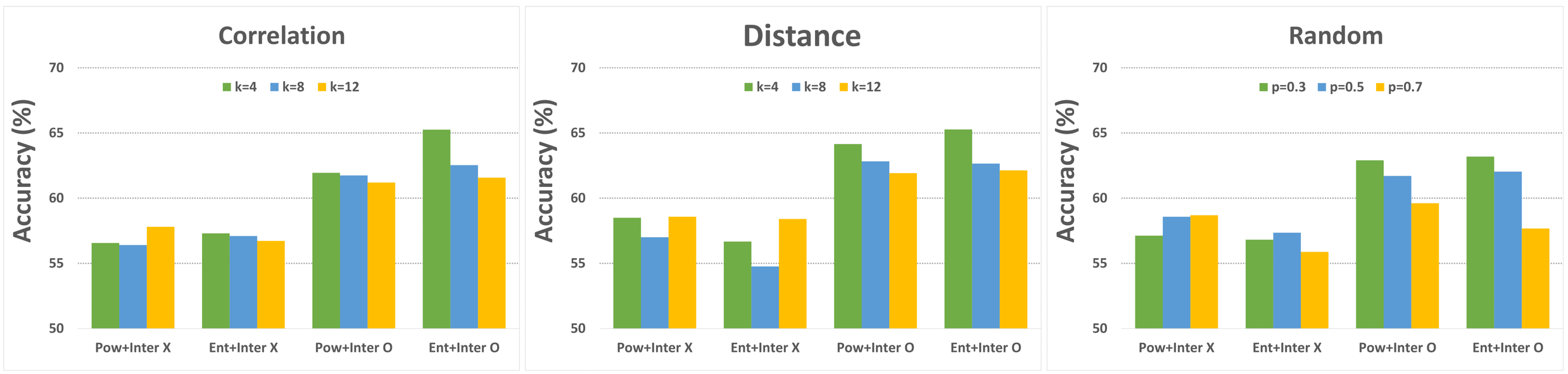
- 32 subjects
- 40 music videos

- 32 EEG channels
- 60 sec. EEG + 3 sec. baseline
- 128Hz sampling

- 3 sec. window + 2 sec. overlap
- 74,240 samples
  - 80% training
  - 20% test

Video identification task

Results



- Graph expansion with inter-band connection helps extracting useful representations between multiple bands.
- Elaborating intra-band graph structure leads to slight advantage in performance.
- Excessive complexity of the graph is not beneficial.

References

[1] M. Defferrard, X. Bresson, and P. Vandergheynst, “Convolutional neural networks on graphs with fast localized spectral filtering,” in Advances in Neural Information Processing Systems, 2016, pp. 3844–3852.

[2] S. Koelstra, C. M¨uhl, M. Soleymani, J.-S. Lee, A. Yazdani, T. Ebrahimi, T. Pun, A. Nijholt, and I. Patras, “DEAP: A database for emotion analysis; using physiological signals,” IEEE Transactions on Affective Computing, vol. 3, no. 1, pp. 18–31, 2012.

Acknowledgement

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