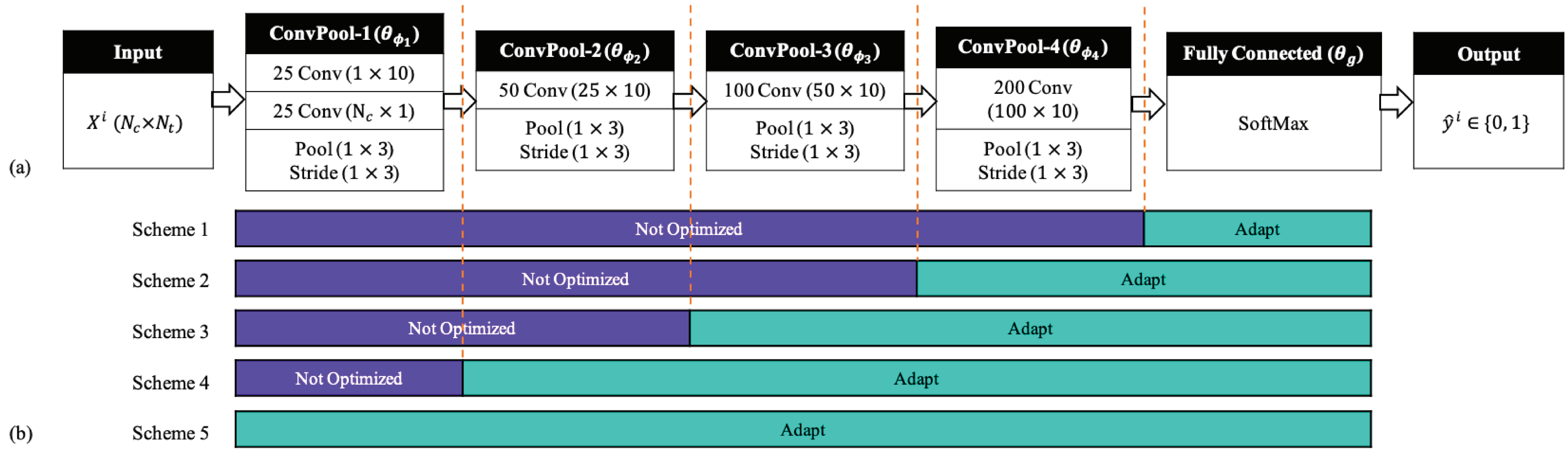
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

School of Computer Science and Engineering
College of Engineering

Subject Adaptation with Deep ConvNet
for EEG-based Motor Imagery Classification

Abstract - Deep learning has emerged as a powerful tool for developing Brain-Computer Interface (BCI) systems. However, the scarcity of subject-specific data results in a marginal performance increase for deep learning models trained entirely on the data from a specific individual. To overcome this, many transfer-based approaches have been proposed, using preexisting data from other subjects. But transfer learning faces its challenges: there are substantial inter-subject variabilities in electroencephalography (EEG) data. Therefore, adaptation is needed to fine-tune the model for the target subject. In this project, we study 5 schemes for adapting a deep convolutional neural network (CNN) based EEG-BCI system for decoding hand motor imagery.



METHODOLOGY

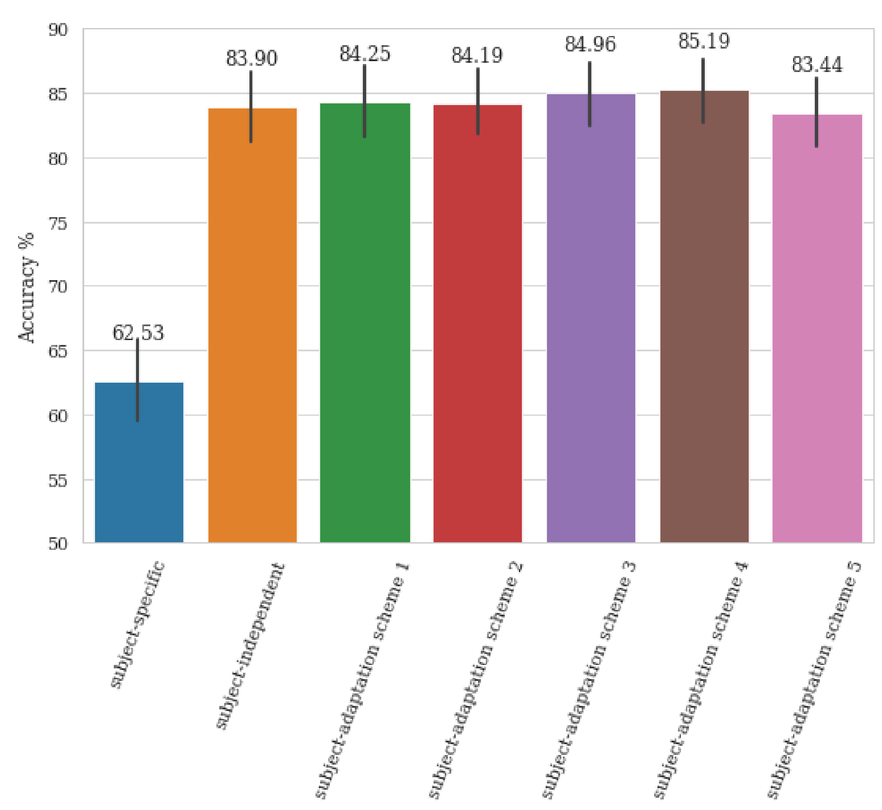
Subject-specific classification is the first baseline for our experiment, where we train and validate a model for each subject using only the same subject's data.

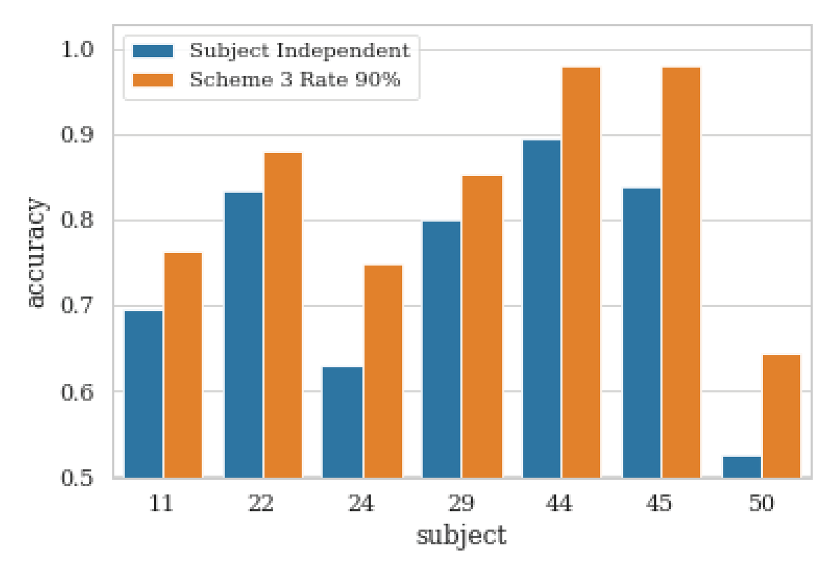
Subject-independent classification is the second baseline for our study, where we use a leave-one-subject-out(LOSO) paradigm for evaluation.

In subject-adaptive classification, we fine-tune and adapt the pre-trained model from subject-independent classification, using a small amount of data from the target subject. We studied the performance gains when the amount of adaptation data increases from 10% to 100%. There are different strategies to do adaptation. We adapted different subsets of the CNN parameters as shown in the figure above and compare their performance gains.

RESULTS

Scheme 4 with 100% adaptation data gives the best average improvement of 1.54% ($p < 0.05$) among all adaptation schemes. Scheme 3 with 90% adaptation data sees the highest improvement in a single subject, with accuracy improved by 22.86% for subject 50.





Student: Zhang Kaishuo
Supervisor: Professor Guan Cuntai