Deep Learning Methods for Acoustic Emission Evaluation

Martin Kovanda & Milan Chlada

Applied Mathematical Stochastic Methods

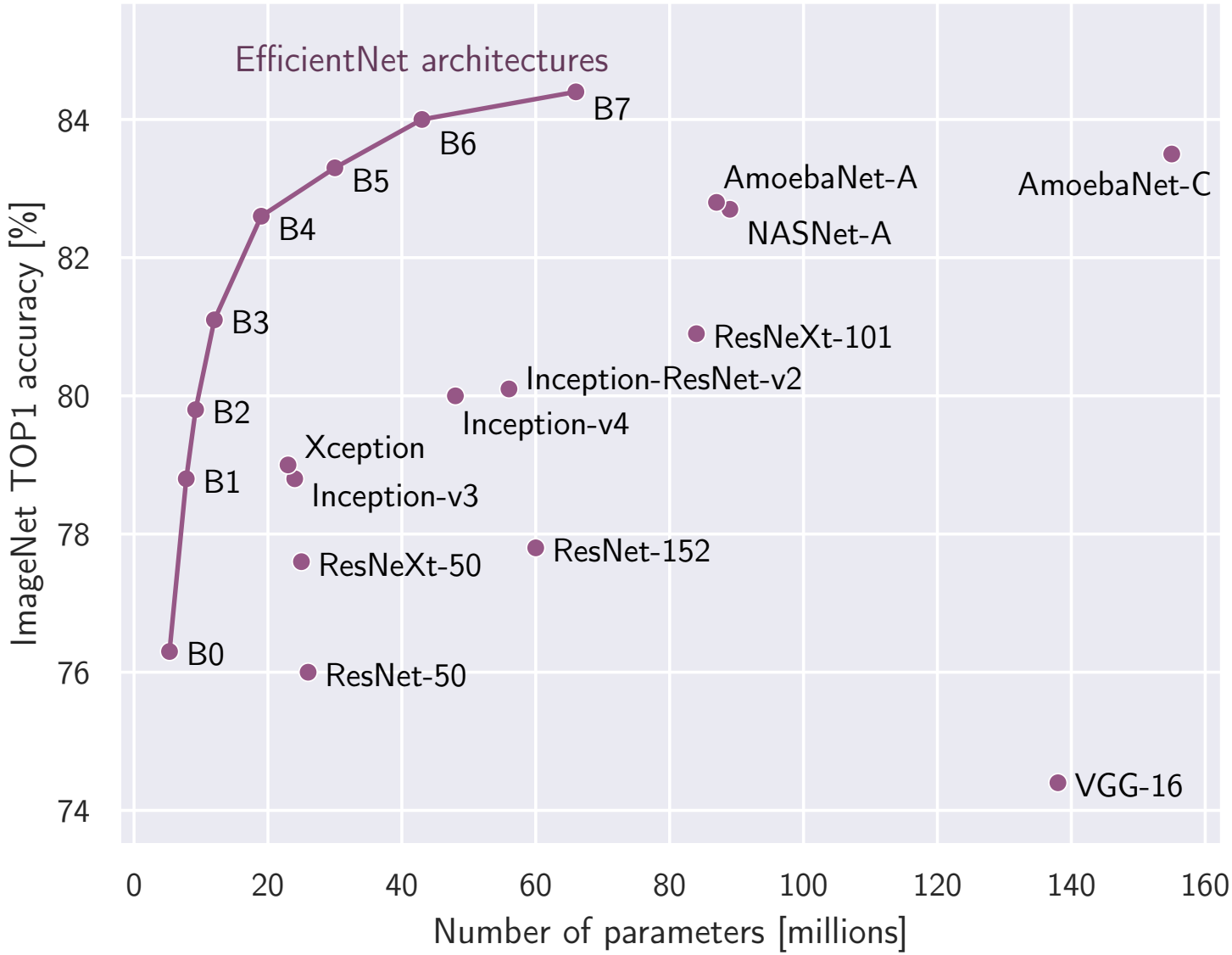
25.6.2021

Content

Goals of this project

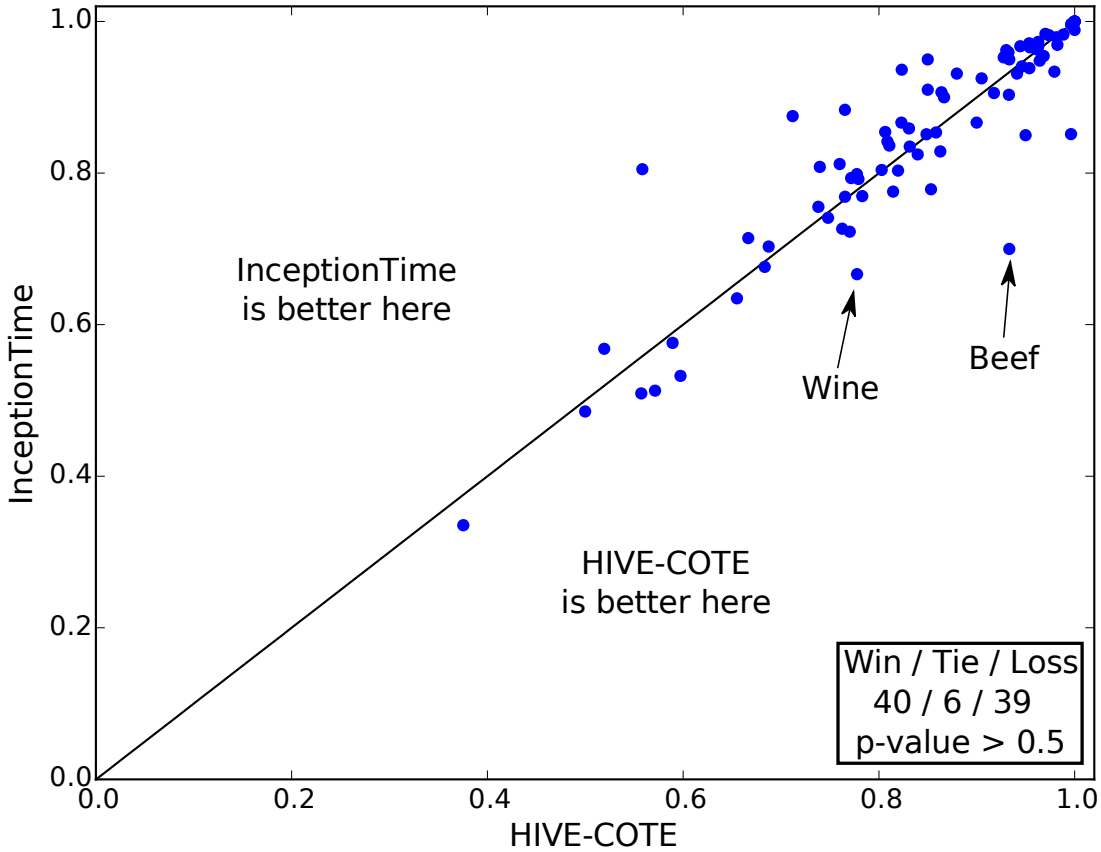
- summarize deep learning methods used in Image Classification and Time Series Classification
- apply chosen architectures on acoustic emission signal and compare their usability
- explore their ability to generalize on signals from different sensors

Image Classification architectures



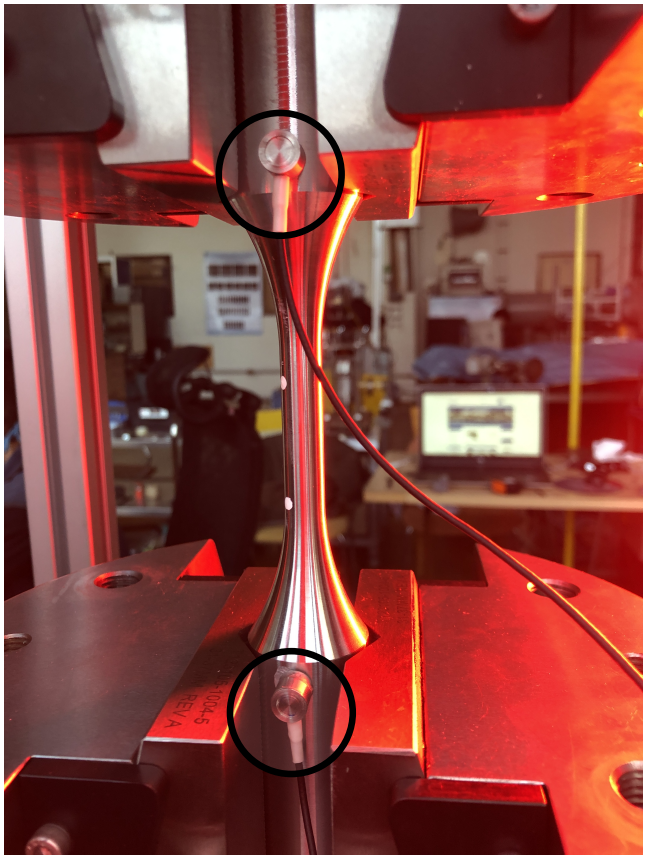
Time Series Classification

- HIVE-COTE
- InceptionTime

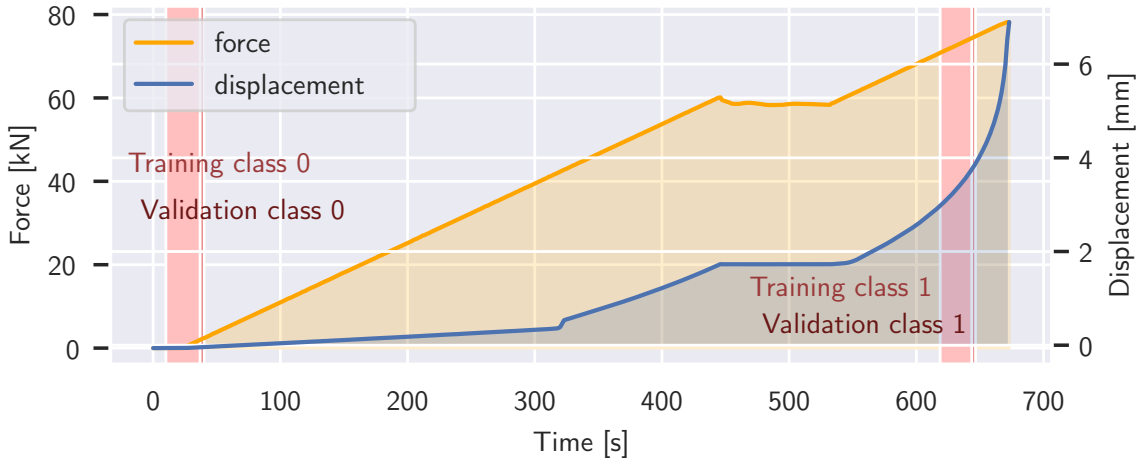


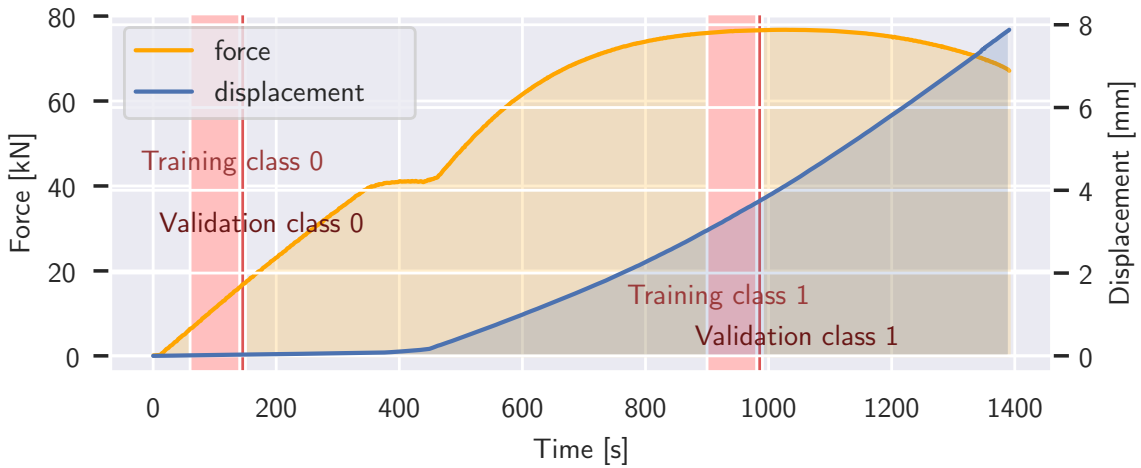
The accuracy comparison plot on several TSC tasks. Source: [1].

Experiments

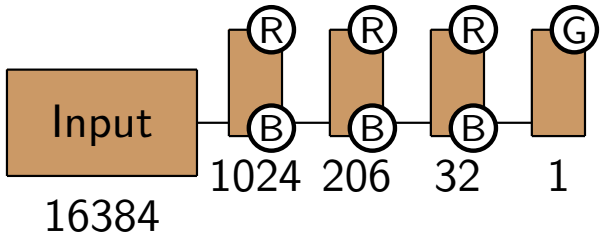


Experiment + setup

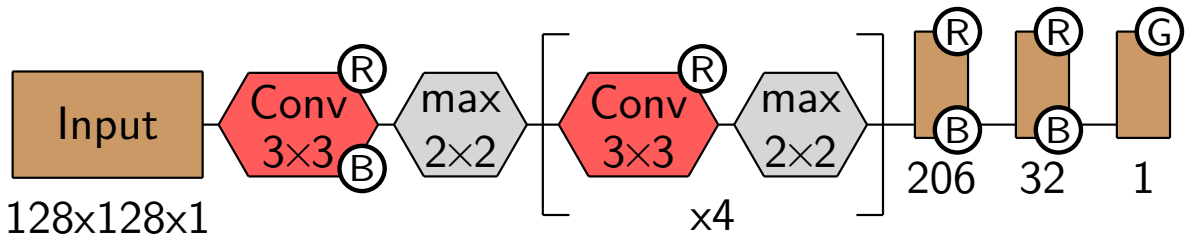




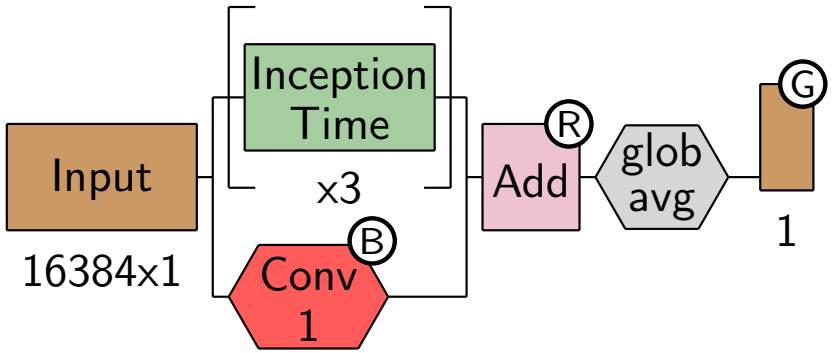
Examined architectures



Perceptron architecture.

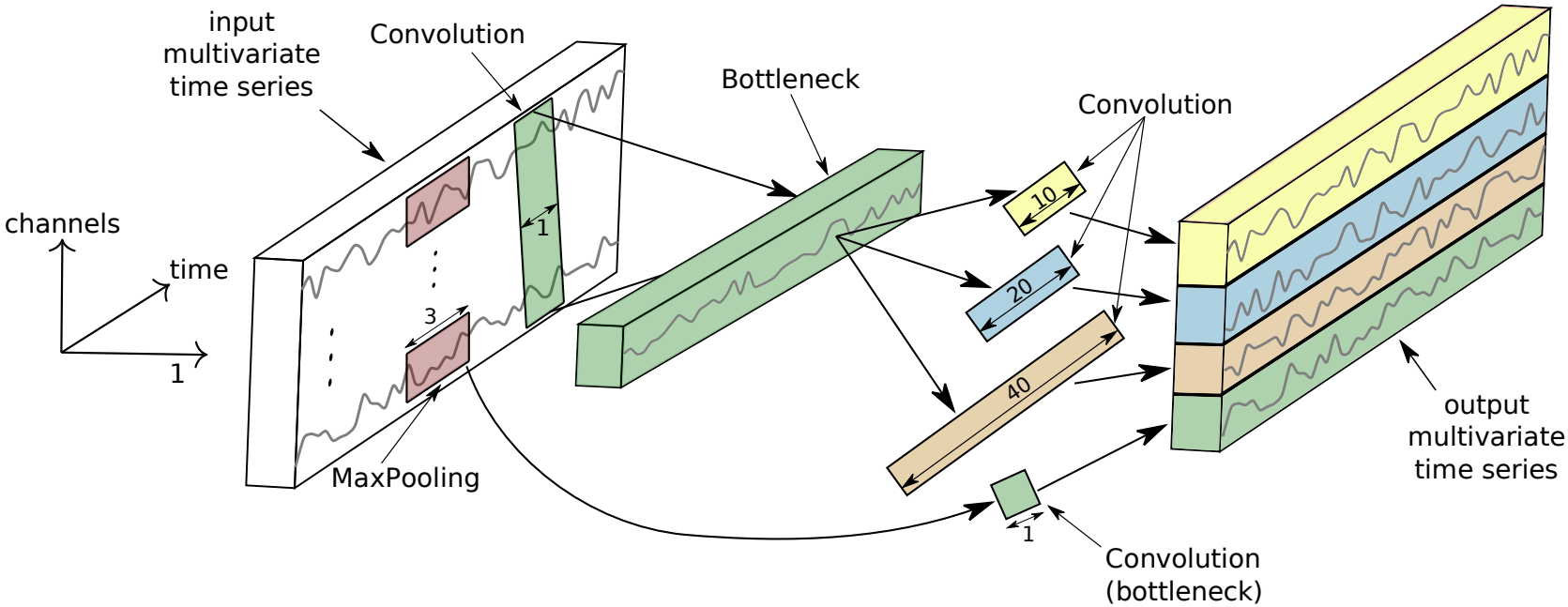


Simple ConvNet architecture.

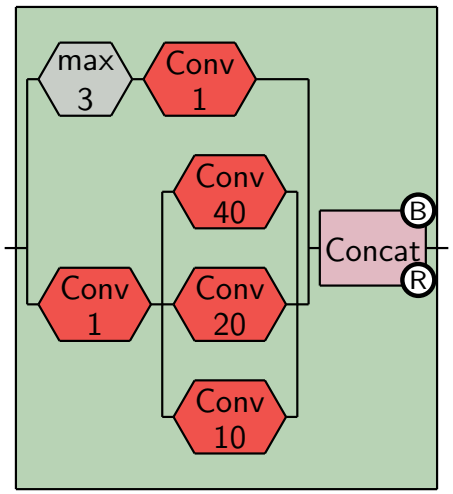


InceptionTime architecture.

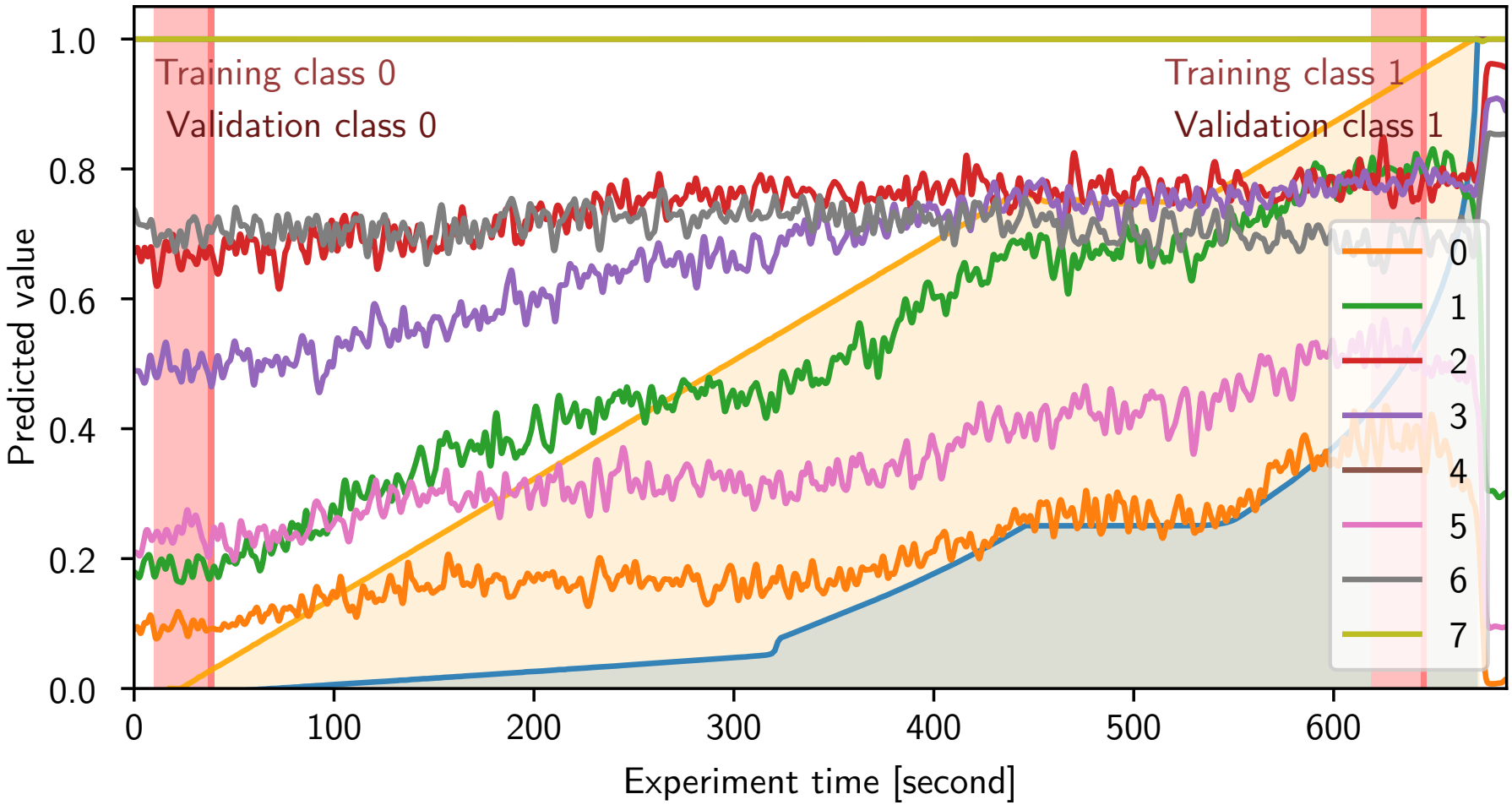
InceptionTime module



Source: [1].

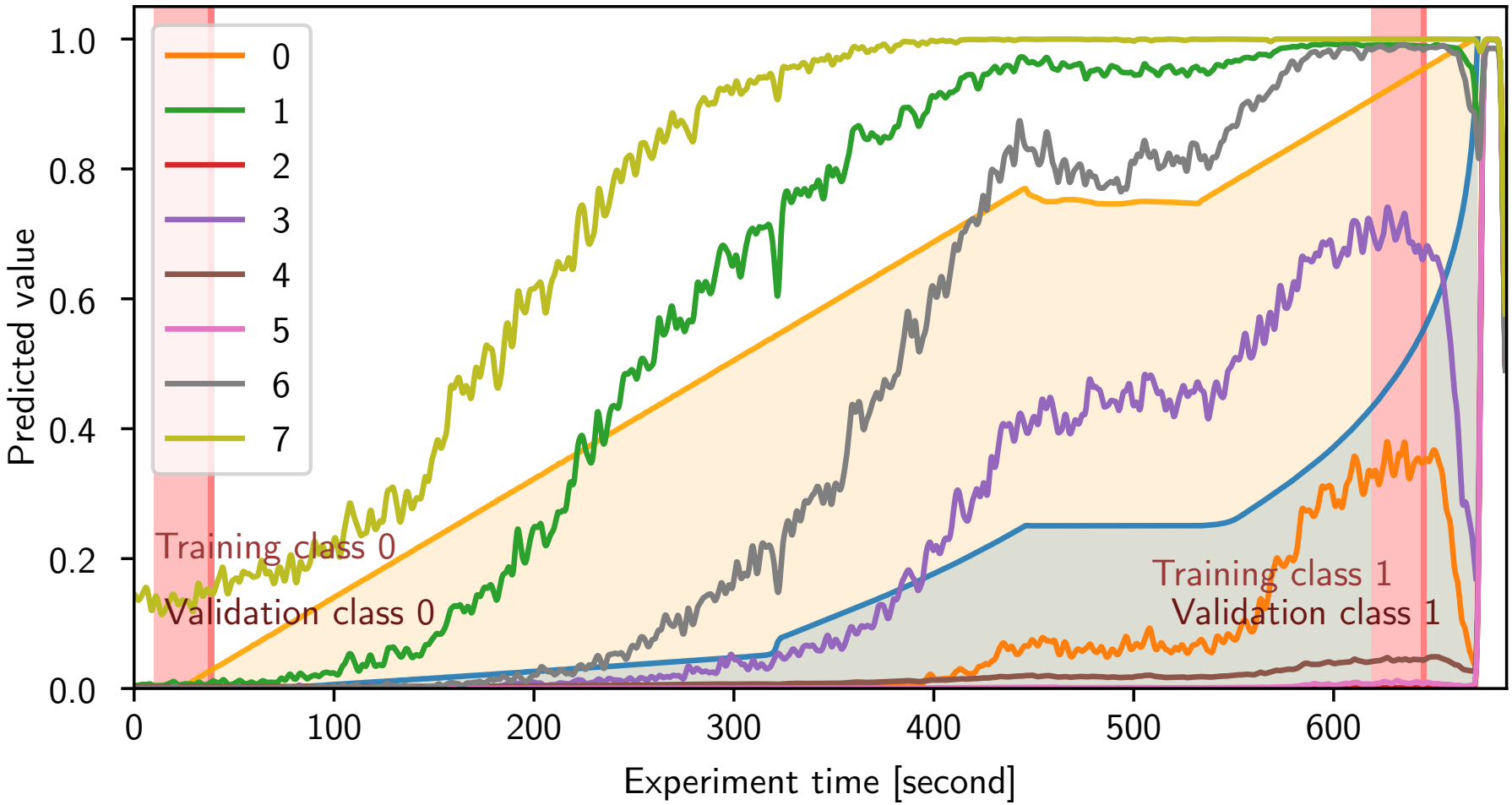


Experiment 1



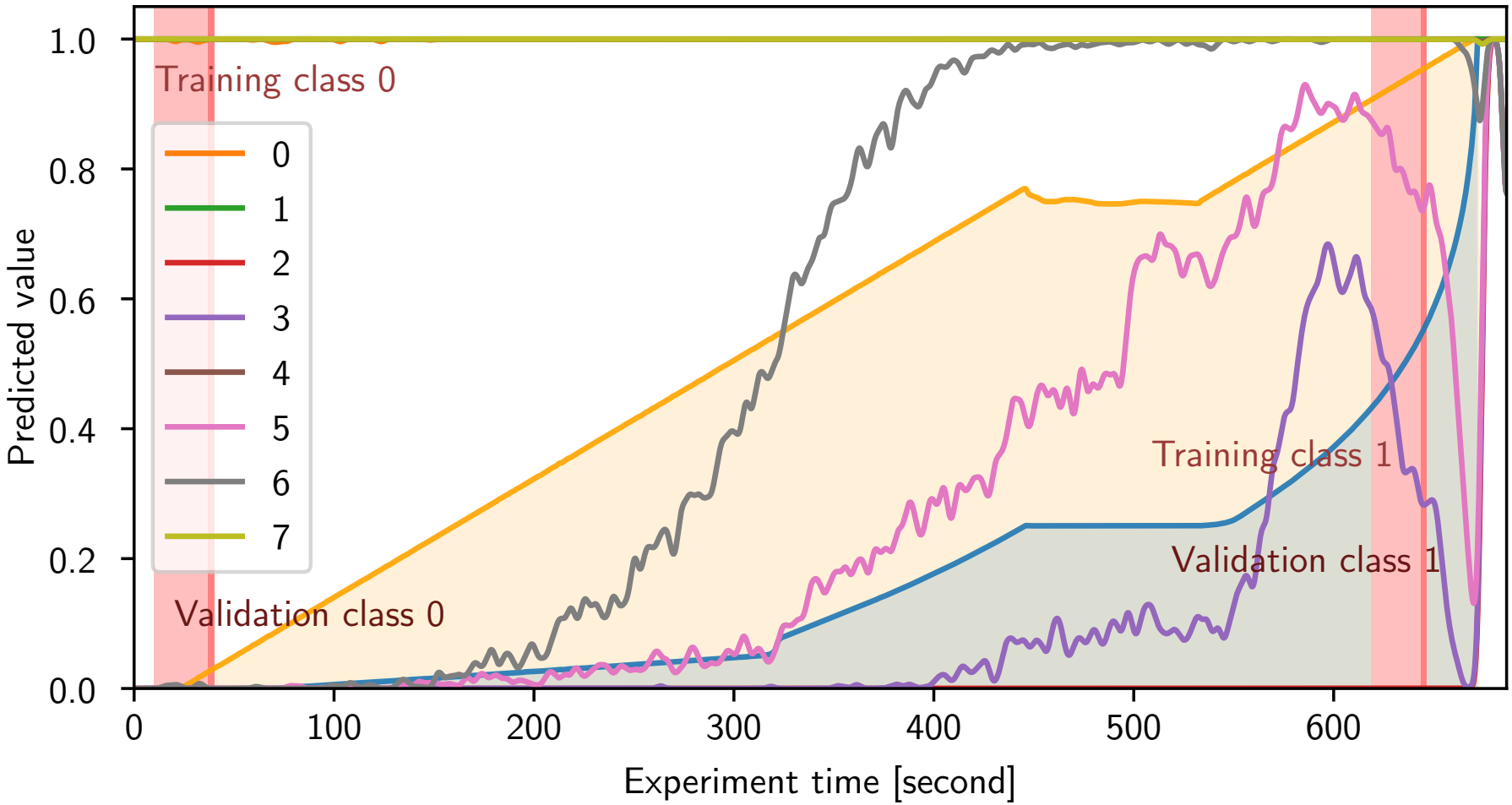
Perceptron models applied to all signal from the first experiment.

Experiment 1



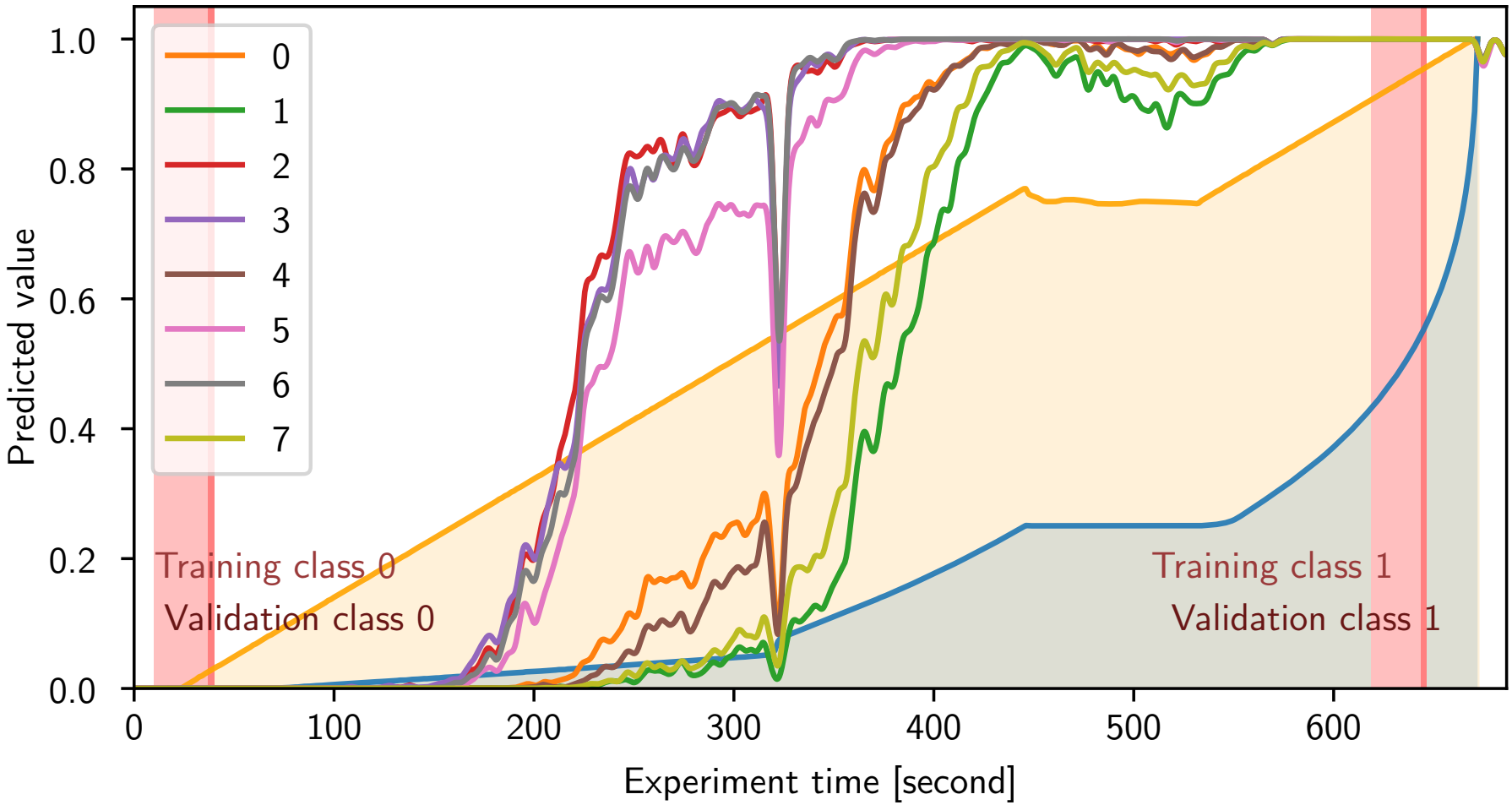
Simple ConvNets applied to all signal from the first experiment.

Experiment 1



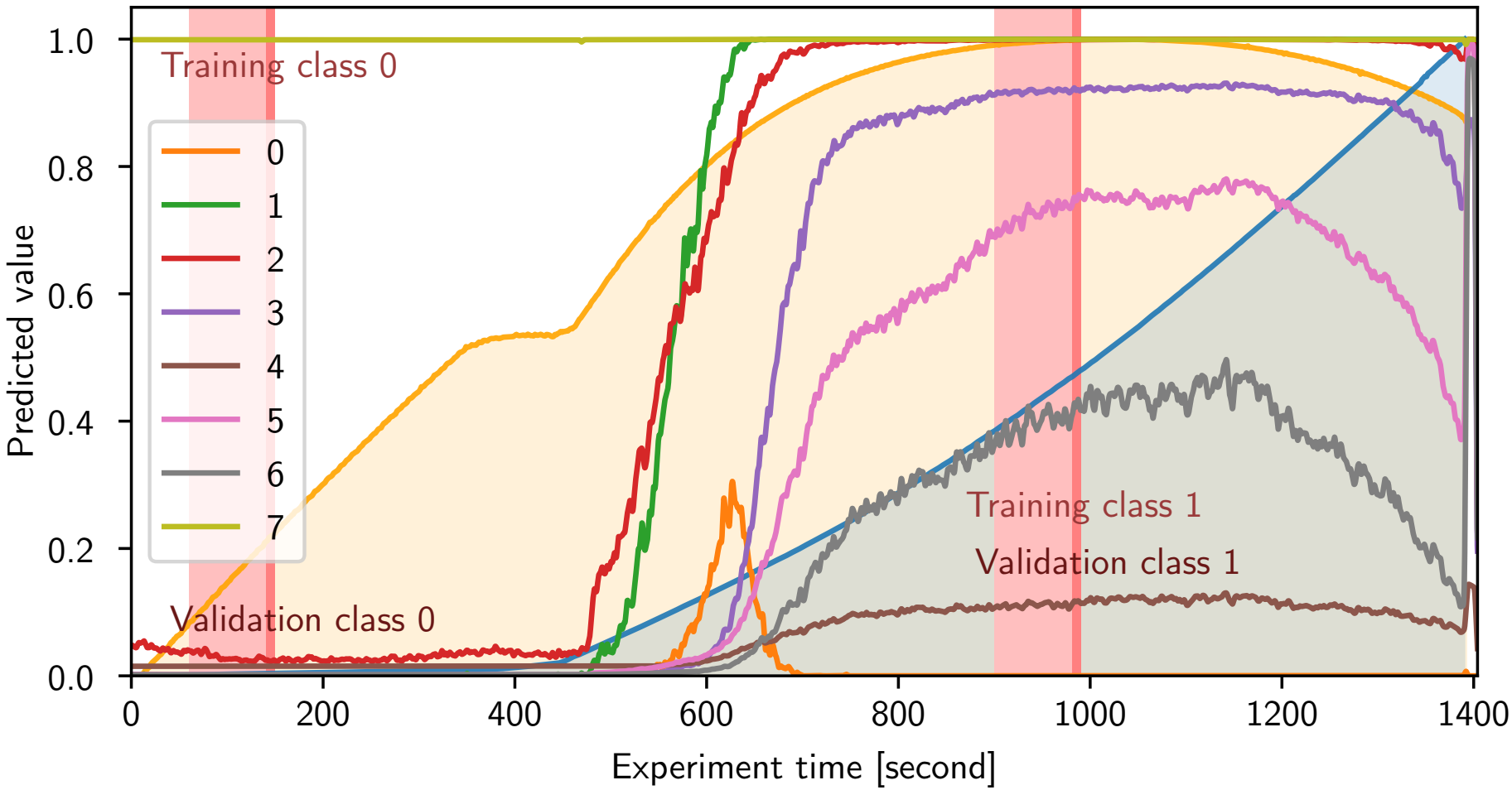
EfficientNet models applied to all signal from the first experiment.

Experiment 1



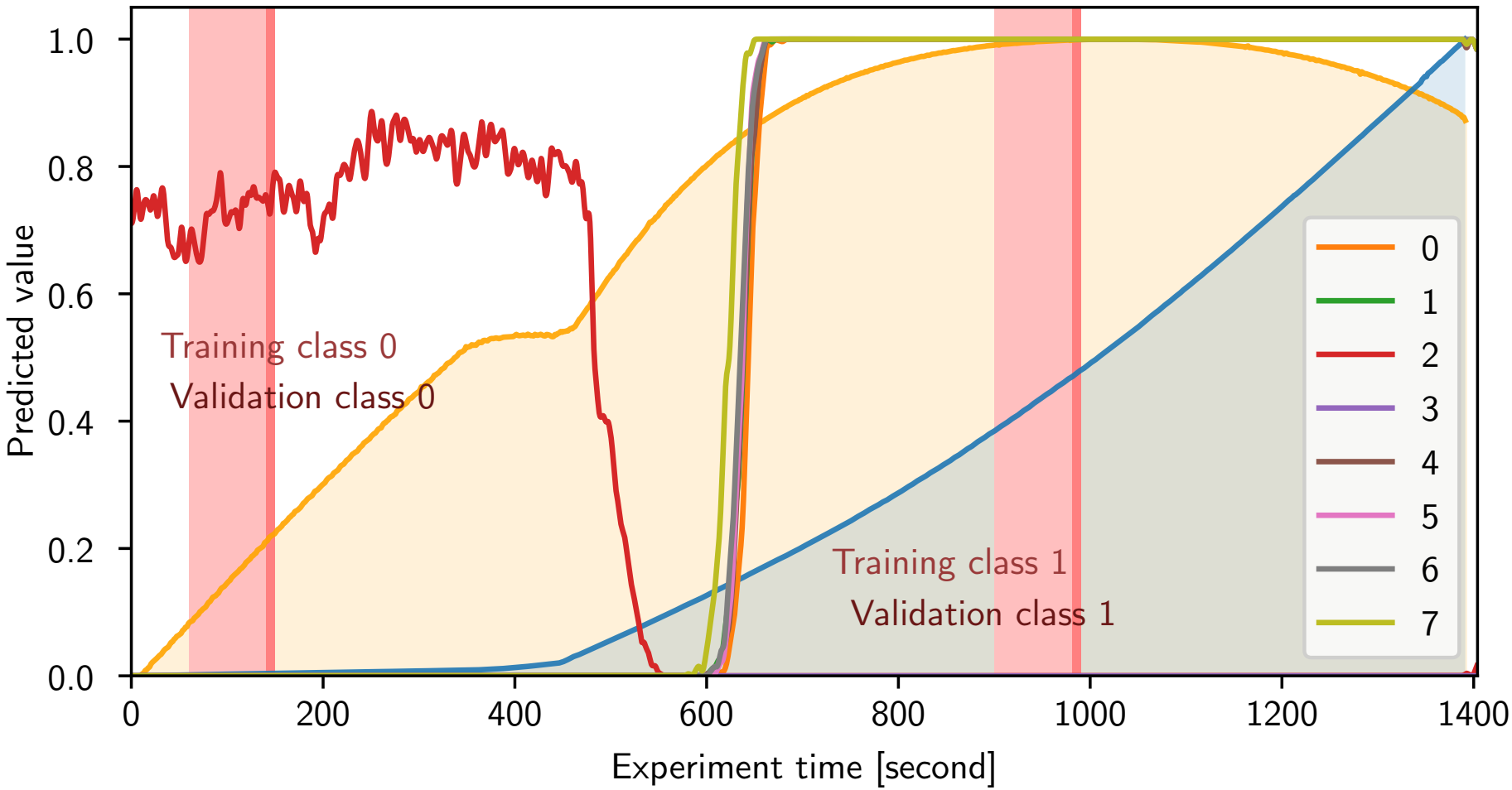
InceptionTime models applied to all signal from the first experiment.

Experiment 2



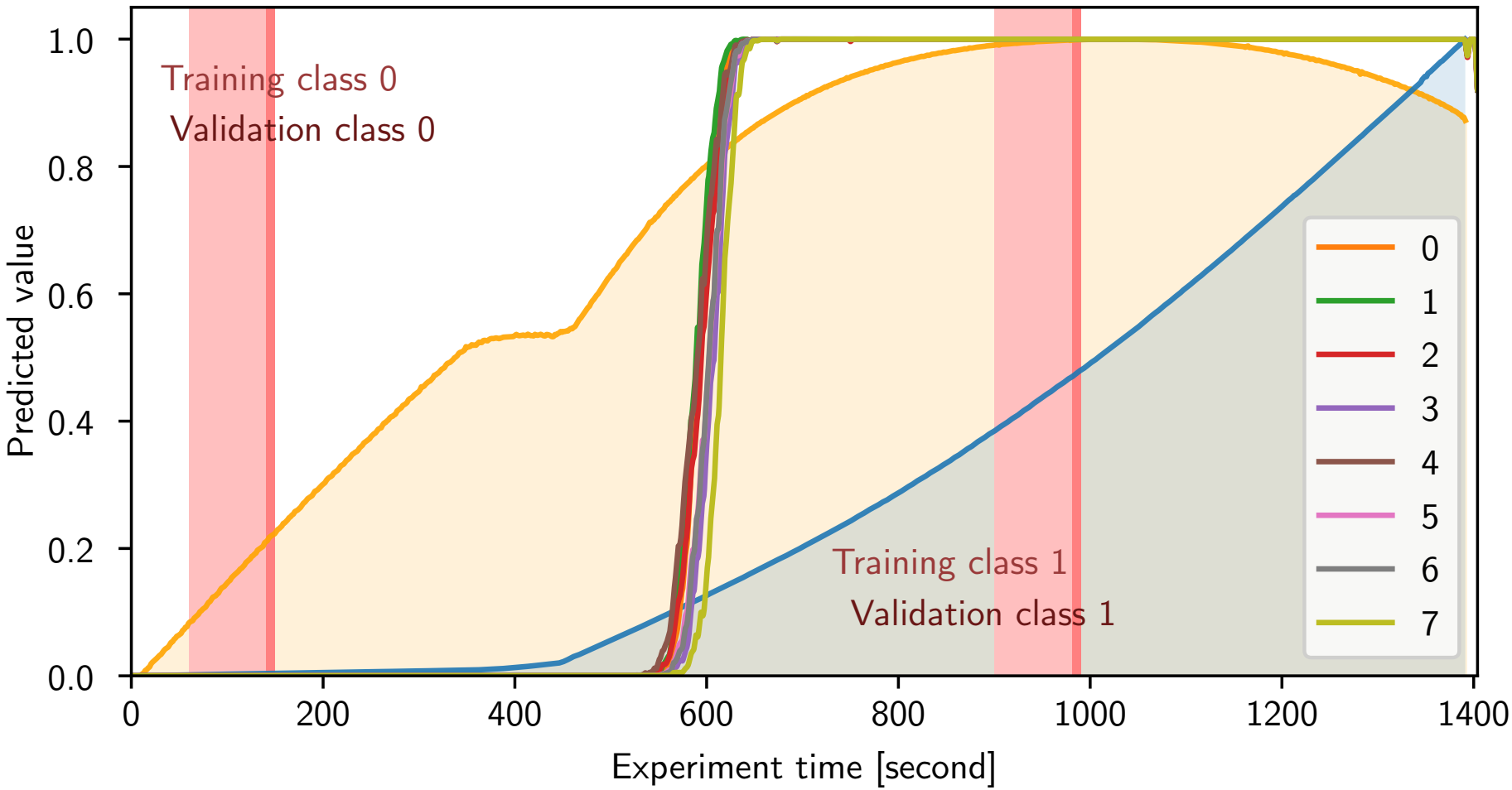
Simple ConvNets models applied to all the signal from the channel 0 second experiment.

Experiment 2



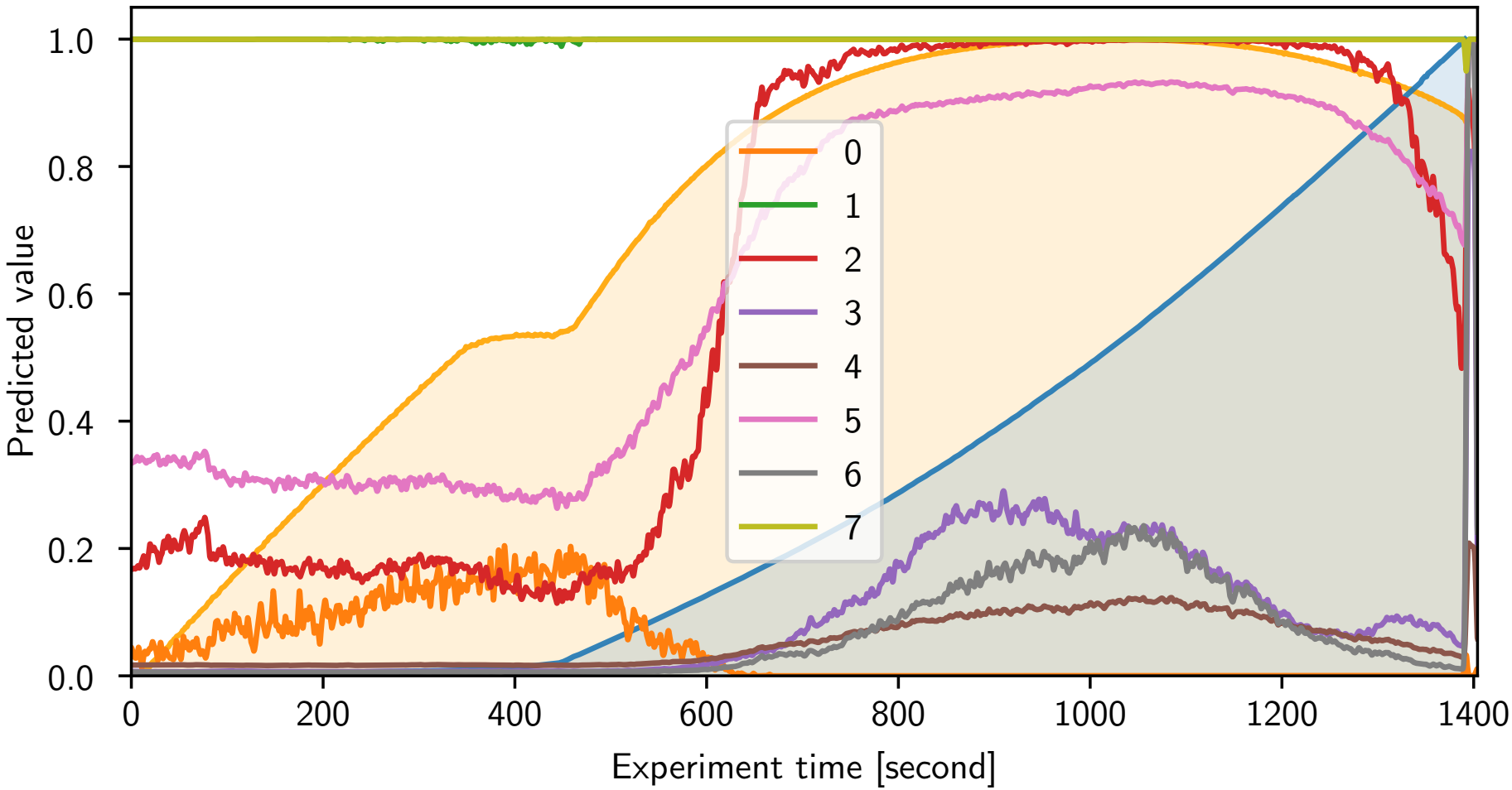
EfficientNet models applied to all the signal from the channel 0 second experiment.

Experiment 2



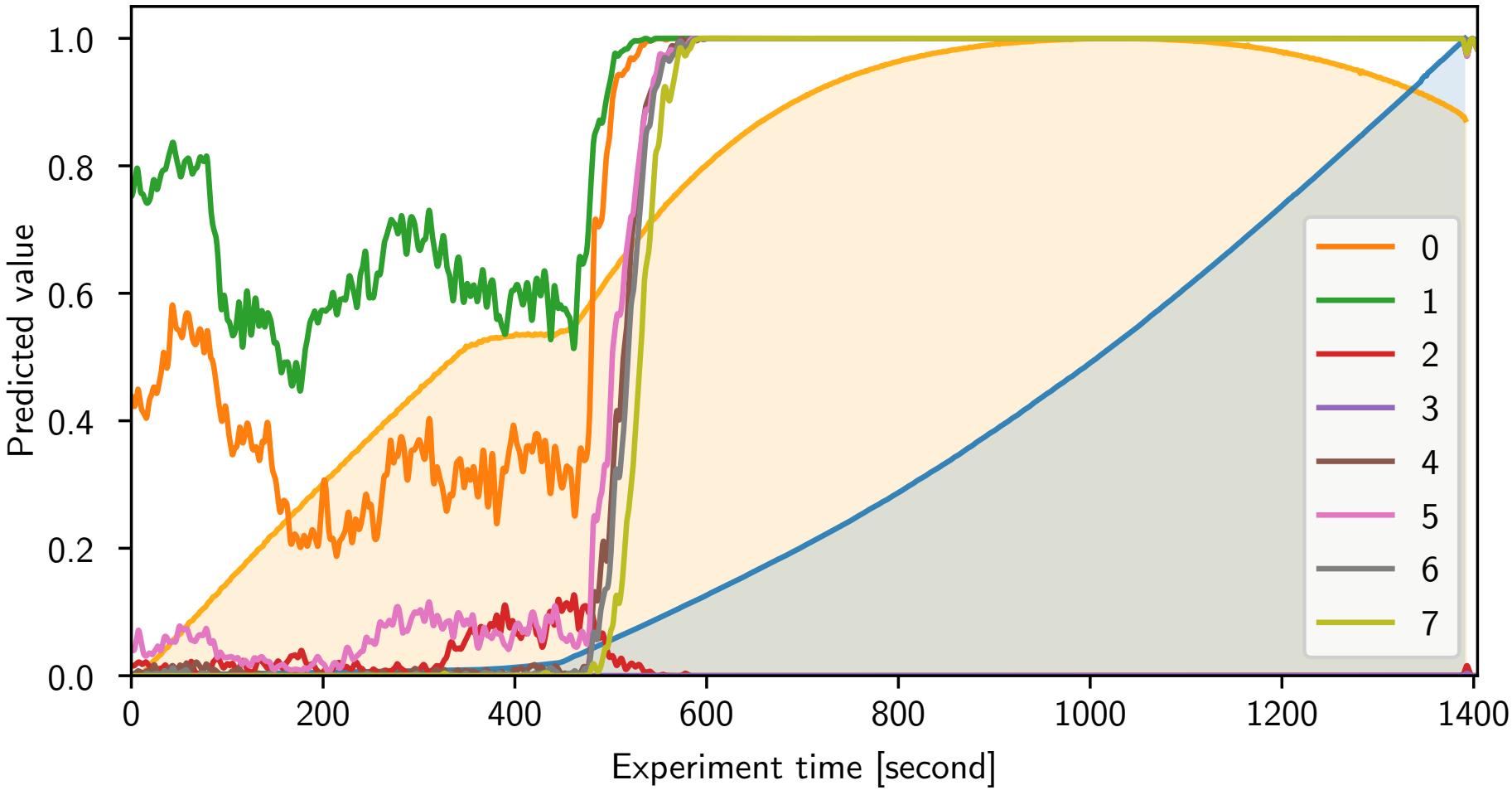
InceptionTime models applied to all the signal from the channel 0 second experiment.

Cross-channel generalization



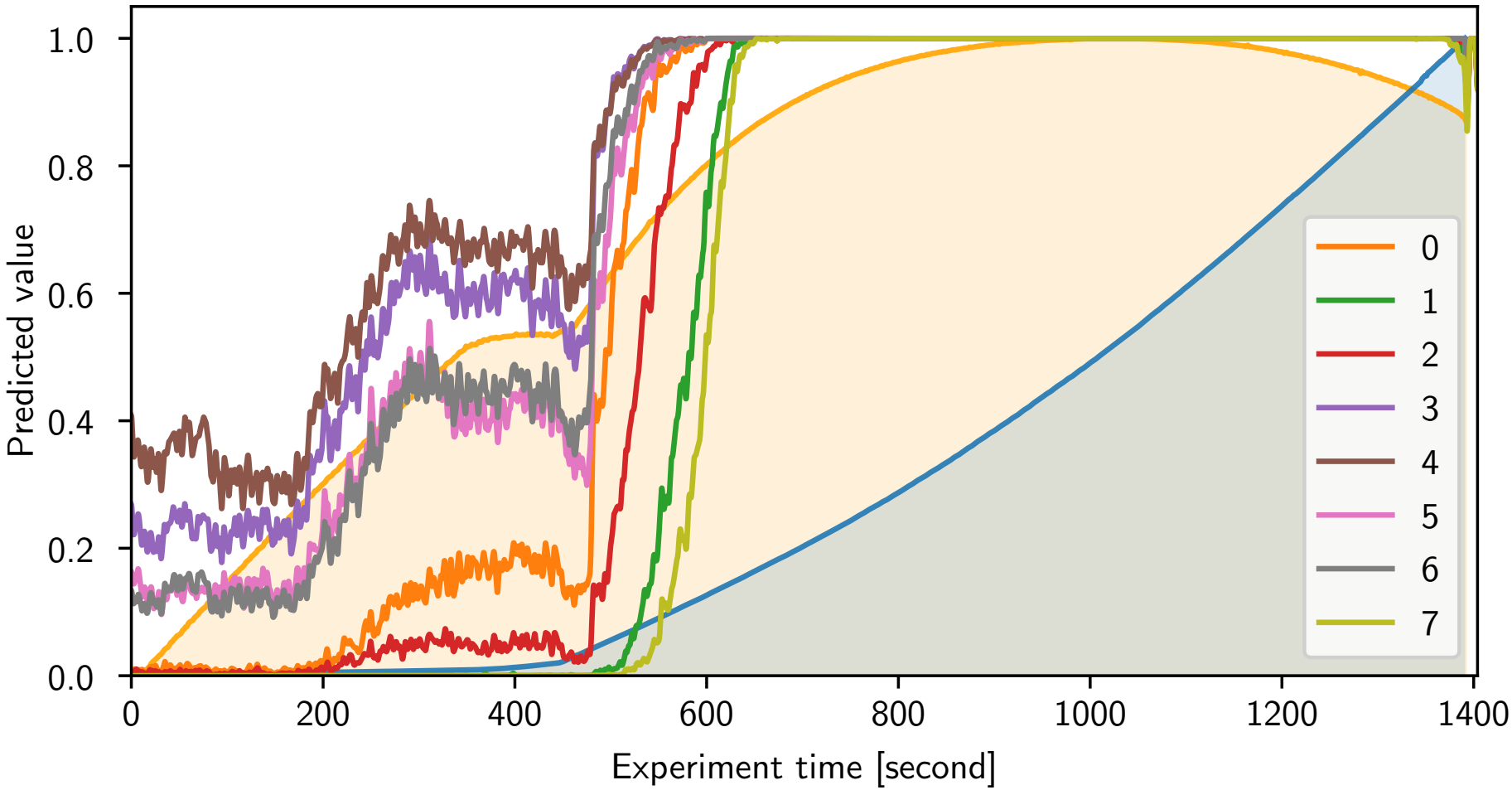
Simple ConvNets applied to all the channel 1 signal from the second experiment.

Cross-channel generalization



EfficientNet models applied to all the channel 1 signal from the second experiment.

Cross-channel generalization



InceptionTime models applied to all the channel 1 signal from the second experiment.

Conclusion

- Perceptron model is inappropriate for the plastic deformation detection
- 2D convolutional networks are capable of detecting the plastic deformation, however, they require an additional transformation
- InceptionTime has a great potential for many tasks

Bibliography:

[1] Hassan Ismail Fawaz et al. "InceptionTime: Finding AlexNet for Time Series Classification". In: *Data Mining and Knowledge Discovery* (2020).