# Improved Gesture Recognition Based on sEMG Signals and TCN

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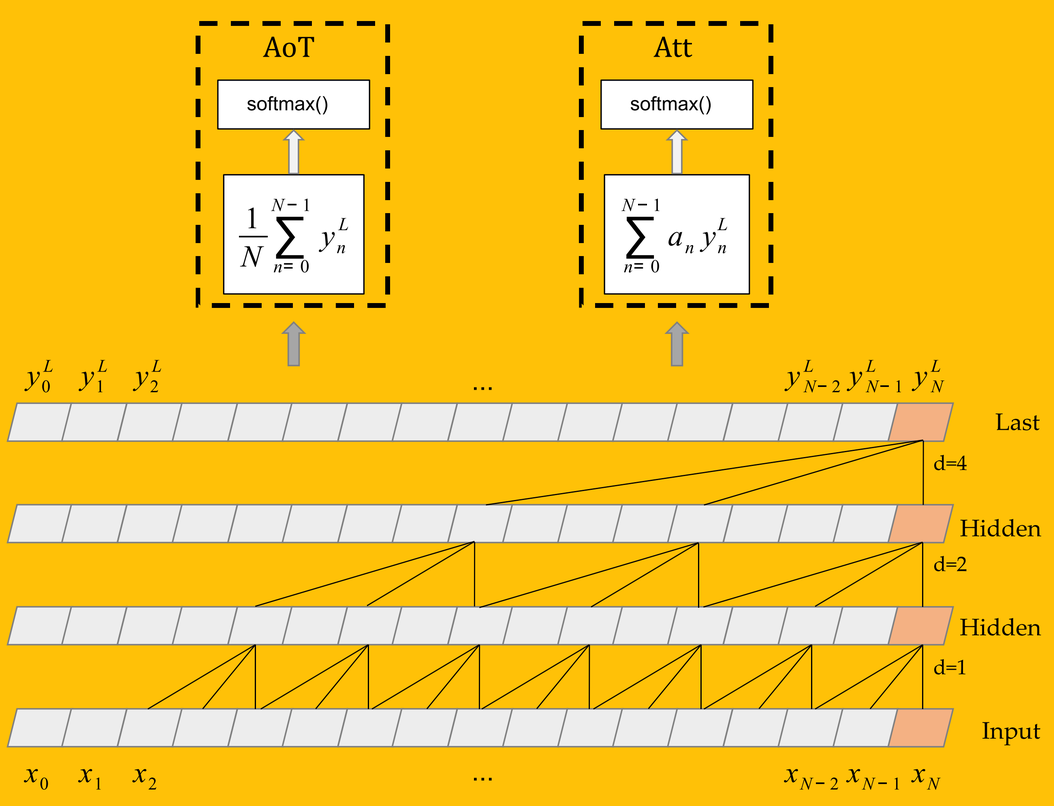
## Introduction

Accurate gesture recognition is important for a number of applications including human computer interaction, prosthesis control and rehabilitation gaming. Surface electromyography (sEMG) signals measured from the forearm contain useful information for decoding muscle activity and hand motion.
In the era of Deep Learning, the problem of gesture recognition is often addressed as an image classification task using Convolutional Neural Networks (CNN). In this paper, we approach sEMG-based hand gesture recognition as a sequence classification problem using Temporal Convolutional Networks (TCN).

addressing hand gesture recognition based on sEMG as sequence classification with TCN improved accuracy by 5%

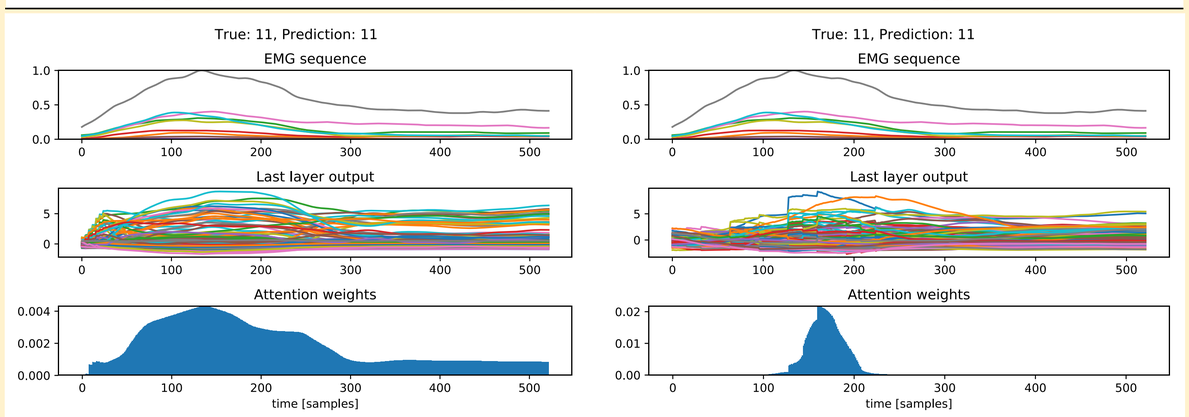
## Proposed Model

- causal convolutions map an input sequence to an output sequence of the same length using only past and current data
- accounting for long sequences, dilated convolutions enable a large receptive field (RF)
- the output of the last convolution is further processed by either an average over time (AoT) calculation or an attention (Att) mechanism so that a single class label characterizes a complete sequence
- advantages of this approach include:
    - processing sequences of arbitrary lengths
    - less memory requirements compared to RNNs due to shared filter parameters




| Model<br>classifier – RF | Model complexity<br>layers, #params | Top-1 test accuracy<br>mean (std) | Top-3 test accuracy<br>mean (std) |
|---|---|---|---|
| AoT – 300ms | 4, 60K | 89.51% (3.43%) | 97.42% (1.51%) |
| AoT – 2500ms | 7, 70K | 89.29% (3.80%) | 97.37% (1.50%) |
| Att – 300ms | 4, 75K | 89.67% (3.50%) | 97.35% (1.77%) |
| Att – 2500ms | 7, 85K | 89.76% (3.49%) | 97.11% (1.68%) |

| | Top-1 test accuracy<br>mean | Model complexity<br>#params |
|---|---|---|
| [1] | 66.59% | 85K |
| [2] | 70.48% | 85K |
| [3] | 76.10% | 500K |
| [4] | 85% | 2.5M |
| This work | 89.76% | 85K |




(a) RF=300ms (b) RF=2500ms

## Results

- two hyperparameters of the model are explored: the RF of the convolutions and the type of classifier
    - attention weights show that the model can identify discriminative features
    - a longer RF combined with Att can isolate useful features, yet an important region of the input may be completely ignored resulting in a classification error
    - Att is only 0.2% better than the AoT
- on the Ninapro benchmark, the TCN approach outperforms the state-of-the-art [4] by 5%

## References

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