

An Ensemble of ConvTransformer Networks for the Sussex-Huawei Locomotion-Transportation (SHL) Recognition Challenge

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Introduction

- ◆ 2021 SHL Challenge [1][2]: Classifying 8 modes of transportation in a user-independent manner based on radio-data.
- ◆ Recognition target: still, walk, run, bike, car, bus, train, and subway.

Method

Preprocessing

- (1) Processed the selected data to be correlated with the timestamps of the label, and sorted all data in chronological order.
- (2) The processed latitude and longitude data of the Step 1 was first transformed to the plane coordinates.
- (3) These discontinuous data was first divided into fragments. Each fragment was further segmented with a sliding window of 180 seconds.

Network

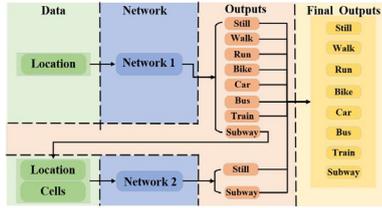


Figure 1: Structure of model

ConvTransformer attempts to enhance the recognition performance from two steps:

- (1) ConvTransformer Network1 aims to classify 8 locomotion and transportation modes through location data.

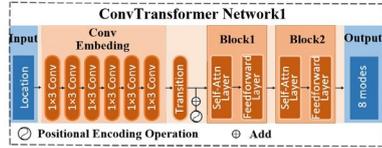


Figure 2: Structure of Network1

- (2) ConvTransformer Network2 aims to further classify these Confusing categories through cells data and location data.

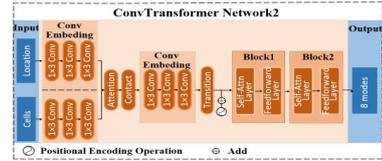


Figure 3: Structure of Network2

Results

F1-score of 0.6664 could be achieved by the 1st network on the validation set. The 2nd network for further classification of the still and subway categories and an F1-score of 0.8779 is achieved. Finally, the 1st network and 2nd network are ensemble to obtain a final F1-score of 0.6838 on the validation dataset.

The confusion matrices of Network1, Network2 and the whole mode are shown in Table 1, Table2 and Table3.

	1	2	3	4	5	6	7	8
1	9387	217	0	0	131	213	390	5275
2	310	13836	600	883	47	256	100	1350
3	0	632	1342	257	0	0	0	0
4	0	470	709	8513	0	192	2	0
5	151	91	96	458	13504	1956	268	1016
6	46	8	0	531	769	4297	703	1639
7	422	0	0	46	1213	872	3775	6443
8	47	8	0	145	78	828	2	16043

Table 1: Confusion matrix of Network1

	1	8
1	15402	4510
8	284	19085

Table 2: Confusion matrix of Network2

	1	2	3	4	5	6	7	8
1	13114	217	0	0	131	213	390	1548
2	1072	13836	600	883	47	256	100	588
3	0	632	1342	257	0	0	0	0
4	0	470	709	8513	0	192	2	0
5	335	91	96	458	13504	1956	268	832
6	1214	8	0	531	769	4297	703	471
7	3326	0	0	46	1213	872	3775	3539
8	747	8	0	145	78	828	2	15343

Table 3: Confusion matrix of model

References

- [1] H. Gjoreski, M. Ciliberto, L. Wang, F.J.O. Morales, S. Mekki, S. Valentin, and D. Roggen, "The University of Sussex-Huawei locomotion and transportation dataset for multimodal analytics with mobile devices," IEEE Access 6 (2018): 42592-42604.
- [2] L. Wang, H. Gjoreski, M. Ciliberto, S. Mekki, S. Valentin, and D. Roggen, "Enabling reproducible research in sensor-based transportation mode recognition with the Sussex-Huawei dataset," IEEE Access 7 (2019): 10870-10891.

Acknowledgments

This work was supported by the National Natural Science Foundation of China under Grant (No.61903373) and (No. 62002372).