Time Series Representation Learning with Supervised Contrastive Temporal Transformer *Supplementary*

I. Datasets

UCR Time Series Classification Archive We evaluate SCOTT's performance on the TSC problem using 45 UCR datasets that cover all types in the archive: image, sensor, motion, spectro, traffic, device, simulate, audio and ECG data. Nine of these datasets, namely: BeetleFly, ChinaTown, ChlorCon, ECG200, GunPoint, InsecWing, Meat, PowerCon, and Wafer (one from each type), are used to develop the model, specifically for hyperparameter tuning. Details of these 45 datasets are provided in Table I.

USC-HAD: This human activity dataset contains 12 activities. Each activity was recorded in five trials with $6-$axes. We follow similar pre-processing steps from the previous work [1]: We use one accelerometer axis of two activities (one of which is the change state), from the first five human subjects. Randomly mixing them up and sampling via the sampling method in main paper, we get over $200,000$ time series.

ECochG: ECochG data consists of the response of the inner ear to sound played during Cochlear Implant (CI) surgery. This surgery implants an electrode in the inner ear to simulate the function of the cochlea and is used to supplement the residual natural hearing of the hearing imapaired. However, there is a high probability that patients would lose their natural hearing due to trauma during the procedure. A previous study [2] found that a $30\%+$ drop in 'Cochlear Microphonic' (CM - one component of ECochG) amplitude may reflect damage to the natural hearing of the patient. This motivated researchers to detect these 'traumatic drops' in CM amplitude to prevent trauma during CI surgery [3]. In this dataset, we have records from 78 patients (78 raw time series) with varying length, ranging from 129 to 991 temporal points. By implementing the sampling method in main paper, we get 30491 time series in total. We consider traumatic drops (as labelled by an expert) to be in the change state and all others to be in the non-change state.

TABLE I: Details of datasets from UCR Archive. **#Item** represents the number of **Item**

Datasets	#Train	#Test	Length	#Class	Type
Adiac	390	391	176	37	IMAGE
ArrowHead	36	175	251	3	IMAGE
Beef	30	30	470	5	SPECTRO
BeetleFly	20	20	512	2	IMAGE
BirdChicken	20	20	512	2	IMAGE
Car	60	60	577	4	SENSOR
CBF	30	900	128	3	SIMULATE
ChinaTown	20	345	24	2	TRAFFIC
ChlorCon	467	3840	166	3	SIMULATE
Coffee	28	28	286	2	SPECTRO
Crop	7200	16800	46	24	IMAGE
Diamond	16	306	345	4	IMAGE
DisPhaxOutAge	400	139	80	3	IMAGE
DisPhaxOutCor	600	276	80	2	IMAGE
DisPhaxTW	400	139	80	6	IMAGE
DodgerLoopWnd	20	138	288	2	SENSOR
Earthquakes	322	139	512	2	SENSOR
ECG200	100	100	96	2	ECG
ECG5000	500	4500	140	2	ECG
FaceAll	560	1690	131	14	IMAGE
FordA	3601	1320	500	2	SENSOR
GunPoint	50	150	150	2	MOTION
Ham	109	105	431	2	SPECTRO
Herring	64	64	512	2	IMAGE
InsecWing	220	1980	256	11	AUDIO
ItaPowerDmd	67	1029	24	2	SENSOR
Lightning7	70	73	319	7	SENSOR
Meat	60	60	448	3	SPECTRO
MedicalImages	381	760	99	10	IMAGE
MelbPedest	1194	2439	24	10	TRAFFIC
MidPhaxOutAge	400	154	80	3	IMAGE
MidPhaxTW	399	154	80	6	IMAGE
MoteStrain	20	1252	84	2	SENSOR
OliveOil	30	30	570	4	SPECTRO
Plane	105	105	144	7	SENSOR
PowerCon	180	180	144	2	DEVICE
ProxPhaxOutAge	400	205	80	3	IMAGE
ProxlPhaxOutCor	600	291	80	2	IMAGE
ProxPhaxTW	400	205	80	6	IMAGE
SonyAISurface1	20	601	70	2	SENSOR
Strawberry	613	370	235	2	SPECTRO
SwedishLeaf	500	625	128	15	IMAGE
Wafer	1000	6164	152	2	SENSOR
Wine	57	54	234	2	SPECTRO
Yoga	300	3000	426	2	IMAGE

II. Result

Detailed results for Time Series Classification on UCR Archive are provided in Table II.

References

[1] S. Deldari, D. V. Smith, H. Xue, and F. D. Salim, "Time series change point detection with self-supervised contrastive predictive coding," in *WWW*, 2021.

[2] L. Campbell, A. Kaicer (Umansky), D. Sly, C. Iseli, B. Wei, R. Briggs, and S. O'Leary, "Intraoperative real-time cochlear response telemetry predicts hearing preservation in cochlear implantation," *Otology & Neurotology*, 2016.

[3] S. Wijewickrema, C. Bester, J.-M. Gerard, A. Collins, and S. O'Leary, "Automatic analysis of cochlear response using electrocochleography signals during cochlear implant surgery," *Plos one*, 2022.

TABLE II: UCR Results (Accuracy). Development datasets are marked with *

Datasets	**ST**	**Boss**	**HCOTE**	**TS-CHIEF**	**Rocket**	**ITime**	**SimCLR** (modified)	**TS2Vec**	**MLP**	**SCOTT** (ours)
Adiac	0.7826	0.7647	0.8107	0.7980	0.7874	**0.8363**	0.6547	0.6572	0.5985	0.7775
ArrowHead	0.7371	0.8343	**0.8628**	0.8229	0.8051	0.8286	0.7943	0.8051	0.8171	0.8514
Beef	0.9000	0.8000	**0.9333**	0.7333	0.8333	0.7000	0.7667	0.7000	0.7667	0.9000
BeetleFly*	0.9000	0.9000	0.9500	0.9500	0.9000	0.8500	0.8500	0.8500	0.7500	**1.0000**
BirdChicken	0.8000	**0.9500**	0.8500	0.9000	0.9000	**0.9500**	0.8000	0.8000	0.6000	0.8500
Car	**0.9167**	0.8333	0.8667	0.8500	0.8917	0.9000	0.8333	0.6833	0.7333	0.8667
CBF	0.9744	0.9978	0.9989	0.9978	**0.9999**	0.9989	0.8689	0.9933	0.8611	0.9456
ChinaTown*	-	-	-	-	**1.0000**	-	0.9417	0.9796	0.9825	0.9854
ChlorCon*	0.6997	0.6609	0.7120	0.7206	0.8130	0.8753	0.7354	0.6938	0.6938	**0.8974**
Coffee	0.9643	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	0.8667	0.9643	0.9643	**1.0000**
Crop	-	-	-	-	0.7502	-	0.7545	0.7295	0.6951	**0.7680**
Diamond	0.9248	0.9314	0.9412	**0.9771**	0.9703	0.9314	0.9412	0.7778	0.9706	0.9706
DisPhaxOutAge	**0.7698**	0.7482	0.7626	0.7410	0.7574	0.7266	0.7194	0.7266	0.7194	**0.7698**
DisPhaxOutCor	0.7754	0.7283	0.7717	0.7862	0.7678	**0.7935**	0.7246	0.7862	0.7536	0.7790
DisPhaxTW	0.6619	0.6763	0.6835	0.6835	0.7187	0.6763	0.6835	0.6475	0.6906	**0.7266**
DodgerLoopWnd	-	-	-	-	0.9725	-	0.8116	0.9493	0.7391	**0.9855**
Earthquakes	0.7410	0.7482	0.7482	0.7482	0.7482	0.7410	0.7266	0.7482	0.7410	**0.7626**
ECG200*	0.8300	0.8700	0.8500	0.8600	0.9060	0.9100	0.8500	0.8600	0.8200	**0.9400**
ECG5000	0.9438	0.9413	0.9462	0.9458	0.9470	0.9409	0.9422	0.9367	0.9058	**0.9478**
FaceAll	0.7787	0.7817	0.8030	0.8426	**0.9475**	0.8041	0.8148	0.7639	0.7598	0.8574
FordA	**0.9712**	0.9295	0.9644	0.9470	0.9449	0.9483	0.8023	0.9273	0.8333	0.9364
GunPoint*	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	0.8367	0.9667	0.9067	0.9733
Ham	0.6857	0.6667	0.6667	0.7143	0.7257	0.7143	0.6762	0.6667	0.6952	**0.7428**
Herring	0.6719	0.5469	0.6875	0.5781	0.6858	0.7031	0.5938	0.6094	0.5469	**0.7344**
InsecWing*	0.6268	0.5232	0.6551	0.6465	**0.6566**	0.6348	0.6204	0.6318	0.6359	**0.6566**
ItaPowerDmd	0.9475	0.9086	0.9631	0.9718	0.9691	0.9679	0.9417	0.9456	0.9602	**0.9738**
Lightning7	0.7260	0.6849	0.7397	0.7534	**0.8219**	0.8082	0.6986	0.7945	0.6575	0.7534
Meat*	0.8500	0.9000	0.9333	0.9000	0.9450	0.9500	0.8667	0.8500	**0.9667**	**0.9667**
MedicalImages	0.6697	0.7184	0.7776	0.7974	0.7975	**0.7987**	0.7237	0.7789	0.6842	0.7434
MelbPedest	-	-	-	-	0.9038	-	0.9524	0.9258	0.9020	**0.9725**
MidPhaxOutAge	**0.6429**	0.5455	0.5974	0.5909	0.5955	0.5325	0.5844	0.6234	0.5844	0.5974
MidPhaxTW	0.5195	0.5455	0.5714	0.5584	0.5558	0.5130	0.6169	0.5909	0.5779	**0.6234**
MoteStrain	0.8970	0.8786	0.9329	**0.9441**	0.9142	0.9034	0.8682	0.8618	0.8682	0.9105
OliveOil	0.9000	0.8667	0.9000	0.9000	0.9267	0.8667	0.8667	0.7000	0.7000	0.9333
Plane	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	0.9524	0.9810	0.9619	0.9905
PowerCon*	-	-	-	-	0.9311	-	0.9274	0.9444	0.9833	**1.0000**
ProxPhaxOutAge	0.8439	0.8341	**0.8585**	0.8488	0.8551	0.8537	0.8341	0.8244	0.8537	**0.8585**
ProxPhaxOutCor	0.8832	0.8488	0.8797	0.8969	0.8990	**0.9313**	0.8763	0.8385	0.8625	0.8866
ProxPhaxTW	0.8049	0.8000	0.8146	0.8146	0.8161	0.7756	0.8098	0.7951	0.7756	**0.8195**
SonyAISurface1	0.8436	0.6323	0.7654	0.8270	**0.9241**	0.8835	0.7271	0.9101	0.6656	0.7854
Strawberry	0.9622	0.9757	0.9703	0.9676	0.9819	0.9838	0.8514	0.8649	0.9622	**0.9865**
SwedishLeaf	0.9280	0.9216	0.9536	0.9664	0.9659	**0.9712**	0.9104	0.8816	0.8464	0.9296
Wafer*	**1.0000**	0.9948	0.9994	**1.0000**	0.9983	0.9987	0.9945	0.9956	0.9938	0.9968
Wine	0.7963	0.7407	0.7778	0.8889	0.8074	0.6667	0.8333	0.5000	0.5926	**0.9074**
Yoga	0.8177	0.9183	0.9177	0.8483	0.9085	0.9057	0.8457	0.7277	0.7587	0.8573
Total Best	7	5	6	6	9	10	0	0	1	**23**
Average Rank	5.93	6.66	4.15	4.16	3.29	4.53	7.16	7.07	7.51	**2.90**