1 2022/7/14

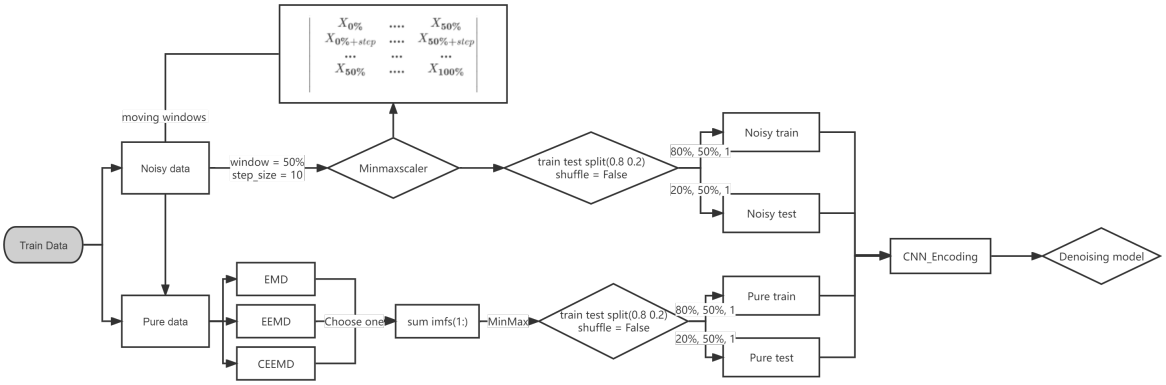


Figure 1: Pretext task

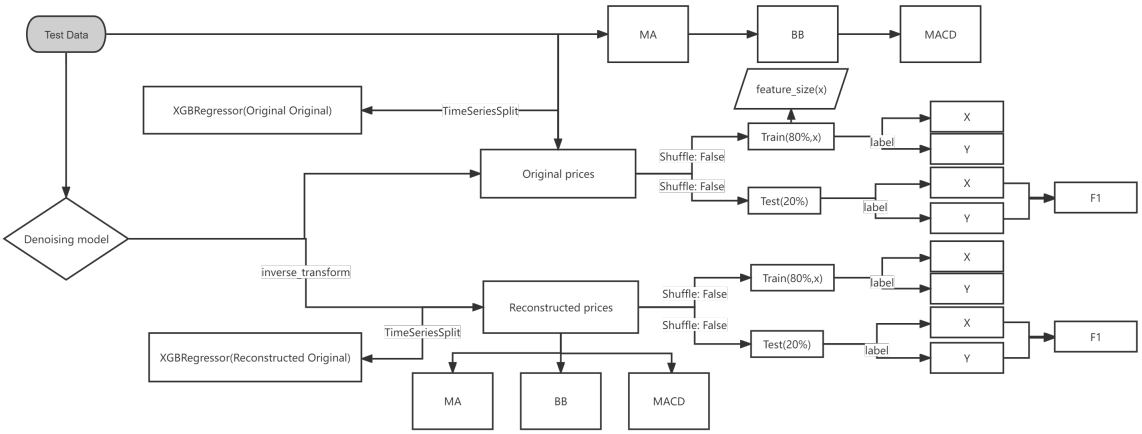


Figure 2: Downstream task

1.1 Close price of S&P 500 index from Yahoo finance (small dataset)

Table 1: R to O and O to O

MSE	EMDCNN	CNN	EMD	O
TimeSplit1	1684	2003	1721	2153
TimeSplit2	2131	1749	1762	1824
TimeSplit3	6463	8757	7077	9295
TimeSplit4	5545	5865	5916	5425
TimeSplit5	3632	3522	3498	3484
TimeSplit6	1095	1490	1230	1631
TimeSplit7	190	375	273	210
TimeSplit8	2480	10084	2620	2939
TimeSplit9	1979	1196	1571	2227
TimeSplit10	2967	1196	2313	4746
The average MSE	2817	3797	2798	3393
BayesianOptimization	1467	2336	1570	2482

SVC(label-Trend Forecast)

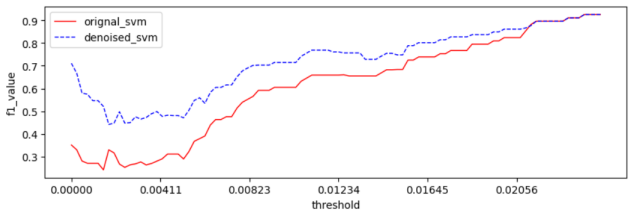


Figure 3: EMDCNN

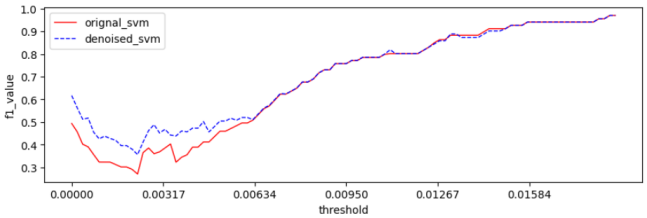


Figure 4: CNN

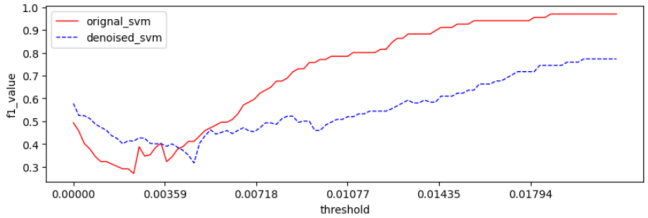


Figure 5: EMD

Strategies

Moving Average crossover

Table 2: Close Price Comparison via MA Crossover

Date	Buy with Original Signals	Date	Buy with Original Signals
2017-01-18	2271.889893	2017-02-06	2292.560059
2017-04-28	2384.199951	2017-04-28	2384.199951
2017-09-05	2457.850098	2017-09-06	2465.540039
2018-03-16	2752.010010	2018-03-16	2752.010010
2018-05-14	2730.129883	2018-05-14	2730.129883

Bollinger Bands

Table 3: Close Price Comparison via BB

Date	Buy with Original Signals	Date	Buy with Original Signals
2017-03-21	2344.020020	2017-03-21	2341.590088
2017-04-13	2328.949951		
2017-06-29	2419.699951	2017-06-29	2419.699951
2017-07-06	2409.750000		
2017-08-10	2438.209961	2017-08-10	2438.209961
2017-08-17	2430.010010	2017-08-16	2468.110107
2018-02-05	2648.939941	2018-02-05	2648.939941
2018-02-08	2581.000000		
2018-03-22	2643.689941	2018-03-21	2711.929932
2018-06-27	2699.629883		
2018-10-10	2785.679932	2018-10-08	2884.429932
2018-10-24	2656.100098	2018-10-24	2656.100098
2018-12-17	2545.939941	2018-12-17	2545.939941
2018-12-19	2506.959961		

Moving average convergence diver

Table 4: Close Price Comparison via MACD

Date	Buy with Original Signals	Date	Buy with Original Signals
2017-01-04	2270.750000		
2017-01-11	2275.320068		
2017-01-24	2280.070068	2017-01-18	2271.889893
2017-04-24	2374.149902	2017-04-21	2348.689941
2017-05-25	2415.070068	2017-05-25	2415.070068
2017-06-19	2453.459961		
2017-07-13	2447.830078	2017-07-13	2447.830078
2017-08-31	2471.649902	2017-08-31	2471.649902
		2017-11-07	2590.639893
2017-11-28	2627.040039	2017-11-27	2601.419922
2018-01-04	2723.989990	2018-01-04	2723.989990
2018-02-23	2747.300049	2018-02-22	2703.959961
2018-03-05	2720.939941		
2018-04-10	2656.870117	2018-04-10	2656.870117
2018-05-07	2672.629883	2018-05-07	2672.629883
2018-06-04	2746.870117	2018-06-04	2746.870117
2018-07-09	2784.169922	2018-07-09	2784.169922
2018-08-06	2850.399902	2018-08-06	2850.399902
2018-08-24	2874.689941	2018-08-27	2896.739990
2018-09-20	2930.750000		
2018-11-02	2723.060059	2018-11-02	2723.060059
2018-11-28	2743.790039	2018-11-28	2743.790039
		2018-12-31	2506.850098

Train Data: 2017.01.01-2019.01.01

Table 5: R to O and O to O

MSE	EMDCNN	CNN	EMD	O
TimeSplit1	852	788	1067	982
TimeSplit2	19785	23803	18756	20546
TimeSplit3	4894	3437	3154	3796
TimeSplit4	17096	20014	18494	24085
TimeSplit5	5671	11100	11201	8463
TimeSplit6	1385	1456	945	1464
TimeSplit7	1393	1836	895	1930
TimeSplit8	2952	2489	1517	1641
TimeSplit9	549	649	1618	3082
TimeSplit10	357	1090	605	1896
The average MSE	5493	6666	5825	6788
BayesianOptimization	331	437	343	637

SVC(label-Trend Forecast)

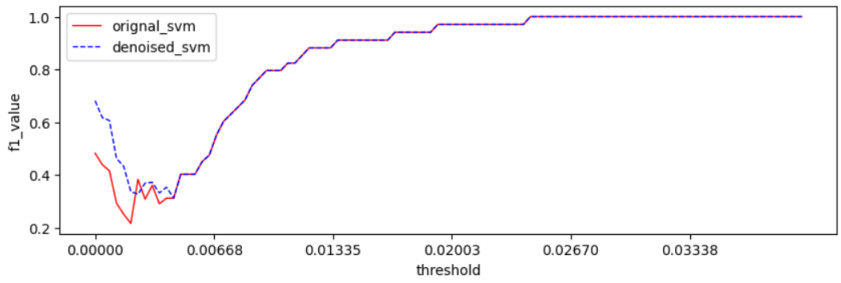


Figure 6: EMDCNN(2018-2019)

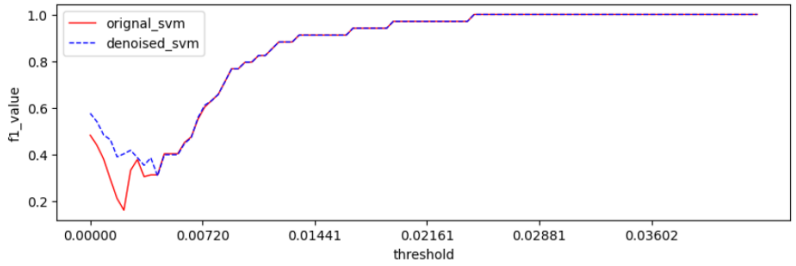


Figure 7: CNN(2018-2019)

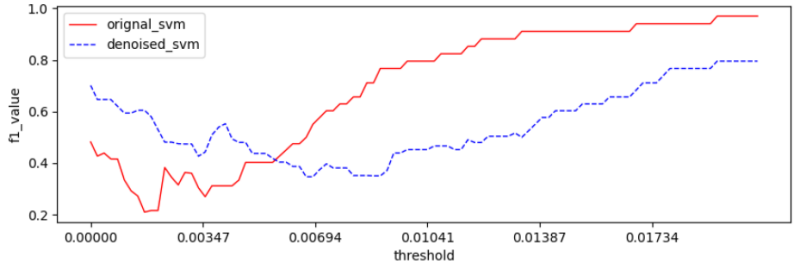


Figure 8: EMD(2018-2019)

Strategies

Moving Average crossover

Table 6: Close Price Comparison via MA Crossover

Date	Buy with Original Signals	Date	Buy with Original Signals
2018-06-15	2779.659912	2018-06-15	2779.659912
2018-07-13	2801.310059	2018-07-12	2798.290039
2019-01-24	2642.330078	2019-01-24	2642.330078

Bollinger Bands

Table 7: Close Price Comparison via BB

Date	Buy with Original Signals	Date	Buy with Original Signals
2018-06-25	2717.070068		
2018-06-27	2699.629883		
2018-10-10	2785.679932	2018-10-08	2884.429932
2018-10-24	2656.100098	2018-10-24	2656.100098
2018-12-17	2545.939941	2018-12-17	2545.939941
2018-12-19	2506.959961		
2019-05-13	2811.870117	2019-05-09	2870.719971
2019-05-31	2752.060059	2019-05-31	2752.060059

Moving average convergence diver

Table 8: Close Price Comparison via MACD

Date	Buy with Original Signals	Date	Buy with Original Signals
2018-06-04	2746.870117	2018-06-04	2746.870117
2018-07-06	2759.820068	2018-07-06	2759.820068
2018-08-03	2840.350098	2018-08-03	2840.350098
2018-08-22	2861.820068		
2018-08-24	2874.689941	2018-08-24	2874.689941
2018-09-20	2930.750000		
2018-11-02	2723.060059	2018-11-02	2723.060059
2018-11-28	2743.790039	2018-11-28	2743.790039
2019-01-02	2510.030029	2019-01-03	2447.889893
2019-03-19	2832.570068		
2019-04-02	2867.239990	2019-04-03	2873.399902
2019-04-23	2933.679932		

1.2 Minute price of bitcoin (large dataset)

Table 9: R to O and O to O

MSE	EMDCNN	CNN	EMD	O
TimeSplit1	4970	4056	5036	6959
TimeSplit2	3104	2752	3392	4641
TimeSplit3	26702459	26292704	27773179	28271068
TimeSplit4	6144499	6020593	6036827	6095684
TimeSplit5	10375	10285	10274	10902
TimeSplit6	191519	172883	196104	198253
TimeSplit7	3298	2953	3081	3662
TimeSplit8	695664	616497	679774	717363
TimeSplit9	6567	6002	6659	8267
TimeSplit10	3798	2947	3176	4237
The average MSE	3376625	3313167	3471750	3532104

SVC(label-Trend Forecast)

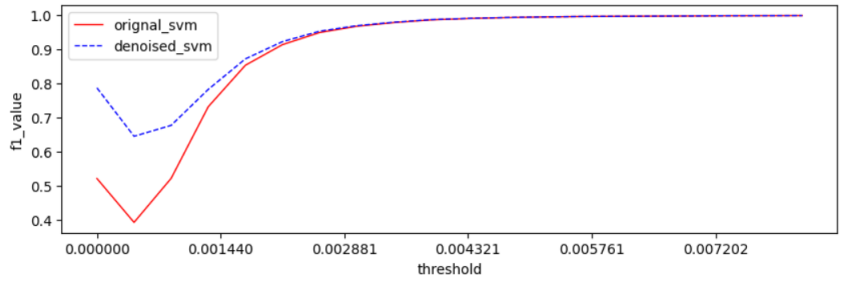


Figure 9: EMDCNN(bit)(10to1)

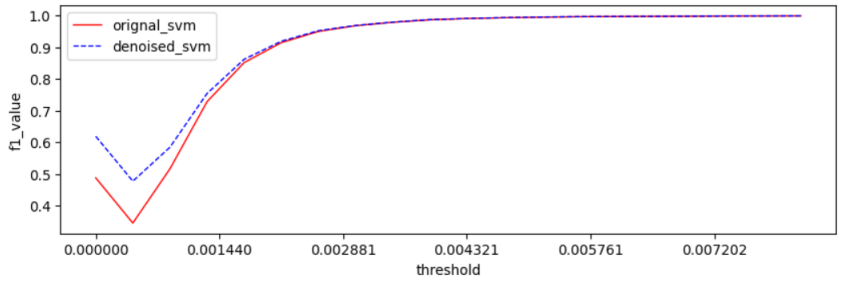


Figure 10: EMDCNN(bit)(1to1)

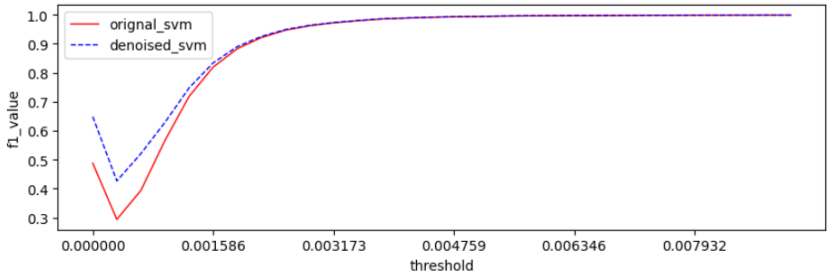


Figure 11: CNN(bit)

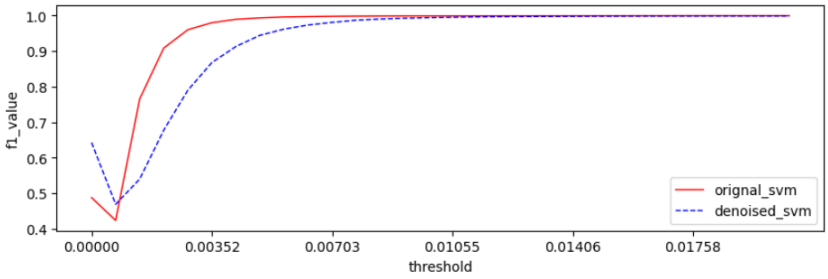


Figure 12: EMDC(bit)

BIT later

Train Data: 2021.01.01-2021.05.12(Only using first 80%, 150652 observation)

Test Data: 2021.01.01-2021.05.12

Table 10: R to O and O to O

MSE	EMDCNN	O
TimeSplit1	4616	6959
TimeSplit2	3104	4641
TimeSplit3	26977903	28271068
TimeSplit4	6303679	6095684
TimeSplit5	10198	10902
TimeSplit6	196822	198253
TimeSplit7	2552	3662
TimeSplit8	670754	717363
TimeSplit9	5562	8267
TimeSplit10	5987	4237
The average MSE	3418117	3532104

SVC(label-Trend Forecast)

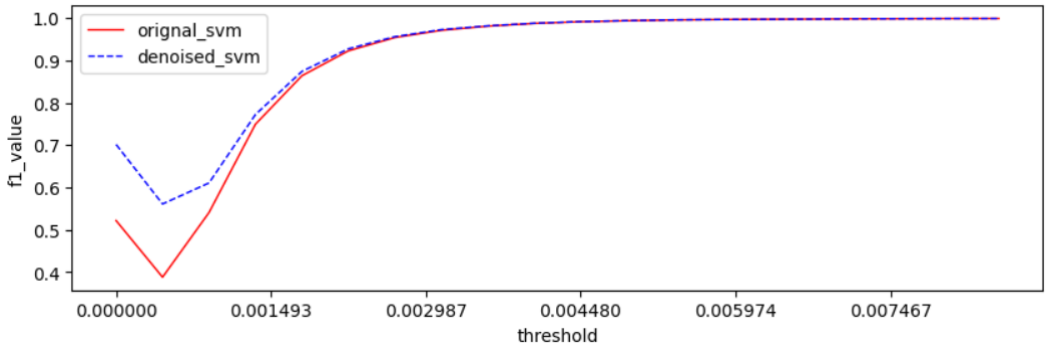


Figure 13: SVC(bit)(10to1)

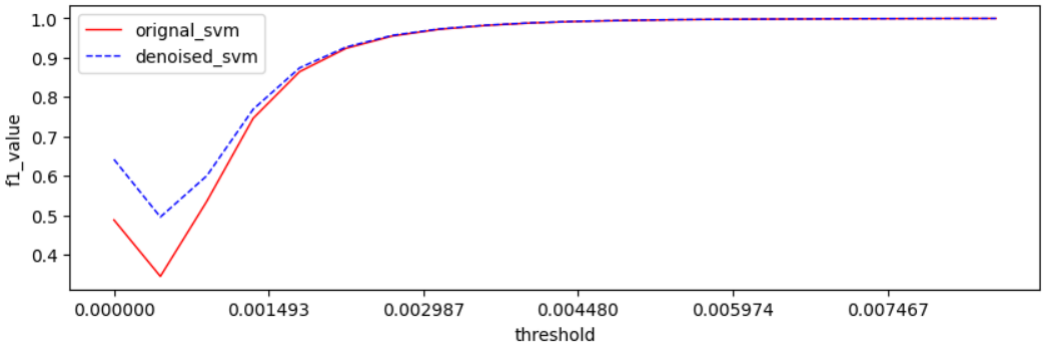


Figure 14: SVC(bit)(1to1)

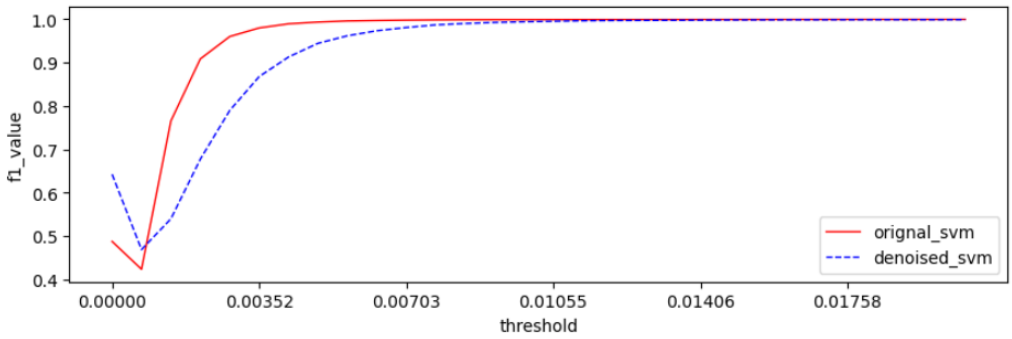


Figure 15: EMDC(bit)Like above

1.3 Minute data of road congestion (another type of dataset)

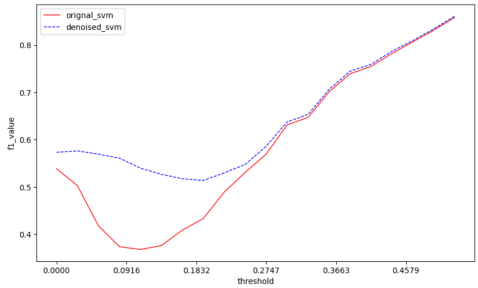
Train Data: 1991.04.01-1991.09.30

Test Data: 1991.04.01-1991.09.30

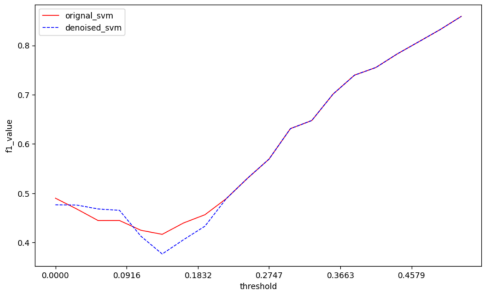
Table 11: R to O and O to O

MSE	EMDCNN	CNN	EMD	O
TimeSplit1	74	144	105	137
TimeSplit2	72	156	100	144
TimeSplit3	62	139	93	150
TimeSplit4	61	134	99	153
TimeSplit5	65	134	100	150
TimeSplit6	55	114	89	131
TimeSplit7	54	122	84	127
TimeSplit8	52	122	79	134
TimeSplit9	67	135	107	152
TimeSplit10	48	104	78	124
The average MSE	61	129	93	140
BayesianOptimization	26	25	25	117

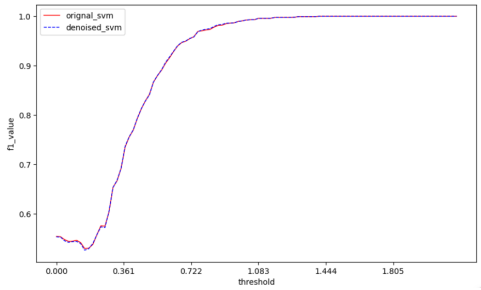
SVC(label-Trend Forecast)



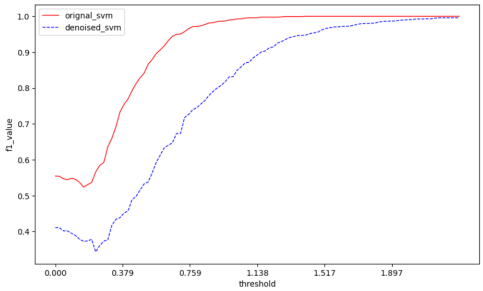
(a) EMDCNN(tra)(10to1)



(b) EMDCNN(tra)(1to1)



(c) CNN(tra)



(d) EMD(tra)

Figure 16: pics

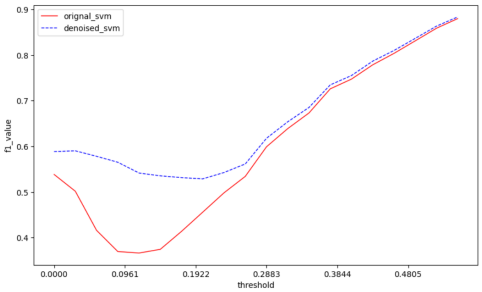
Traffic congestion

Train Data: 1991.04.01-1991.09.30(Only using first 80%, 10446 observation)
Test Data: 1991.04.01-1991.09.30(Later 20%)

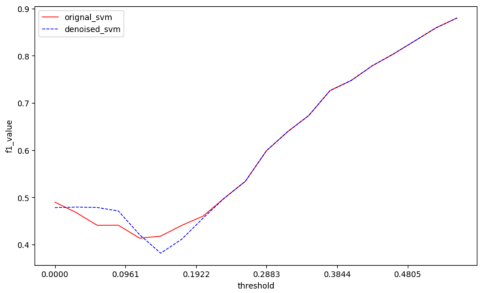
Table 12: R to O and O to O

MSE	EMDCNN	O
TimeSplit1	76	137
TimeSplit2	69	144
TimeSplit3	61	150
TimeSplit4	61	153
TimeSplit5	66	150
TimeSplit6	56	131
TimeSplit7	50	127
TimeSplit8	54	134
TimeSplit9	64	152
TimeSplit10	50	124
The average MSE	61	140
BayesianOptimization	28	117

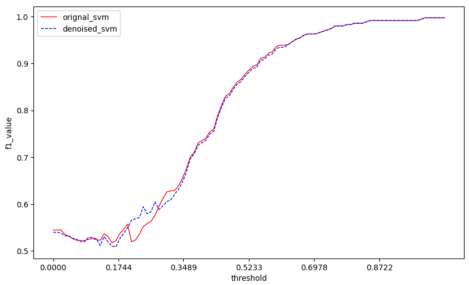
SVC(label-Trend Forecast)



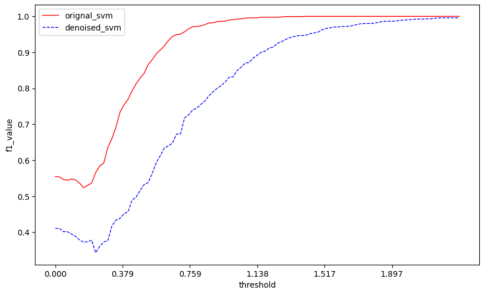
(a) EMDCNN(tra)(10to1)



(b) EMDCNN(tra)(1to1)



(c) CNN(tra)



(d) EMD(tra)

Figure 17: pics