DILC-ESAE: Data-Info Envelope Stacked Autoencoder on correlation among samples rather than themselves

Complete experimental results

B. Verification of effectiveness by Ablation study

In this subsection, several sensitivity experiments are designed to evaluate the proposed DILC-ESAE algorithm.

1) Verification of reconstructed samples on SVM

TABLE 4

EXPERIMENTAL RESULTS (MEAN ±STD) OF OUR PROPOSED METHOD IN DIFFERENT STAGES. (BEST RESULTS IN EACH COLUMN ARE HIGHLIGHTED IN BOLD.)

Dataset	Acc (%)					
	MSPC	KM	JCDR	KM+ICM	JCDR+ICM	DILC
AD	64.67 ±4.47	75.33 ±7.30	66.67 ±7.84	66.00 ±5.96	72.67 ±10.38	**75.58 ±9.59**
LSVT	94.29 ±3.98	92.86 ±1.67	95.24 ±4.45	94.76 ±2.61	95.80 ±3.33	**96.54 ±4.48**
PD	70.75 ±1.74	66.21 ±1.70	66.84 ±1.52	70.75 ±3. 40	71.03 ±1.40	**74.14 ±4.18**
Pendigits	98.62 ±0.07	98.64 ±0.28	99.09 ±0.35	98.83 ±1.46	98.78 ±0.12	**99.27 ±0.26**
Statlog	**88.65 ±0.75**	85.59 ±0.76	85.86 ±0.69	85.13 ±0.30	86.02 ±0.75	88.36 ±0.45
Vehicle	83.90 ±0.19	79.93 ±2.93	83.40 ±0.77	85.67 ±1.98	**87.30 ±0.81**	87.16 ±0.81
heart	85.56 ±2.83	90.89 ±0.50	90.91 ±4.08	88.44 ±2.30	91.20 ±4.25	**92.44 ±3.37**
Maxlittle	86.77 ±2.57	87.69 ±3.61	88.27 ±3.86	88.31 ±3.19	89.23 ±5.65	**91.25 ±8.39**
Urban	90.67 ±2.65	72.62 ±2.99	88.27 ±2.36	76.49 ±1.90	93.51 ±3.35	**94.46 ±1.47**
WDBC	97.57 ±1.38	97.99 ±0.24	98.59 ±0.38	98.73 ±0.29	98.99 ±1.09	**99.18 ±0.72**
Wisconsin	97.18 ±1.48	97.53 ±1.01	97.89 ±0.79	97.89 ±0.85	98.06 ±0.50	**98.41 ±0.74**
PID	74.14 ±4.27	78.52 ±2.52	80.08 ±2.16	81.72 ±3.13	82.95 ±2.25	**83.63 ±2.99**
LR	89.65 ±0.21	87.73 ±0.33	87.92 ±0.30	**89.83 ±0.15**	89.06 ±0.11	89.79 ±0.3**4**
GSAD	**99.45 ±0.09**	96.60 ±2.34	96.67 ± 1.04	97.58 ± ± 0.12	97.45 ±0.30	96.05 ±0.60
HAR	98.72 ±0.07	98.35 ±0.27	98.36 ±0.27	98.58 ± 0.16	98.35 ±0.15	**99.10 ±0.26**

Dataset	MACRO-F1 (%)					
	MSPC	KM	JCDR	KM+ICM	JCDR+ICM	DILC
AD	64.78 ±8.32	53.70 ±8.28	72.09 ±7.55	70.01 ±6.01	73.85 ±9.76	**74.12 ±10.90**
LSVT	93.61 ±4.60	92.50 ±5.34	94.75 ±4.86	94.19 ±2.92	95.24 ±6.52	**95.77 ±5.62**
PD	70.62 ±1.73	62.62 ±1.62	66.89 ±1.52	70.79 ±3.44	70.94 ±2.46	**71.54 ±3.18**
Pendigits	**99.04 ±0.09**	98.62 ±0.28	97.95 ±0.05	96.21 ±0.41	98.03 ±0.09	**99.04 ±0.09**
Statlog	**85.60 ±1.07**	81.49 ±0.99	75.24 ±0.84	79.46 ±1.22	77.26 ±0.91	85.59 ±1.05
Vehicle	84.55 ±0.96	81.51 ±0.73	90.53 ±0.83	85.88 ±2.02	**90.83 ±1.47**	87.40 ±0.70
heart	86.14 ±2.63	79.77 ±2.99	90.43 ±2.92	88.54 ±2.43	90.86 ±3.72	**91.09 ±3.67**
Maxlittle	79.36 ±4.24	71.98 ±3.81	79.35 ±3.67	83.54 ±4.60	84.54 ±8.68	**87.15 ±5.87**
Urban	90.77 ±2.76	72.58 ±5.98	87.32 ±1.81	77.31 ±4.93	**94..37 ±2.37**	92.13 ±3.67
WDBC	97.63 ±1.52	95.94 ±1.68	97.31 ±0.46	98.65 ±0.31	98.80 ±0.69	**98.85 ±1.47**
Wisconsin	95.95 ±1.69	93.10 ±3.17	97.69 ±0.84	97.72 ±0.84	97.87 ±0.56	**98.11 ±1.28**
PID	74.82 ±2.20	72.66 ±2.95	77.43 ±2.66	74.54 ±2.08	74.66 ±3.16	**75.98 ±1.90**

LR	89.61±0.23	87.67±0.35	87.87±0.32	89.91±0.20	89.01±0.05	**90.18±1.26**
GSAD	**99.43±0.10**	96.42±2.49	96.55±0.99	97.49±0.10	97.37±0.33	96.17±0.47
HAR	98.79±0.08	98.46±0.25	98.46±0.25	98.65±0.17	98.42±0.14	**99.20±0.22**

Dataset	AUC (%)					
	MSPC	KM	JCDR	KM+ICM	JCDR+ICM	DILC
AD	73.90±7.25	66.16±7.98	70.00±9.39	69.48±4.42	78.73±9.24	**81.83±8.51**
LSVT	94.83±3.15	92.14±6.00	**96.75±1.90**	93.70±4.70	93.30±9.26	96.59±3.92
PD	71.79±2.96	63.78±1.57	68.05±1.38	71.61±4.71	72.12±3.06	**72.16±5.66**
Pendigits	99.52±0.06	**99.70±0.18**	98.96±0.07	99.40±2.64	98.99±0.10	99.47±0.05
Statlog	**91.98±0.59**	90.12±0.67	87.61±0.65	87.20±1.12	88.77±0.71	91.29±0.60
Vehicle	89.62±1.24	88.04±1.32	90.53±2.20	90.98±1.31	**92.52±0.42**	92.12±1.19
heart	86.92±3.04	80.01±3.36	91.81±3.49	90.92±5.63	91.95±4.44	**92.08±2.67**
Maxlittle	92.89±0.89	81.09±17.95	92.66±1.14	93.56±0.72	83.34±2.46	**93.78±1.32**
Urban	94.63±1.89	73.31±2.97	92.94±0.56	84.21±1.77	95.45±0.85	**96.25±2.11**
WDBC	98.77±1.16	97.67±1.40	98.08±0.36	98.27±0.01	98.30±0.83	**98.61±1.13**
Wisconsin	96.08±1.12	96.92±1.87	97.62±1.05	97.88±1.37	97.29±1.00	**98.01±0.57**
PID	74.43±3.73	67.35±10.02	80.00±2.35	81.75±4.77	81.97±2.58	**82.21±2.49**
LR	94.57±0.11	93.57±0.17	93.66±0.16	94.66±0.08	94.25±0.05	**95.88±0.57**
GSAD	**99.65±0.07**	97.48±1.85	97.78±0.69	98.48±0.21	98.40±0.21	97.66±0.33
HAR	99.27±0.05	99.06±0.15	99.06±0.15	99.18±0.10	99.04±0.09	**99.51±0.14**
Dataset	AP (%)					
	MSPC	KM	JCDR	KM+ICM	JCDR+ICM	DILC
AD	78.21±8.08	70.18±10.17	77.78±10.81	75.52±1.48	82.42±5.54	**84.38±8.77.**
LSVT	93.60±5.58	91.72±7.58	97.56±2.71	96.24±2.65	96.78±4.42	**97.84±3.33**
PD	71.60±2.62	61.82±2.17	66.39±1.93	71.63±4.95	73.00±3.48	**73.76±3.35**
Pendigits	98.89±0.09	99.70±0.05	99.58±0.02	92.57±0.98	99.59±0.04	**99.80±0.04**
Statlog	96.26±0.27	95.55±0.32	93.96±0.35	95.27±0.55	94.43±0.44	**96.47±0.37**
Vehicle	92.52±1.30	91.25±0.96	91.42±0.77	92.90±0.66	**94.12±1.17**	93.96±0.72
heart	83.15±5.18	81.00±4.36	89.84±5.37	87.66±4.77	90.28±5.39	**92.02±5.51**
Maxlittle	76.90±4.37	57.00±14.15	71.45±8.12	78.74±10.12	80.63±10.35	**81.57±4..15**
Urban	97.80±0.80	90.12±0.96	96.61±0.31	92.09±0.73	**98.48±1.04**	98.02±1.06
WDBC	96.54±2.46	95.65±2.46	95.94±0.66	96.92±1.31	97.43±0.64	**97.81±1.33**
Wisconsin	92.56±3.35	90.11±3.65	95.89±1.47	95.99±1.76	96.72±0.72	**98.10±2.49**
PID	75.31±5.34	70.31±6.04	78.05±3.05	80.11±4.06	75.40±3.60	**80.85±2.74**
LR	99.24±0.04	99.09±0.03	99.10±0.01	99.22±0.03	99.15±0.01	**99.38±0.09**
GSAD	**99.66±0.09**	98.90±0.51	99.03±0.34	99.14±0.05	99.09±0.07	96.17±0.65
HAR	99.53±0.09	99.34±0.19	99.34±0.19	99.47±0.06	99.36±0.09	**99.54±0.07**

2) Verification of the reconstructed samples on ESAE

TABLE 5

EXPERIMENTAL RESULTS (MEAN±STD) OF THE DILC ON ESAE. (BEST RESULTS IN EACH COLUMN ARE HIGHLIGHTED IN BOLD.)

Dataset	Acc (%)						
	OF(ESAE)	MSPC(ESAE)	KM(ESAE)	JCDR(ESAE)	KM+ICM(ESAE)	JCDR+ICM(ESAE)	DILC-ESAE
AD	57.67±12.11	73.33±6.24	67.33±10.11	73.33±7.82	84.67±10.70	76.00±4.35	**76.67±8.16**
LSVT	82.38±9.00	96.19±3.61	96.07±9.85	96.46±6.18	95.05±11.72	97.41±5.86	**97.62±1.68**
PD	67.27±1.77	74.43±1.61	69.89±2.74	73.68±5.38	72.36±1.68	74.60±4.56	**75.98±4.29**
Pendigits	98.94±0.09	99.51±0.17	98.84±0.57	99.20±0.46	98.93±0.80	99.50±0.82	**99.54±0.11**

Statlog	87.38±0.45	88.72±0.84	85.92±1.26	86.98±3.58	88.39±2.36	88.57±2.39	**89.42±0.81**
Vehicle	84.75±6.11	88.33±0.18	80.61±4.93	84.16±3.43	86.45±7.47	87.30±3.79	**87.36±1.15**
heart	82.22±2.24	87.43±3.48	90.96±5.28	91.11±5.56	90.55±4.87	92.67±3.20	**94.67±2.98**
Maxlittle	91.38±3.37	92.52±3.19	88.08±5.57	89.23±6.97	94.72±2.46	94.07±2.67	**98.75±1.71**
Urban	80.76±3.85	97.62±2.68	82.31±1.78	88.29±3.80	**99.74±0.31**	94.02±0.46	97.42±0.91
WDBC	96.64±3.79	98.09±2.68	98.10±3.70	98.61±1.61	98.98±2.20	**99.15±2.91**	98.08±0.89
Wisconsin	96.65±1.31	99.19±1.28	97.86±1.37	98.68±0.44	98.68±0.88	99.12±0.44	**99.82±0.40**
PID	76.17±1.27	80.08±2.49	78.95±1.72	81.84±6.26	**85.31±1.58**	82.53±3.79	84.06±3.34
LR	88.69±2.53	90.14±1.60	88.09±2.62	89.94±10.59	84.15±6.96	90.07±4.46	**94.38±0.37**
GSAD	**99.81±6.16**	99.04±3.17	97.94±1.57	95.33±4.79	98.06±1.85	97.72±0.40	96.71±0.33
HAR	98.63±5.25	98.86±0.31	98.81±1.24	98.39±0.85	94.17±1.77	99.39±0.15	**99.51±0.43**

Dataset	MACRO-F1 (%)						
	OF(ESAE)	MSPC(ESAE)	KM(ESAE)	JCDR(ESAE)	KM+ICM(ESAE)	JCDR+ICM(ESAE)	DILC-ESAE
AD	56.88±7.64	66.51±13.00	67.21±10.51	74.59±7.40	75.00±11.64	74.59±7.40	**71.86±2.14**
LSVT	82.20±9.83	95.24±3.88	90.41±2.81	90.62±5.25	92.18±5.96	94.73±4.27	**95.79±3.97**
PD	61.52±2.14	74.01±3.53	70.28±2.31	74.28±4.79	70.81±3.64	75.96±3.31	**77.07±2.90**
Pendigits	98.94±0.09	99.52±0.17	98.42±0.07	98.37±0.67	98.99±1.47	99.46±0.73	**99.55±0.14**
Statlog	84.67±1.06	86.45±0.44	82.73±3.57	84.13±2.71	85.95±5.78	86.81±1.58	**87.81±1.04**
Vehicle	81.96±4.06	84.68±8.11	82.48±4.19	90.85±4.46	86.04±4.18	91.54±2.59	**91.61±3.79**
heart	82.22±2.96	91.50±3.12	83.37±5.85	91.58±5.16	91.80±2.70	93.29±2.95	**93.61±2.96**
Maxlittle	88.14±4.83	91.62±3.56	81.26±8.59	87.30±6.10	87.54±3.67	91.58±2.33	**92.43±3.25**
Urban	76.41±1.13	79.33±2.32	71.62±2.99	71.74±3.89	74.98±3.13	75.58±4.98	**81.31±1.99**
WDBC	95.58±3.68	97.69±1.48	97.04±2.89	95.75±2.59	99.32±0.47	96.69±1.73	**97.15±1.82**
Wisconsin	96.37±1.39	98.68±1.01	97.72±1.47	98.56±0.49	98.56±0.49	98.57±0.47	**99.13±0.80**
PID	74.57±1.00	77.76±3.45	71.79±0.84	76.67±6.99	83.17±3.02	77.03±3.33	**79.75±3.29**
LR	88.85±2.46	90.30±1.49	88.37±2.34	80.35±10.53	84.32±6.69	89.77±1.33	**91.67±2.48**
GSAD	**99.56±6.58**	99.41±2.17	98.68±9.61	55.29±8.89	98.42±1.57	95.24±2.58	96.73±0.18
HAR	95.49±5.66	98.71±0.31	95.60±5.79	98.88±1.27	94.25±1.70	98.98±0.57	**99.78±0.16**

Dataset	AUC (%)						
	OF(ESAE)	MSPC(ESAE)	KM(ESAE)	JCDR(ESAE)	KM+ICM(ESAE)	JCDR+ICM(ESAE)	DILC-ESAE
AD	63.00±9.08	77.00±9.94	75.50±7.58	80.00±5.86	80.50±8.73	80.00±5.86	**82.11±3.74**
LSVT	90.08±3.78	94.29±5.27	96.42±8.74	89.29±4.55	91.43±4.96	93.30±5.90	**96.62±2.67**
PD	67.30±5.96	72.99±4.51	69.89±2.74	73.68±5.38	69.48±3.77	75.50±3.69	**79.30±4.94**
Pendigits	99.41±0.05	99.73±0.10	99.01±0.04	99.08±0.38	99.14±1.49	99.48±0.69	**99.75±0.08**
Statlog	90.85±0.74	92.74±0.74	90.54±2.18	87.93±1.92	88.62±7.78	89.72±1.56	**92.69±0.94**
Vehicle	87.92±4.33	83.86±5.48	89.57±4.56	91.28±1.59	91.14±3.89	92.99±1.29	**93.11±0.48**
heart	82.25±2.83	91.20±3.36	82.95±6.05	91.00±4.97	91.70±2.58	92.94±2.81	**95.68±1.99**
Maxlittle	94.38±0.39	94.61±1.88	82.74±2.91	94.66±2.47	93.72±2.11	90.31±4.22	**95.68±1.99**
Urban	85.95±4.11	87.75±1.57	78.84±3.22	82.92±2.71	85.14±1.83	**98.53±1.37**	90.61±1.94
WDBC	96.96±4.12	97.82±1.26	97.35±2.31	96.05±2.05	99.14±0.60	96.74±1.54	**98.54±1.38**
Wisconsin	96.72±1.27	98.94±0.79	97.97±1.62	98.57±0.78	98.57±0.78	98.69±0.72	**99.03±0.94**
PID	74.53±1.88	77.41±3.03	70.22±2.10	74.81±8.18	83.23±2.70	76.92±3.33	**82.94±2.16**
LR	94.10±1.31	94.85±0.83	93.80±1.31	79.11±5.53	91.72±6.77	94.33±3.07	**97.56±0.14**
GSAD	**99.61±3.69**	99.36±1.66	86.48±7.03	72.81±6.15	93.05±0.92	98.48±0.89	98.52±0.16
HAR	97.30±3.37	99.22±0.19	97.38±3.42	99.08±0.51	96.48±1.17	99.46±0.24	**99.67±0.08**

	AP (%)						
Dataset	OF(ESAE)	MSPC(ESAE)	KM(ESAE)	JCDR(ESAE)	KM+ICM(ESAE)	JCDR+ICM(ESAE)	DILC-ESAE
AD	68.72±9.67	78.58±11.58	86.60±6.78	79.75±2.74	81.39±11.74	79.75±2.74	**71.86±2.14**

LSVT	82.61±10.81	96.68±2.66	81.40±14.28	92.57±4.71	93.14±5.26	96.33±2.47	**97.24±2.88**
PD	68.15±3.04	75.45±5.48	70.21±3.56	73.54±7.31	69.27±6.33	76.40±3.14	**76.91±4.06**
Pendigits	99.76±0.05	99.92±0.04	99.88±0.04	99.65±0.17	93.23±1.17	99.65±0.17	**99.92±0.04**
Statlog	95.99±0.29	96.69±0.12	95.94±1.01	94.60±1.18	95.98±2.56	95.72±0.21	**96.77±0.17**
Vehicle	91.04±1.45	92.62±1.50	93.31±0.80	94.09±3.66	94.17±2.06	**95.11±1.56**	94.81±2.42
heart	79.67±5.26	90.53±5.13	82.99±5.44	89.87±9.20	93.24±4.14	93.93±1.76	**92.46±5.83**
Maxlittle	84.84±8.53	90.68±4.64	78.18±11.03	86.23±10.12	88.46±4.82	91.61±4.61	**91.41±3.88**
Urban	95.32±1.00	95.58±0.26	91.68±1.94	94.27±1.14	94.28±0.64	95.17±1.33	**95.96±0.43**
WDBC	94.64±2.32	97.89±1.79	97.56±1.49	96.61±1.75	99.20±0.56	96.96±1.81	**97.91±1.05**
Wisconsin	93.60±2.46	97.50±2.31	95.49±3.02	97.52±0.73	97.52±0.73	97.38±0.93	**98.62±1.63**
PID	74.34±4.73	77.95±6.48	73.70±2.91	78.14±4.51	82.72±4.60	78.18±0.77	**81.11±4.00**
LR	99.11±0.20	99.24±0.12	99.10±0.19	98.52±0.99	94.52±2.83	99.41±0.16	**99.73±0.22**
GSAD	**99.74±1.12**	99.29±0.84	93.65±3.63	85.85±3.30	96.14±0.26	96.34±0.46	97.10±0.31
HAR	98.41±1.82	99.46±0.22	98.46±1.74	99.43±0.94	97.95±0.96	99.47±0.37	**99.78±0.09**

C. Comparison on different classifier

1) Comparison with original sample oriented EASE

TABLE 6

COMPARISON SAMPLE WITH CORRELATION INFORMATION (BEST RESULTS IN EACH COLUMN ARE HIGHLIGHTED IN BOLD)(%)

Dataset	Measure	OF	Two-ESAE	DILC-ESAE
AD	ACC	54.00±9.55	53.10±10.90	**76.67±8.16**
	MACRO-F1	50.24±8.44	51.34±8.44	**71.86±2.14**
	AUC	58.04±3.75	55.77±5.57	**82.11±3.74**
	AP	71.46±9.75	67.95±2.41	**71.86±2.14**
LSVT	ACC	80.48±6.39	87.62±7.22	**97.62±1.68**
	MACRO-F1	76.57±4.38	88.33±6.96	**95.79±3.97**
	AUC	79.02±7.72	86.78±8.61	**96.62±2.67**
	AP	78.08±5.49	91.07±5.71	**97.24±2.88**
Pendigits	ACC	98.13±0.05	98.56±0.19	**99.54±0.11**
	MACRO-F1	97.74±0.13	98.42±0.05	**99.55±0.14**
	AUC	99.10±0.18	98.67±0.15	**99.75±0.08**
	AP	99.56±0.03	98.85±0.03	**99.92±0.04**
WDBC	ACC	95.66±1.52	97.02±3.86	**98.08±0.89**
	MACRO-F1	95.23±1.33	96.61±1.64	**97.15±1.82**
	AUC	96.00±1.80	96.39±0.98	**98.54±1.38**
	AP	94.15±2.05	96.33±1.01	**97.91±1.05**
LR	ACC	85.84±0.16	85.43±0.21	**94.38±0.37**
	MACRO-F1	85.83±0.19	85.40±0.22	**91.67±2.48**
	AUC	92.59±0.09	92.37±0.11	**97.56±0.14**
	AP	98.96±0.02	98.92±0.02	**99.73±0.22**
HAR	ACC	98.25±0.32	97.55±2.53	**99.51±0.43**
	MACRO-F1	98.35±0.29	97.20±2.48	**99.78±0.16**
	AUC	98.99±0.18	96.70±2.40	**99.67±0.08**
	AP	99.31±0.16	96.14±3.98	**99.78±0.09**

2) Comparison with classical feature-learning algorithms

TABLE 7

COMPARISON OF DIFFERENT FEATURE-LEARNING ALGORITHMS THE BOLD VALUES INDICATE THE BEST RESULTS, RESPECTIVELY.

Dataset	Acc (%)							
	OF	PCA	LDA	LPP	Relief	Lasso	P_value	DILC-ESAE
AD	54.00±9.55	60.00±8.50	62.67±4.94	60.67±7.60	54.00±10.90	54.00±9.55	48.67±7.67	**76.67±8.16**
LSVT	80.48±6.39	90.48±3.37	87.14±3.61	90.48±3.76	88.57±3.10	76.67±5.16	75.71±5.93	**97.62±1.68**
PD	62.70±1.86	64.94±1.95	64.20±1.74	65.29±1.47	64.08±1.13	62.70±1.86	56.61±3.92	**75.98±4.29**
Pendigits	98.13±0.05	98.07±0.13	97.87±0.23	97.97±0.11	97.82±0.23	98.13±0.05	92.87±1.46	**99.54±0.11**
Statlog	86.13±0.53	87.23±0.54	87.09±0.63	87.27±0.48	86.10±0.40	86.15±0.51	86.13±0.68	**89.42±0.81**
Vehicle	80.35±1.31	82.34±1.05	82.55±0.92	81.77±0.89	78.16±0.19	80.781.05	75.39±0.89	**87.36±1.15**
heart	78.89±3.42	**85.33±2.53**	**84.67±2.14**	84.22±3.37	81.78±3.00	78.29±3.42	62.00±4.67	**94.67±2.98**
Maxlittle	84.62±3.92	88.62±2.79	88.62±4.16	86.77±4.43	85.85±5.03	85.23±4.16	76.62±2.75	**98.75±1.71**
Urban	79.91±3.87	82.40±2.80	83.38±2.10	82.93±2.53	80.18±2.53	79.91±3.84	80.44±2.67	**97.42±0.91**
WDBC	95.66±1.52	97.88±0.84	97.46±0.69	97.35±0.53	97.04±1.43	95.78±1.54	88.78±2.19	**98.08±0.89**
Wisconsin	96.30±1.72	97.18±1.19	96.83±1.26	97.00±1.18	96.74±1.83	96.30±1.72	93.66±1.67	**99.82±0.40**
PID	70.40±2.74	72.34±1.98	75.78±3.49	69.67±5.54	73.29±4.51	70.39±2.74	73.91±3.55	**84.06±3.34**
LR	85.84±0.16	85.30±0.26	85.43±0.21	85.39±0.27	84.89±0.07	85.84±0.16	84.21±0.63	**94.38±0.37**
GSAD	99.20±0.15	99.27±0.14	**99.41±0.10**	99.29±0.14	99.19±0.16	99.23±0.13	99.23±0.13	96.71±0.33
HAR	98.25±0.32	98.44±0.28	98.40±0.29	98.43±0.26	98.30±0.26	99.23±0.31	97.92±0.39	**99.51±0.43**
Dataset	MACRO-F1(%)							
	OF	PCA	LDA	LPP	Relief	Lasso	P_value	DILC-ESAE
AD	50.24±8.44	55.64±4.31	51.73±8.81	55.64±4.31	51.44±8.44	55.60±4.26	64.28±3.32	71.86±2.14
LSVT	76.57±4.38	76.57±4.38	76.57±4.38	76.96±4.62	79.29±7.22	73.21±5.84	69.31±5.18	**95.79±3.97**
PD	60.12±1.65	62.95±1.80	63.35±1.58	62.95±1.80	62.72±1.78	62.95±1.80	56.80±3.11	**77.07±2.90**
Pendigits	97.74±0.13	98.12±0.12	98.00±0.23	98.09±0.15	98.02±0.16	98.25±0.17	93.24±1.30	**99.55±0.14**
Statlog	80.98±1.85	**93.04±1.13**	82.89±0.99	83.14±0.97	82.74±1.15	82.91±1.17	82.61±1.09	87.81±1.04
Vehicle	80.57±0.56	80.63±0.88	80.75±1.49	80.49±1.01	78.07±0.59	80.56±1.05	75.43±1.19	**91.61±3.79**
heart	79.95±4.23	82.36±4.25	80.62±4.17	78.78±1.60	81.88±3.61	80.60±4.23	64.08±4.52	**93.61±2.96**
Maxlittle	80.30±4.78	80.96±6.37	81.24±6.29	80.96±6.37	80.92±6.72	80.96±6.37	68.90±3.42	**92.43±3.25**
Urban	76.06±2.12	80.70±1.55	80.75±1.52	80.70±1.55	79.68±1.35	80.46±1.91	82.23±3.18	81.31±1.99
WDBC	95.23±1.33	95.23±1.33	95.36±0.76	95.23±1.33	94.81±0.96	95.23±1.33	88.21±1.65	97.15±1.82
Wisconsin	95.16±1.59	95.17±2.30	95.75±1.89	95.16±1.59	95.94±1.88	95.16±1.59	93.09±1.66	**99.13±0.80**
PID	71.23±3.96	73.27±4.01	73.32±4.14	73.77±3.44	71.85±3.21	73.23±3.96	70.30±4.75	**79.75±3.29**
LR	85.83±0.19	85.24±0.28	85.40±0.22	85.38±0.30	84.87±0.10	85.83±0.19	84.17±0.63	**90.18±1.26**
GSAD	99.16±0.15	99.16±0.15	99.17±0.14	99.16±0.15	99.03±0.14	99.19±0.14	**99.21±0.13**	96.73±0.18
HAR	98.35±0.29	98.35±0.29	98.33±0.29	98.35±0.29	98.28±0.26	98.34±0.29	98.00±0.38	**99.78±0.16**
Dataset	AUC (%)							
	OF	PCA	LDA	LPP	Relief	Lasso	P_value	DILC-ESAE
AD	58.04±3.75	57.78±5.79	55.52±6.56	57.78±5.79	55.91±5.57	59.09±7.08	67.46±4.93	**82.11±3.74**
LSVT	79.02±7.72	79.01±7.72	79.02±7.72	79.65±8.43	83.56±9.43	76.06±2.36	60.63±11.01	**96.62±2.67**
PD	60.14±3.58	64.30±3.35	63.83±2.61	64.30±3.65	64.25±3.71	64.30±3.35	56.83±3.76	**79.30±4.94**
Pendigits	99.10±0.18	99.02±0.12	98.96±0.16	98.95±0.06	97.95±0.15	99.06±0.14	96.45±0.70	**99.75±0.08**
Statlog	90.36±0.75	90.50±0.87	90.45±0.62	90.55±0.91	90.39±0.82	90.43±0.83	90.26±0.77	**92.69±0.94**
Vehicle	87.29±0.68	87.28±0.70	87.33±0.03	87.24±0.70	85.19±0.33	87.35±0.73	84.78±1.85	**93.11±0.48**
heart	81.64±5.54	85.19±5.27	82.46±4.15	82.50±5.23	84.47±5.99	82.50±5.23	66.72±4.65	**95.68±1.99**
Maxlittle	93.34±0.94	93.48±1.03	93.64±0.92	93.49±1.03	93.23±0.69	93.49±1.03	56.67±14.91	**95.68±1.99**
Urban	89.48±1.00	89.48±1.00	89.79±1.07	89.48±1.00	88.99±1.08	89.68±1.26	89.57±1.71	90.61±1.94

WDBC	96.00±1.80	96.82±1.40	96.78±2.08	96.82±1.40	96.16±2.74	96.82±1.40	93.07±2.24	98.54±1.38
Wisconsin	95.81±1.61	96.43±1.62	96.35±1.49	95.46±2.06	96.73±1.33	95.46±2.06	96.35±2.02	**99.03±0.94**
PID	73.51±4.11	73.37±2.40	74.45±2.49	73.66±2.15	72.91±4.16	73.94±1.86	73.29±4.72	**82.94±2.16**
LR	92.59±0.09	92.28±0.14	92.37±0.11	92.35±0.14	92.09±0.04	92.59±0.09	91.73±0.33	**97.56±0.14**
GSAD	99.48±0.09	99.48±0.09	99.48±0.08	99.48±0.09	99.37±0.08	99.49±0.09	**99.51±0.09**	98.52±0.16
HAR	98.99±0.18	98.99±0.18	98.99±0.18	98.99±0.18	98.95±0.16	98.99±0.18	98.79±0.23	**99.67±0.08**

	AP (%)							
Dataset	OF	PCA	LDA	LPP	Relief	Lasso	P_value	DILC-ESAE
AD	71.46±9.75	66.92±4.43	63.93±8.47	66.92±4.44	67.65±2.41	67.06±4.54	70.75±3.72	71.86±2.14
LSVT	78.08±5.49	78.08±5.49	80.09±7.97	78.07±6.66	80.78±6.72	75.47±7.60	76.07±6.73	97.24±2.88
PD	60.18±3.32	62.10±3.95	62.46±3.78	62.10±3.95	61.63±3.93	62.10±3.95	57.01±3.35	**76.91±4.06**
Pendigits	99.56±0.03	99.61±0.04	99.58±0.04	99.61±0.03	99.59±0.05	99.65±0.02	98.60±0.33	**99.92±0.04**
Statlog	95.28±0.24	90.70±0.32	95.67±0.28	95.74±0.32	95.57±0.29	95.67±0.36	95.61±0.33	**96.77±0.17**
Vehicle	89.93±1.01	90.64±0.49	90.80±0.75	90.73±0.55	89.48±0.45	90.90±0.74	88.23±0.89	**94.81±2.42**
heart	77.70±7.72	79.57±7.38	78.35±7.39	77.70±7.72	81.96±4.92	77.70±7.72	67.90±3.38	**92.46±5.83**
Maxlittle	77.01±5.23	79.91±5.00	80.83±5.17	79.91±5.00	80.84±6.36	79.91±5.00	43.27±4.08	**91.41±3.88**
Urban	94.01±0.84	95.81±0.72	95.84±0.61	95.81±0.72	95.75±0.66	95.75±0.66	95.76±0.97	**95.96±0.43**
WDBC	94.15±2.05	95.15±2.05	93.95±1.66	94.15±2.05	93.14±1.63	94.15±2.05	83.90±2.88.	**97.91±1.05**
Wisconsin	92.41±2.71	91.82±3.37	93.00±3.90	92.41±2.71	92.68±4.11	92.41±2.71	90.34±2.84	**98.62±1.63**
PID	74.08±5.54	75.12±4.28	73.72±±5.40	74.90±3.91	72.68±2.20	74.08±5.54	72.56±4.85	**81.11±4.00**
LR	98.96±0.02	98.92±0.02	98.92±0.02	98.93±0.01	98.88±0.01	98.96±0.02	98.83±0.05	**99.73±0.22**
GSAD	99.59±0.05	99.59±0.05	**99.60±0.04**	99.59±0.05	99.57±0.06	**99.60±0.05**	**99.60±0.09**	97.10±0.31
HAR	99.31±0.16	99.31±0.16	99.30±0.15	99.31±0.16	99.27±0.13	99.30±0.13	99.12±0.14	**99.78±0.09**

3) Comparison with the state-of-the-art stacked autoencoders

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TABLE 8

COMPARE THE PERFORMANCE OF DIFFERENT AUTOENCODER ALGORITHMS

Dataset	Acc (%)										
	SSAE	SDSAE	SPSAE	ESGSAE-FF	GSTAE	WGLAE	DSAE	SGAE	S-MMAE	AAMRSAE	DILC-ESAE
AD	56.67±5.27	55.58±4.36	57.78±4.27	67.33±2.49	71.11±8.16	52.67±5.48	56.67±5.27	56.11±1.07	48.80±4.52	53.33 ± 7.48	**76.67±8.16**
LSVT	83.33±5.83	76.62±5.29	84.33±5.36	92.76±0.62	84.66±4.32	75.71±5.43	72.38±5.48	71.59±5.77	79.52 ± 5.75	85.71 ± 7.22	**97.62±1.68**
PD	64.48±2.05	64.88±1.84	64.22±2.34	66.72±0.87	73.89±4.27	64.00±6.81	59.63±3.14	63.88±1.71	53.79 ± 2.73	63.45 ± 3.09	**75.98±4.29**
Pendigits	93.80±0.51	75.17±1.88	91.60 ±0.57	98.00 ±0.12	93.53±0.77	98.85±1.24	92.53±1.22	90.33±0.30	93.42±0.33	98.98 ± 0.21	**99.54±0.11**
Statlog	84.85±0.84	98.60±0.34	85.87± 0.86	87.28±0.12	85.42±0.38	**99.83±0.12**	85.31±0.50	74.13±0.24	86.13±0.53	87.85 ± 0.45	89.42±0.81
Vehicle	70.00±2.99	72.00±2.25	74.76±2.93	81.91±0.42	79.71±2.93	83.48±12.53	55.25±2.22	65.86±0.23	75.39±0.89	75.04 ± 1.64	**87.36±1.15**
heart	82.89±3.20	94.58 ± 0.53	88.90±2.53	84.67±1.99	82.56±3.55	80.22±9.21	82.67±1.27	69.67±3.60	68.67 ± 10.31	81.11 ± 2.43	**94.67±2.98**
Maxlittle	92.92±4.16	83.65± 0.71	91.93±4.22	92.00±3.34	92.15±4.94	89.54±6.10	81.23±1.29	88.97±2.86	75.38 ±0.17	82.46 ± 0.75	**98.75±1.71**
Urban	**98.89±0.17**	93.20±1.17	77.81±1.17	83.20±1.01	76.98±0.73	72.53±8.63	70.49±2.75	82.90±0.15	72.91±3.84	78.04 ± 2.40	97.42±0.91

WDBC	93.02±5.09	95.77±0.17	93.03±2.49	**99.81±0.45**	99.34±1.27	95.05±5.99	94.29±1.96	90.65±0.26	90.16 ± 2.36	96.51 ± 0.72	98.08±0.89
Wisconsin	97.71±1.22	97.65±0.25	96.62±2.40	97.09±1.31	96.92±1.56	97.19±2.49	96.32±0.80	88.97±0.52	96.12 ± 1.56	96.39 ± 1.20	**99.82±0.40**
PID	76.41±3.20	76.17±1.03	78.76±3.62	72.27±3.46	77.81±2.84	**95.19±4.60**	69.30±1.60	73.29±1.83	65.00 ± 0.19	75.08 ± 2.92	84.06±3.34
LR	91.38±1.71	93.20±1.17	94.88±0.12	**95.55±0.78**	92.10±0.99	96.18±1.55	89.50±2.08	84.30±0.05	72.52 ±1.35	84.21 ±0.63	94.38±0.37
GSAD	95.78±0.63	95.77±0.17	98.89±0.59	**99.07±0.36**	97.42±0.43	98.78±0.17	91.17±4.31	87.86±1.22	91.17±1.33	99.20 ± 0.18	96.71±0.33
HAR	98.82±1.19	97.36±0.72	98.13±0.45	97.81±0.18	98.22±1.10	99.02±0.11	97.88±0.90	97.03±4.18	97.42 ±0.33	98.90 ±0.23	**99.51±0.43**

Dataset	MACRO-F1 (%)										
	SSAE	SDSAE	SPSAE	ESGSAE-FF	GSTAE	WGLAE	DSAE	SGAE	S-MMAE	AAMRSAE	DILC-ESAE
AD	64.51±5.48	66.99±6.60	67.02±2.11	69.32±9.47	67.19±8.21	42.78±8.49	54.21±5.94	66.67±3.24	45.19±4.30	42.64 ± 5.11	**71.86±2.14**
LSVT	80.36±6.35	72.60±2.22	81.87±8.52	88.92±5.56	63.25±4.89	73.32±6.30	66.70±10.12	78.53±2.20	75.77 ± 7.64	85.44 ± 7.53	**95.79±3.97**
PD	76.54±3.21	63.47±1.69	63.93±6.80	68.09±2.00	67.10±5.91	63.87±6.82	58.73±3.52	65.21±9.46	53.11 ± 2.60	63.33 ± 3.01	**77.07±2.90**
Pendigits	91.27±2.26	73.20±2.30	91.51±2.49	99.36±0.34	91.68±0.82	98.84±1.26	92.56±1.23	91.51±0.40	91.57±0.32	98.98 ± 0.21	**99.55±0.14**
Statlog	70.39±2.61	72.62±6.69	75.75±3.28	82.76±0.80	81.71±1.16	**99.80±0.13**	81.78±0.43	75.55±4.69	82.61±1.09	87.61 ± 0.50	87.81±1.04
Vehicle	71.54±4.55	74.75±5.12	70.19±4.23	73.56±8.64	70.41±3.33	82.58±13.96	53.42±1.33	68.27±6.24	70.43±1.19	73.75 ± 1.79	**91.61±3.79**
heart	82.83±3.06	79.44±1.48	81.24±4.61	84.53z±2.04	82.54±4.84	78.95±10.43	81.90±1.26	57.16±4.00	63.47 ± 1.69	81.05 ± 2.37	**93.61±2.96**
Maxlittle	90.63±5.57	85.13±1.64	87.02±5.10	89.09±4.87	95.95±5.04	83.06±8.45	70.88±2.88	84.29±2.52	64.80 ±1.22	79.13 ± 1.15	**92.43±3.25**
Urban	79.07±16.10	72.30±0.51	78.29±2.92	76.09±5.72	72.51±1.37	61.58±9.33	61.28±4.77	81.22±4.89	72.51±0.37	77.89 ± 2.47	**81.31±1.99**
WDBC	93.35±4.37	95.05±4.18	94.36±3.39	94.44±2.65	94.30±1.01	94.91±6.05	93.84±2.09	92.83±3.42	89.78 ± 2.61	96.50 ± 0.72	**97.15±1.82**
Wisconsin	97.58±1.21	97.46±0.21	96.81±1.16	96.91±1.30	95.51±1.98	96.97±2.62	95.91±0.93	84.29±4.81	96.14 ± 1.54	96.39 ± 1.19	**99.13±0.80**
PID	74.80±2.65	73.76±0.32	82.04±4.06	68.22±3.97	69.52±6.96	94.92±4.51	64.08±1.31	66.52±7.74	51.21 ± 0.24	74.38 ± 3.52	**79.75±3.29**
LR	90.28±1.48	95.59±3.49	96.28±1.76	**96.34±3.05**	83.27±2.27	92.29±2.79	89.74±4.32	87.41±0.01	72.63 ± 1.23	84.17 ±0.63	90.18±1.26
GSAD	93.68±3.25	97.83±1.96	**99.39±0.53**	99.37±0.16	95.35±2.04	93.76±0.94	91.36±1.65	89.50±0.69	95.35±0.97	99.20 ± 0.18	96.73±0.18
HAR	95.66±1.16	98.18±1.75	98.72±0.37	99.08±0.69	97.39±0.37	93.24±1.57	97.31±3.37	96.60±3.57	95.35 ±0.67	98.90 ±0.33	**99.78±0.16**

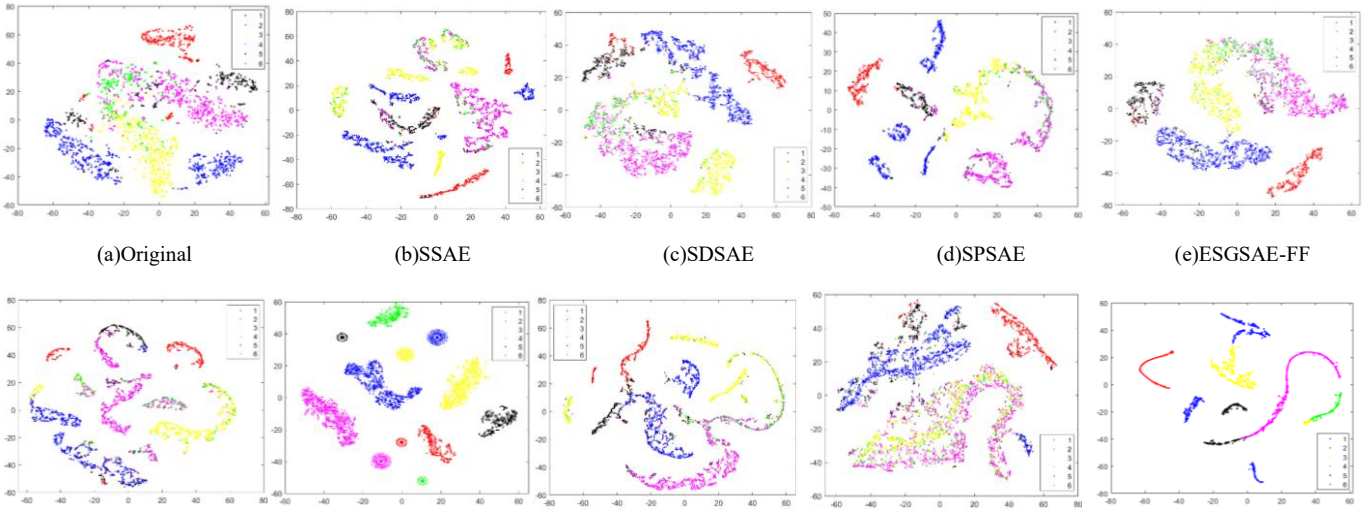
Dataset	AUC (%)										
	SSAE	SDSAE	SPSAE	ESGSAE-FF	GSTAE	WGLAE	DSAE	SGAE	S-MMAE	AAMRSAE	DILC-ESAE

AD	71.36±4.52	52.00±4.47	58.19±2.27	79.00±12.94	75.27±4.69	37.67±0.96	48.49±2.37	62.81±3.00	68.47±6.29	63.33 ± 3.26	**82.11±3.74**
LSVT	89.24±4.64	66.07±3.09	77.50±12.28	61.43±19.50	75.50±5.02	76.00±7.83	67.86±9.45	66.43±4.76	88.06 ± 6.70	86.73 ± 7.47	**96.62±2.67**
PD	63.93±8.75	60.73±2.72	63.93±6.80	67.87±2.00	71.72±3.83	64.13±7.09	60.06±2.86	63.35±2.61	55.34 ± 2.79	68.82 ± 4.04	**79.30±4.94**
Pendigits	89.42±11.35	68.64±1.21	93.29±1.73	99.09±0.19	81.42±0.72	89.41±0.64	86.08±0.68	94.35±0.37	89.31±0.46	**99.92 ± 0.02**	99.75±0.08
Statlog	78.35±2.17	80.11±5.06	87.72±3.17	89.62±0.46	89.36±0.74	83.25±0.06	74.19±0.27	84.42±0.82	90.26±0.77	**98.12 ± 0.27**	92.69±0.94
Vehicle	72.24±5.71	67.51±3.54	70.96±1.24	82.48±5.59	74.80±2.15	66.68±6.48	54.36±1.40	60.19±3.21	84.78±1.85	92.45 ± 0.94	**93.11±0.48**
heart	82.90±3.05	84.90±1.62	87.16±1.98	84.25±1.90	85.25±4.24	80.24±0.86	81.46±1.21	60.19±5.32	80.65 ± 4.85	89.34 ± 1.80	**95.68±1.99**
Maxlittle	90.68±6.70	84.12±6.31	86.52±8.29	87.54±7.49	77.19±10.06	85.24±9.85	68.50±2.98	80.77±3.79	81.22 ± 4.94	84.52 ± 3.37	**95.68±1.99**
Urban	79.92±11.90	67.32±1.12	75.69±6.72	85.17±3.89	90.15±1.43	72.68±5.53	70.05±2.35	80.03±0.53	89.57±1.71	**96.83 ± 0.49**	90.61±1.94
WDBC	93.87±3.60	95.25±3.17	96.13±1.39	96.94±2.85	95.07±0.62	95.32±5.52	94.23±1.79	95.57±3.24	97.54 ± 1.15	**99.29 ± 0.23**	98.54±1.38
Wisconsin	98.13±0.86	97.71±0.27	96.60±1.48	97.42±1.04	96.74±1.34	97.07±1.82	95.95±0.66	80.77±3.79	99.10 ± 0.46	**99.47 ± 0.39**	99.03±0.94
PID	74.14±3.12	73.24±1.21	78.30±4.39	66.41±4.47	71.92±4.06	**95.40±3.77**	63.72±1.27	60.78±3.80	46.04 ± 11.90	80.67 ± 4.00	82.94±2.16
LR	91.64±1.28	96.52±0.54	95.57±1.75	**98.08±0.83**	91.81±3.04	91.39±1.27	89.93±3.79	85.19±5.29	97.56 ± 0.24	91.73 ±0.33	97.56±0.14
GSAD	96.06±0.19	98.48±0.34	**99.26±0.01**	99.10±0.28	95.75±2.59	87.19±3.09	92.82±1.11	94.46±0.14	94.51± 0.09	99.87 ± 0.06	98.52±0.16
HAR	96.39±0.87	98.23±1.38	98.42±0.34	98.97±0.94	97.17±1.88	87.11±4.40	94.63±1.24	95.15±0.58	95.75 ±0.23	**99.97 ±0.21**	99.67±0.08

Dataset	AP (%)										
	SSAE	SDSAE	SPSAE	ESGSAE-FF	GSTAE	WGLAE	DSAE	SGAE	S-MMAE	AAMRSAE	DILC-ESAE
AD	**80.34±6.12**	60.49±7.78	67.05±3.40	72.07±9.23	69.36±11.84	39.20±9.96	45.81±9.13	58.02±2.78	55.90±6.75	46.62 ± 1.87	71.86±2.14
LSVT	83.66±3.72	75.09±7.65	84.53±10.63	76.71±16.15	93.68±16.47	82.31±5.64	76.45±5.85	76.66±4.45	92.00 ± 5.06	91.47 ± 5.47	**97.24±2.88**
PD	61.76±10.18	60.38±1.70	61.50±5.68	67.46±2.03	74.59±3.94	58.39±4.12	55.79±3.60	64.73±3.30	53.68 ± 1.76	66.10 ± 4.40	**76.91±4.06**
Pendigits	92.49±4.18	88.53±0.52	94.35±0.16	99.57±0.09	90.31±0.90	88.99±1.10	82.64±1.25	87.31±0.57	92.38±0.47	99.92 ± 0.02	**99.92±0.04**
Statlog	90.58±1.03	90.93±2.29	91.16±1.95	95.46±0.24	97.94±0.65	83.14±0.17	69.43±0.61	86.75±6.04	85.61±0.33	90.53 ± 0.95	**96.77±0.17**
Vehicle	73.11±3.91	76.13±2.76	79.74±2.96	87.11±4.52	74.46±3.68	64.01±11.43	42.22±1.97	69.43±3.49	78.23±0.89	79.30 ± 2.62	**94.81±2.42**
heart	79.73±4.28	82.96±2.94	72.83±2.01	82.09±4.75	88.83±6.58	68.34±15.66	72.62±2.09	60.02±5.27	85.00 ± 2.87	90.93 ± 1.73	**92.46±5.83**
Maxlittle	92.01±5.06	87.19±5.49	88.55±6.92	88.11±6.62	93.88±5.05	93.19±5.95	80.61±2.58	80.73±3.60	58.20 ± 8.93	69.13 ± 5.18	**91.41±3.88**

Urban	93.07±3.6	89.13±0.	92.67±2.8	94.62±1.5	**96.18±6.6**	63.70±9.5	60.09±1.9	82.57±5.	78.76±0.	82.89 ±	95.96±0.
	6	54	5	9	**5**	3	8	36	97	1.55	43
WDBC	95.05±1.6	96.51±0.	96.38±2.1	97.50±5.5	96.75±2.3	90.59±8.5	87.39±4.6	98.04±1.	98.30 ±	**99.54 ±**	97.91±1.
	2	92	8	0	0	9	2	09	0.98	**0.17**	05
Wiscons	96.91±2.3	96.45±1.	92.35±2.5	94.97±1.4	94.66±3.6	93.98±6.1	91.46±2.6	80.73±3.	99.55 ±	**99.74 ±**	98.62±1.
in	9	55	0	4	1	5	7	60	0.26	**0.18**	63
PID	74.36±6.3	72.31±3.	76.70±4.6	71.04±3.5	75.64±4.6	**89.83±8.1**	66.60±3.7	61.21±5.	62.36 ±	87.98 ±	81.11±4.
	5	81	1	6	9	**0**	8	93	7.19	2.81	00
LR	93.73±3.1	98.08±1.	98.16±0.7	99.33±0.9	93.99±4.6	93.45±1.5	92.72±3.4	84.17±0.	78.61	98.83	**99.73±0.**
	6	54	2	4	1	8	8	46	±1.57	±0.05	**22**
GSAD	97.53±0.8	99.22±0.	**99.62±0.2**	99.30±0.3	95.85±2.5	90.39±1.6	96.68±0.2	90.35±0.	94.60±	99.62 ±	97.10±0.
	5	32	**6**	9	9	5	1	23	0.09	0.16	31
HAR	97.68±0.1	98.70±0.	98.55±1.0	99.35±0.0	99.34±1.0	85.90±1.2	96.36±3.3	94.22±3.	95.85	**99.86**	99.78±0.
	0	65	9	8	7	6	3	00	±0.41	**±0.42**	09

4) Model Visualization and Convergence Analysis.



(a)Original (b)SSAE (c)SDSAE (d)SPSAE (e)ESGSAE-FF

(f)GSTAE (g)WGLAE (h)DSAE (i)SGAE (j)DILC-ESAE

Fig.7. Visualization of the embedding space learned by different methods on the Statlog dataset, and the final output of the encoder is used as the visual embedding. Different colors correspond to different classes.

D. *Parameter analysis*

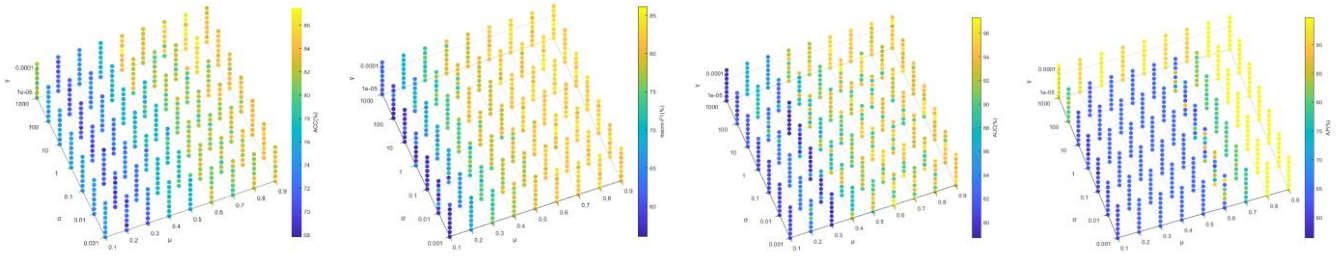
1) Effect of the MSPC splicing number υ .

TABLE 9

CLASSIFICATION ACCURACY (MEAN ±STD) OF THE MSPC SPLICING NUMBER

Dataset	$\upsilon = 0$	$\upsilon = 1$	$\upsilon = 2$
AD	57.67±12.11	64.67±4.47	**76.67±8.16**
LSVT	82.38±9.00	**97.62±1.68**	95.71±5.16
PD	62.70±1.86	70.75±1.74	**75.98±4.29**
Pendigits	98.13±0.05	98.62±0.07	**99.54±0.11**
Statlog	87.38±0.45	88.65±0.75	**89.42±0.81**
Vehicle	84.75±6.11	83.90±0.19	**87.36±1.15**
heart	82.22±2.24	85.56±2.83	**94.67±2.98**
Maxlittle	91.38±3.37	96.77±2.57	**98.75±1.71**
Urban	80.76±3.85	73.42±2.48	**97.42±0.91**
WDBC	96.64±3.79	97.57±1.38	**98.08±0.89**
Wisconsin	96.65±1.31	**99.82±0.40**	98.15±0.85
PID	76.17±1.27	74.14±4.27	**84.06±3.34**
LR	88.69±2.53	89.65±0.21	**94.38±0.37**
GSAD	**99.81±6.16**	96.71±0.33	92.45±0.09
HAR	98.63±5.25	98.72±0.07	**99.51±0.43**

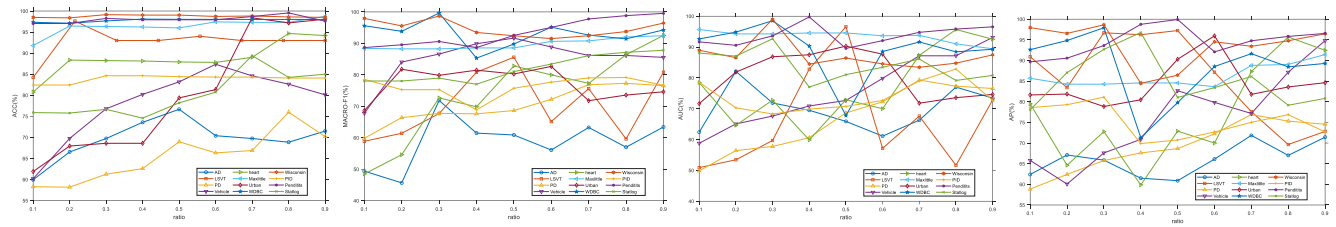
2) Effect of the μ , σ , γ .



(a) (b) (c) (d)

Fig.8. Performance of JCDR with respect to different parameter value sets on Statlog. (a) ACC; (b) MACRO-F1; (c) AUC; (d) AP.

3) Effect of JCDR dimension reduction δ in the JCDR .



(a)ACC (b) MACRO-F1 (c)AUC (d) AP

Fig.9. Influence of the different dimensions for the proposed framework measured by (a)ACC, (b)MACRO-F1, (c)AUC and (d)AP on 12 datasets

4) Comparison on different classifier

TABLE 10

CLASSIFICATION ACCURACY (MEAN ± STD) OF THE PROPOSED ALGORITHM WITH DIFFERENT CLASSIFIERS

Dataset	SVM (%)	RF (%)	ELM (%)
AD	**76.67±8.16**	68.89±14.18	74.67±15.58
LSVT	**97.62±1.68**	91.43±5.22	94.29±3.98
PD	**75.98±4.29**	75.06±6.56	73.22±6.29
Pendigits	**99.54±0.11**	98.22±0.77	95.84±1.36
Statlog	**89.42±0.81**	88.06±1.47	86.92±0.99
Vehicle	**87.36±1.15**	71.06±11.46	74.04±6.90
heart	**94.67±2.98**	94.67±2.98	94.67±3.53
Maxlittle	98.75±1.71	92.50±4.19	**99.38±1.90**
Urban	**97.42±0.91**	79.12±5.56	77.68±4.55
WDBC	98.08±0.89	96.93±2.98	**98.51±1.21**
Wisconsin	**99.82±0.40**	99.47±0.48	99.47±0.48
PID	**84.06±3.34**	83.44±3.84	82.03±3.82
LR	94.38±0.37	**95.40±0.68**	93.90±0.36
GSAD	**96.71±0.33**	95.09±0.19	95.69±1.67
HAR	**99.51±0.43**	98.33±1.25	98.71±1.27

5) Confusion matrix

(a)Urban (b) Pendigits

Fig. 10. Confusion matrix on datasets.

E. Time Analysis

1) Computational complexity:

TABLE 11

TIME COST (MEAN ±STD) OF DIFFERENT METHODS

Dataset	Time (s)								
	SSAE	SDSAE	SPSAE	ESGSAE-FF	GSTAE	WGLAE	DSAE	SGAE	DILC-ESAE
AD	115.00 ±7.21	216.96 ±19.06	184.46 ±6.74	141.16 ±12.07	36.03 ±1.04	79.16 ±1.32	72.97 ±0.23	**41.73 ±6.04**	251.20 ±2.43
LSVT	414.92 ±9.77	644.68 ±12.51	1405.18 ±25.13	2466.83 ±278.36	955.61 ±18.60	228.86 ±1.82	**4.79 ±0.02**	40.26 ±3.59	971.47 ±60.52
PD	890.68 ±49.29	256.60 ±18.41	**167.26 ±4.40**	464.14 ±134.29	165.82 ±24.41	895.74 ±12.50	244.01 ±0.60	976.88 ±187.48	1274.31 ±24.19
Pendigits	2262.58 ±104.55	1486.54 ±28.29	2632.23 ±83.11	2816.48 ±326.35	714.47 ±23.94	**570.36 ±9.99**	1840.71 ±46.41	24767.38 ±1922.50	3989.00 ±64.27
Statlog	208.66 ±73.08	1816.99 ±53.82	919.22 ±61.99	**186.23 ±36.35**	275.96 ±18.27	236.49 ±7.86	217.81 ±0.08	8601.45 ±772.69	1320.95 ±47.50
Vehicle	**53.86 ±1.66**	236.33 ±25.79	174.11 ±26.21	208.15 ±21.22	132.20 ±9.82	119.71 ±6.67	187.99 ±0.55	250.14 ±28.43	129.60 ±7.19
heart	160.82 ±9.51	247.08 ±63.85	242.48 ±21.68	488.22 ±24.20	162.67 ±7.77	149.37 ±3.87	**74.56 ±1.52**	93.95 ±13.54	318.00 ±3.74
Maxlittle	168.26 ±9.60	76.58 ±4.52	**66.19 ±4.62**	418.50 ±15.34	89.42 ±26.31	131.19 ±6.51	74.32 ±0.95	117.97 ±6.11	437.78 ±7.42
Urban	368.54 ±52.22	564.69 ±99.29	324.80 ±26.42	341.60 ±14.62	139.30 ±13.63	325.45 ±14.30	**59.83 ±0.57**	700.43 ±118.90	712.56 ±38.20
WDBC	271.41 ±13.08	141.39 ±7.08	263.71 ±27.87	637.48 ±25.04	**66.65 ±15.94**	446.41 ±9.13	131.78 ±0.35	331.14 ±9.88	509.27 ±50.59
Wisconsin	161.79 ±2.74	198.77 ±12.76	235.75 ±30.31	317.09 ±76.87	76.05 ±7.43	197.04 ±6.24	186.81 ±0.44	**67.38 ±6.11**	339.51 ±9.23
PID	165.49 ±6.58	207.24 ±7.88	274.50 ±6.67	662.60 ±73.98	**48.98 ±9.53**	167.9 ±9.41	190.89 ±3.66	258.53 ±13.69	325.42 ±3.04
LR	2346.00 ±10.77	2039.00 ±71.42	2469.00 ±21.70	10694 ±69.09	**660.01 ±17.22**	1723.45 ±32.27	7387.27 ±322.11	9663.76 ±946.27	10999.26 ±224.32
GSAD	**701.73 ±17.33**	1351.05 ±19.81	1960.53 ±59.01	2058.03 ±25.37	2392.22 ±35.74	2604.37 ±164.85	2141.69 ±11.9	5146.21 ±145.35	5621.88 ±142
HAR	18002.00	9724.00	9214.00	6453	4904.64	4322.69	2697.61	**1483.06**	1983.63

	±67.63	±49.26	±45.71	±26.79	±9.79	±405.60	±55.34	**±67.01**	±258