Table 1: The time complexity of training and inference phases.

DI Methods	AD Methods	Time Complexity (Training)	Time Complexity (Inference)
MissForest $\mathcal{O}(T \cdot p(t_1 \cdot v \cdot n \log n))$	I-Forest	$\mathcal{O}(T \cdot p(t_1 \cdot v \cdot n \log n) + t_2 \cdot \psi \log \psi)$	$\mathcal{O}(p(t_1 \cdot v \cdot m \log n) + t_2 \cdot m \log \psi)$
	Deep SVDD	$\mathcal{O}(T \cdot p(t_1 \cdot v \cdot n \log n) + (T_{ae} + T_{oc})(n\bar{d}^2\bar{L} + n))$	$\mathcal{O}(p(t_1 \cdot v \cdot m \log n) + (m\bar{d}^2\bar{L} + m))$
	NeutraL AD	$\mathcal{O}(T \cdot p(t_1 \cdot v \cdot n \log n) + T(n\bar{d}^2\bar{L} + n \cdot K))$	$\mathcal{O}(p(t_1 \cdot v \cdot m \log n) + (m\bar{d}^2\bar{L} + m \cdot K))$
	DPAD	$\mathcal{O}(T \cdot p(t_1 \cdot v \cdot n \log n) + T(n\bar{d}^2\bar{L} + n^2))$	$\mathcal{O}(p(t_1 \cdot v \cdot m \log n) + (m\bar{d}^2\bar{L} + mn))$
GAIN $\mathcal{O}((T_g + T_d)n\bar{d}^2\bar{L})$	I-Forest	$\mathcal{O}((T_g + T_d)n\bar{d}^2\bar{L} + t_2 \cdot \psi \log \psi)$	$\mathcal{O}(m\bar{d}^2\bar{L} + t_2 \cdot m \log \psi)$
	Deep SVDD	$\mathcal{O}((T_g + T_d)n\bar{d}^2\bar{L} + (T_{ae} + T_{oc})(n\bar{d}^2\bar{L} + n))$	$\mathcal{O}(m\bar{d}^2\bar{L} + (m\bar{d}^2\bar{L} + m))$
	NeutraL AD	$\mathcal{O}((T_g + T_d)n\bar{d}^2\bar{L} + T(n\bar{d}^2\bar{L} + n \cdot K))$	$\mathcal{O}(m\bar{d}^2\bar{L} + (m\bar{d}^2\bar{L} + m \cdot K))$
	DPAD	$\mathcal{O}((T_g + T_d)n\bar{d}^2\bar{L} + T(n\bar{d}^2\bar{L} + n^2))$	$\mathcal{O}(m\bar{d}^2\bar{L} + (m\bar{d}^2\bar{L} + mn))$
ImAD (Ours)		$\mathcal{O}(T(n\bar{d}^2\bar{L} + t \cdot n^2))$	$\mathcal{O}(m\bar{d}^2\bar{L} + m)$

Table 2: The time cost (second) on Speech and Usoskin dataset.

DI Methods	AD Methods	Speech		Usoskin	
		Time (Training)	Time (Inference)	Time (Training)	Time (Inference)
MissForest	I-Forest	86.48	82.69	5648.62	5662.65
	Deep SVDD	109.12	82.59	5651.65	5660.07
	NeutraL AD	115.17	82.59	5658.38	5660.11
	DPAD	106.40	82.66	5652.64	5660.09
GAIN	I-Forest	149.95	0.11	3664.48	9.42
	Deep SVDD	172.59	0.01	3567.51	6.84
	NeutraL AD	178.64	0.01	3574.24	6.88
	DPAD	169.87	0.08	3568.50	6.86
ImAD (Ours)		471.43	0.02	95.04	0.04

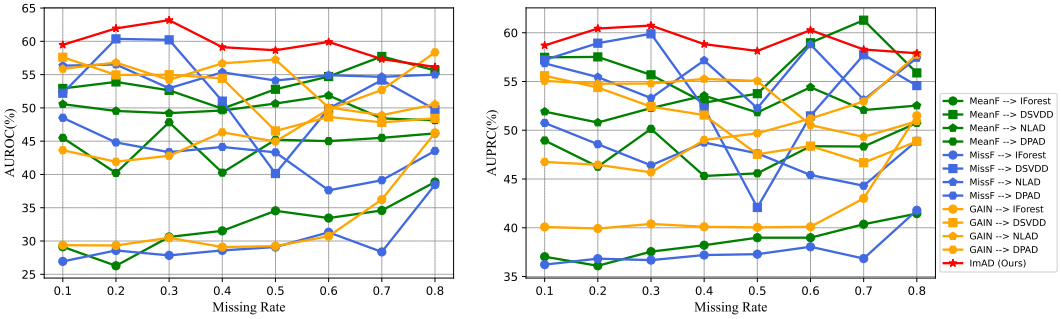

Figure 1: The performance fluctuation with the changes of missing rate from 0.1 to 0.8 on the Speech dataset. The missing rates of training and testing stages are the same.

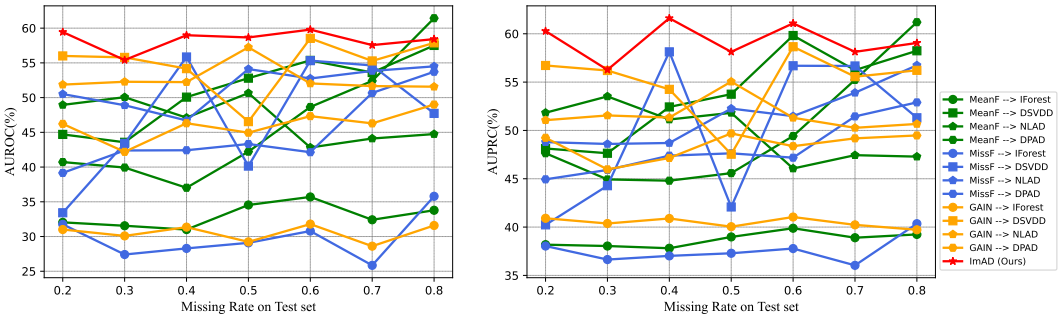

Figure 2: The performance fluctuation with the missing rate varying from 0.2 to 0.8 on the test set of Speech. In all experiments, the missing rate of the training set is fixed at mr $= 0.5$.

Table 3: Comparison of missing mechanisms of the mask for generated pseudo-abnormal data.

Dataset	Missing Mechanism on Normal Data	Missing Mechanism on Pseudo-Abnormal Samples					
		MCAR		MAR		MNAR	
		AUROC(%)	AUPRC(%)	AUROC(%)	AUPRC(%)	AUROC(%)	AUPRC(%)
Titanic	Unknown	82.09	81.39	79.06	77.08	80.50	79.17
MovieLens1M	Unknown	66.32	65.34	63.14	63.39	61.44	60.91
Bladder	Unknown	100.00	100.00	99.95	99.95	100.00	100.00
Seq2_Heart	Unknown	96.62	96.40	96.79	96.60	95.56	94.41
Adult	MCAR	71.19	71.50	64.11	66.44	67.28	66.72
Adult	MAR	65.66	67.23	74.61	70.74	71.14	69.69
Adult	MNAR	70.69	69.17	68.35	68.78	71.60	68.97