TABLE IX
RESULTS WITH SIMULATED SCENARIO d_1 WITH PACKET LOSS

Model	Normal		Loss 10%		Loss 20%		Loss 30%	
	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	90.02%	90.03%	61.62%(28.40%↓)	58.57%(31.46%↓)	53.59%(36.43%↓)	50.74%(39.29%↓)	51.45%(38.57%↓)	50.74%(39.29%↓)
LSTM	90.61%	90.58%	62.11%(28.50%↓)	57.56%(33.02%↓)	53.23%(37.38%↓)	48.29%(42.29%↓)	52.66%(37.95%↓)	47.16%(43.42%↓)
GRU	89.13%	89.09%	59.72%(29.41%↓)	56.93%(32.16%↓)	47.36%(41.77%↓)	46.10%(42.99%↓)	43.52%(45.61%↓)	43.32%(45.77%↓)
TST	94.25%	94.23%	64.91%(29.34%↓)	60.51%(33.72%↓)	58.86%(35.39%↓)	53.96%(40.27%↓)	58.01%(36.24%↓)	51.32%(42.91%↓)
SDAE	72.71%	65.83%	60.36%(12.35%↓)	53.26%(12.57%↓)	55.14%(17.57%↓)	47.09%(18.74%↓)	55.99%(16.72%↓)	46.58%(19.25%↓)
FS-Net	91.91%	91.09%	87.65%(4.26%↓)	86.01%(5.08%↓)	80.52%(11.39%↓)	77.41%(13.68%↓)	71.46%(20.45%↓)	66.12%(24.97%↓)
Average	**88.11%**	**86.81%**	**66.06%(22.04%↓)**	**62.14%(24.67%↓)**	**58.12%(29.99%↓)**	**53.93%(32.88%↓)**	**55.52%(32.59%↓)**	**50.87%(35.94%↓)**

TABLE X
RESULTS OF SIMULATED SCENARIO d_3 WITH PACKET LOSS.

Model	Normal		Loss 10%		Loss 20%		Loss 30%	
	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	84.26%	84.24%	67.99%(16.27%↓)	67.87%(16.37%↓)	61.15%(23.11%↓)	60.60%(23.64%↓)	56.38%(27.88%↓)	55.27%(28.97%↓)
LSTM	92.17%	92.18%	63.79%(28.38%↓)	63.37%(28.81%↓)	54.87%(37.30%↓)	53.98%(38.20%↓)	48.79%(43.38%↓)	48.33%(43.85%↓)
GRU	84.10%	84.05%	62.30%(21.80%↓)	62.04%(22.01%↓)	54.22%(29.88%↓)	53.97%(30.08%↓)	47.21%(36.89%↓)	47.39%(36.66%↓)
TST	95.93%	95.93%	72.51%(23.42%↓)	72.14%(23.79%↓)	62.6%(33.33%↓)	61.55%(34.38%↓)	56.94%(38.99%↓)	55.27%(40.66%↓)
SDAE	74.62%	74.44%	63.96%(10.66%↓)	63.53%(10.91%↓)	56.92%(17.70%↓)	55.93%(18.51%↓)	51.04%(23.58%↓)	49.72%(24.72%↓)
FS-Net	81.51%	78.36%	77.84%(3.67%↓)	74.31%(4.05%↓)	72.11%(9.40%↓)	67.71%(10.65%↓)	66.06%(15.45%↓)	60.79%(17.57%↓)
Average	**85.43%**	**84.87%**	**68.07%(17.37%↓)**	**67.21%(17.66%↓)**	**60.31%(25.12%↓)**	**58.96%(25.91%↓)**	**54.40%(31.03%↓)**	**52.80%(32.07%↓)**

TABLE XI
RESULTS OF SIMULATED SCENARIO d_4 WITH PACKET LOSS.

Model	Normal		Loss 10%		Loss 20%		Loss 30%	
	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	83.47%	83.08%	60.09%(23.38%↓)	58.79%(24.29%↓)	52.23%(31.24%↓)	50.06%(33.02%↓)	41.66%(41.81%↓)	36.29%(46.79%↓)
LSTM	83.21%	81.96%	51.69%(31.52%↓)	49.9%(32.06%↓)	48.05%(35.16%↓)	44.37%(37.59%↓)	40.00%(43.21%↓)	37.94%(44.02%↓)
GRU	83.33%	82.62%	50.87%(32.46%↓)	49.00%(33.62%↓)	45.62%(37.71%↓)	44.46%(38.16%↓)	38.75%(44.58%↓)	35.22%(47.40%↓)
TST	83.68%	83.24%	65.28%(18.40%↓)	61.08%(22.16%↓)	56.07%(27.61%↓)	51.22%(32.02%↓)	44.75%(38.93%↓)	42.34%(40.90%↓)
SDAE	66.12%	55.63%	53.83%(12.29%↓)	44.19%(11.44%↓)	47.59%(18.53%↓)	38.65%(16.98%↓)	43.73%(22.39%↓)	35.19%(20.44%↓)
FS-Net	82.02%	84.79%	76.19%(5.83%↓)	78.22%(6.57%↓)	66.59%(15.43%↓)	70.29%(14.50%↓)	59.72%(22.30%↓)	62.49%(22.30%↓)
Average	**80.31%**	**78.55%**	**59.66%(20.65%↓)**	**56.86%(21.69%↓)**	**52.69%(27.61%↓)**	**49.84%(28.71%↓)**	**44.77%(35.54%↓)**	**41.58%(36.98%↓)**

IX. APPENDIX

APPENDIX A
ADDITIONAL RESULTS ON PACKET LOSS

The classifying results of simulated packet loss on the other three scenarios are shown in Tables IX, X and XI.
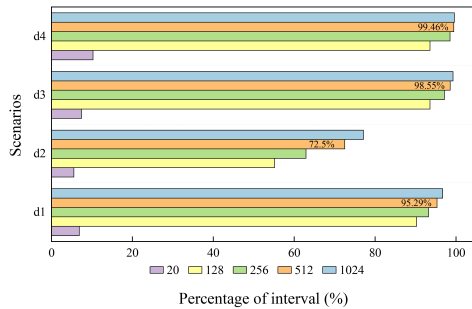

Fig. 13. Distribution of session length intervals for 4 scenarios.

And the classifying results of simulated packet loss on the other three scenarios are shown in Tables XII, XIII and XIV.

APPENDIX B
ADDITIONAL RESULTS ON SDA

The classifying results of simulated feature imputation on the other three scenarios are shown in Tables XV, XVI and XVII.

The classifying results of real-word feature imputation on the other three scenarios are shown in Tables XVIII, XIX and XX.

APPENDIX C
ADDITIONAL RESULTS ON SFDA

The classifying results on the other three scenarios are shown in Tables XXV, XXVI and XXVII and Fig. 14.

Results on scenario d_1 in SFDA. As shown in the Table XXV, the average performance of TFM models on d1 improves 11.68%-15.06% accuracy and 13.16%-16.92% F1 score. In the case of high percentage of packet loss, most of the models show more than 10% performance improvement. It shows that our TFI can still be effective in zero-shot scenarios.

Result on d_3 in SFDA. As Table XXVI shows, the TFI contribute more to the improvement of the performance of the DL models under IoT attack traffic. In the d_3 scenario, the models obtained an improvement of about 7% in accuracy and f1 score. The advanced models, such as TST and FS-Net, have less performance improvement. We consider TST to be a Transformer-based classification model and its training pattern learns a portion of the mask knowledge. Therefore, in the prediction stage of missing samples, its performance degradation, although also more serious, is slightly lower compared to other models. FS-Net is based on bi-directional GRU, which is more prominent in sequence position focus compared to uni-directional GRU. However, our TFI can still

TABLE XII
RESULTS WITH REAL-WORD SCENARIO d_1 WITH PACKET LOSS.

Model	Normal		Loss 10%		Loss 20%		Loss 30%	
	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	90.60%	90.62%	52.63%(37.97%↓)	49.78%(40.84%↓)	41.85%(48.75%↓)	40.55%(50.07%↓)	39.16%(51.44%↓)	38.83%(51.79%↓)
LSTM	90.53%	90.53%	53.14%(37.39%↓)	49.00%(41.53%↓)	51.34%(39.19%↓)	46.27%(44.26%↓)	50.33%(40.20%↓)	45.41%(45.12%↓)
GRU	87.83%	87.77%	51.23%(36.60%↓)	48.82%(38.95%↓)	45.47%(42.36%↓)	44.00%(43.77%↓)	44.15%(43.68%↓)	43.15%(44.62%↓)
TST	94.16%	94.13%	58.47%(35.69%↓)	52.06%(42.07%↓)	53.28%(40.88%↓)	47.62%(46.51%↓)	48.69%(45.47%↓)	43.01%(51.12%↓)
SDAE	69.37%	62.16%	56.45%(12.92%↓)	48.14%(14.02%↓)	55.68%(13.69%↓)	45.69%(16.47%↓)	54.36%(15.01%↓)	44.72%(17.44%↓)
FS-Net	88.83%	87.87%	84.47%(4.36%↓)	82.43%(5.44%↓)	76.88%(11.95%↓)	72.58%(15.29%↓)	65.82%(23.01%↓)	61.09%(26.78%↓)
Average	**86.89%**	**85.51%**	**86.89%(27.49%↓)**	**85.51%(30.47%↓)**	**59.40%(32.81%↓)**	**55.04%(36.06%↓)**	**54.08%(36.47%↓)**	**49.45%(39.47%↓)**

TABLE XIII
RESULTS WITH REAL-WORD SCENARIO d_3 WITH PACKET LOSS.

Model	Normal		Loss 10%		Loss 20%		Loss 30%	
	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	83.36%	82.75%	52.01%(31.35%↓)	51.91%(30.84%↓)	41.33%(42.03%↓)	40.46%(42.29%↓)	38.58%(44.78%↓)	36.88%(45.87%↓)
LSTM	83.37%	83.05%	46.61%(36.76%↓)	44.91%(38.14%↓)	35.78%(47.59%↓)	32.58%(50.47%↓)	38.56%(44.81%↓)	35.48%(47.57%↓)
GRU	83.21%	82.58%	45.59%(37.62%↓)	44.27%(38.31%↓)	37.55%(45.66%↓)	36.06%(46.52%↓)	35.53%(47.68%↓)	34.41%(48.17%↓)
TST	83.59%	83.15%	57.42%(26.17%↓)	53.62%(29.53%↓)	45.28%(38.31%↓)	43.31%(39.84%↓)	43.11%(40.48%↓)	39.09%(44.06%↓)
SDAE	67.29%	60.48%	47.16%(20.13%↓)	44.77%(15.71%↓)	36.27%(31.02%↓)	29.73%(30.75%↓)	35.28%(32.01%↓)	30.45%(30.03%↓)
FS-Net	82.64%	84.32%	73.03%(9.61%↓)	75.77%(8.55%↓)	64.07%(18.57%↓)	66.64%(17.68%↓)	52.71%(29.93%↓)	53.90%(30.42%↓)
Average	**80.58%**	**79.39%**	**80.58%(26.94%↓)**	**79.39%(26.85%↓)**	**53.64%(37.20%↓)**	**52.54%(37.93%↓)**	**43.38%(39.95%↓)**	**41.46%(41.02%↓)**

TABLE XIV
RESULTS WITH REAL-WORD SCENARIO d_4 WITH PACKET LOSS.

Model	Normal		Loss 10%		Loss 20%		Loss 30%	
	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	83.49%	82.55%	52.01%(31.48%↓)	50.45%(32.10%↓)	50.45%(33.04%↓)	40.13%(42.42%↓)	40.63%(42.86%↓)	35.91%(46.64%↓)
LSTM	83.26%	82.76%	47.03%(36.23%↓)	45.19%(37.57%↓)	36.99%(46.27%↓)	35.13%(47.63%↓)	38.00%(45.26%↓)	35.43%(47.33%↓)
GRU	83.27%	82.71%	44.82%(38.45%↓)	43.25%(39.46%↓)	38.25%(45.02%↓)	37.07%(45.64%↓)	39.40%(43.87%↓)	36.46%(46.25%↓)
TST	83.69%	83.25%	56.49%(27.20%↓)	53.27%(29.98%↓)	42.73%(40.96%↓)	41.13%(42.12%↓)	41.87%(41.82%↓)	38.07%(45.18%↓)
SDAE	67.95%	60.45%	47.64%(20.31%↓)	42.47%(17.98%↓)	40.50%(27.45%↓)	38.29%(22.16%↓)	40.58%(27.37%↓)	37.37%(23.08%↓)
FS-Net	81.59%	83.99%	70.08%(11.51%↓)	72.61%(11.38%↓)	59.21%(22.38%↓)	60.46%(23.53%↓)	50.95%(30.64%↓)	50.2%(33.79%↓)
Average	**80.54%**	**79.29%**	**80.54%(27.53%↓)**	**79.29%(28.08%↓)**	**53.01%(35.85%↓)**	**51.21%(37.25%↓)**	**44.69%(38.63%↓)**	**42.04%(40.38%↓)**

TABLE XV
CLASSIFICATION RESULTS OF SIMULATED SCENARIO d_1 WITH IMPUTATION LOSS SIDE-CHANNEL FEATURES.

Model	Imputed Loss 10%		Imputed Loss 20%		Imputed Loss 30%	
	Acc	F1	Acc	F1	Acc	F1
CNN+TFI	85.02%(23.40%↑)	84.97%(26.40%↑)	80.49%(26.90%↑)	80.07%(29.33%↑)	77.1%(25.65%↑)	76.24%(25.50%↑)
LSTM+TFI	86.96%(24.85%↑)	86.90%(29.34%↑)	82.32%(29.09%↑)	81.95%(33.66%↑)	78.16%(25.50%↑)	77.30%(30.14%↑)
GRU+TFI	85.4%(25.68%↑)	85.36%(28.43%↑)	80.71%(33.35%↑)	80.48%(34.38%↑)	76.87%(33.35%↑)	76.32%(33.00%↑)
TST+TFI	84.65%(19.74%↑)	84.36%(23.85%↑)	80.86%(22.00%↑)	79.82%(25.86%↑)	74.71%(16.70%↑)	73.10%(21.78%↑)
SDAE+TFI	72.14%(11.78%↑)	65.27%(12.01%↑)	71.51%(16.37%↑)	64.66%(17.57%↑)	70.57%(14.58%↑)	63.74%(17.16%↑)
FS-Net+TFI	90.33%(2.68%↑)	89.29%(3.28%↑)	88.58%(8.06%↑)	87.12%(9.71%↑)	85.75%(14.29%↑)	83.57%(17.45%↑)
Average	**84.08%(18.02%↑)**	**82.69%(20.55%↑)**	**80.75%(22.63%↑)**	**79.02%(25.09%↑)**	**77.19%(21.68%↑)**	**75.05%(24.17%↑)**

improve the performance of these classification models in the zero-shot case.

Result on d_4 in SFDA. TFI is the most effective in d_4 scenarios for side channel feature imputation, improving the average performance of base deep learning models by 17.98%-25.41% in Accuracy and 18.86%-26.62% in F1 score. The traditional model can be improved by 31.45% accuracy and 33.71% F1 score at 30% packet loss rate. The experimental results demonstrate that our TFI is able to reconstruct a large number of missing side channel features and improve the detection performance of existing models without prior knowledge of the target domain.

APPENDIX D
ADDITIONAL RESULTS OF OTHER FEATURE IMPUTATION METHODS

The classification results are shown in Tables XXVIII, XXIX, XXX, XXXI and Fig. 15. In d_1, on average, the four comparative algorithms achieved improvements of up to 12.52%, 13.72%, and 11.00% in accuracy for packet loss rates ranging from 10% to 30%, respectively. These results are significantly lower than the enhancements provided by TFI, which increased by 18.02%, 22.63%, and 21.68% for the same loss rates. Similar results were achieved for the d_3 and d_4 scenarios, further demonstrating the effectiveness of our proposed TFI feature imputation model.

APPENDIX E
ADDITIONAL RESULTS OF SUB-STRATEGIES OF TFM

The other classification results are shown in Table XXXII.

TABLE XVI
CLASSIFICATION RESULTS OF SIMULATED SCENARIO d_3 WITH IMPUTED LOSS SIDE-CHANNEL FEATURES.

Model	Imputed Loss 10%		Imputed Loss 20%		Imputed Loss 30%	
	Acc	F1	Acc	F1	Acc	F1
CNN+TFI	81.19%(13.20%↑)	81.20%(13.33%↑)	78.42%(17.27%↑)	78.46%(17.86%↑)	75.57%(19.19%↑)	75.66%(20.39%↑)
LSTM+TFI	88.60%(24.81%↑)	88.62%(25.25%↑)	84.32%(29.45%↑)	84.34%(30.36%↑)	80.11%(31.32%↑)	80.11%(31.78%↑)
GRU+TFI	81.29%(18.99%↑)	81.24%(19.20%↑)	78.40%(24.18%↑)	78.33%(24.36%↑)	75.61%(28.40%↑)	75.52%(28.13%↑)
TST+TFI	91.94%(19.43%↑)	91.95%(19.81%↑)	86.77%(24.17%↑)	86.75%(25.20%↑)	81.58%(24.64%↑)	81.54%(26.27%↑)
SDAE+TFI	73.78%(9.82%↑)	73.57%(10.04%↑)	72.60%(15.68%↑)	72.35%(16.42%↑)	71.19%(20.15%↑)	70.89%(21.17%↑)
FS-Net+TFI	81.05%(3.20%↑)	77.78%(3.47%↑)	80.05%(7.94%↑)	76.63%(8.92%↑)	78.52%(12.46%↑)	74.85%(14.06%↑)
Average	**82.98%(14.91%↑)**	**82.39%(15.18%↑)**	**80.09%(19.78%↑)**	**79.48%(20.52%↑)**	**77.10%(22.69%↑)**	**76.43%(23.63%↑)**

TABLE XVII
CLASSIFICATION RESULTS OF SIMULATED SCENARIO d_4 WITH IMPUTED LOSS SIDE-CHANNEL FEATURES.

Model	Imputed Loss 10%		Imputed Loss 20%		Imputed Loss 30%	
	Acc	F1	Acc	F1	Acc	F1
CNN+TFI	82.32%(22.23%↑)	81.30%(22.51%↑)	80.52%(28.29%↑)	80.07%(30.01%↑)	78.99%(37.33%↑)	78.37%(42.08%↑)
LSTM+TFI	82.15%(30.46%↑)	80.90%(31.00%↑)	80.65%(32.60%↑)	79.34%(34.97%↑)	79.26%(39.26%↑)	77.67%(39.73%↑)
GRU+TFI	81.69%(30.82%↑)	80.97%(31.97%↑)	79.80%(34.18%↑)	79.04%(34.58%↑)	78.18%(39.43%↑)	77.20%(41.98%↑)
TST+TFI	82.99%(17.71%↑)	82.54%(21.46%↑)	81.54%(25.47%↑)	81.04%(29.82%↑)	80.09%(35.34%↑)	79.40%(37.06%↑)
SDAE+TFI	65.61%(11.78%↑)	55.13%(10.94%↑)	65.17%(17.58%↑)	54.68%(16.03%↑)	64.29%(20.56%↑)	54.13%(18.94%↑)
FS-Net+TFI	81.54%(5.35%↑)	84.21%(5.99%↑)	81.00%(14.41%↑)	83.53%(13.24%↑)	80.11%(20.39%↑)	82.38%(19.89%↑)
Average	**79.38%(19.73%↑)**	**77.51%(20.65%↑)**	**78.11%(25.42%↑)**	**76.28%(26.44%↑)**	**76.82%(32.05%↑)**	**74.86%(33.28%↑)**

TABLE XVIII
CLASSIFICATION RESULTS OF REAL-WORD SCENARIO d_1 WITH IMPUTATION LOSS SIDE-CHANNEL FEATURES.

Model	Imputed Loss 10%		Imputed Loss 20%		Imputed Loss 30%	
	Acc	F1	Acc	F1	Acc	F1
CNN+TFI	89.93%(37.30%↑)	89.94%(40.16%↑)	80.89%(48.08%↑)	80.37%(49.39%↑)	72.90%(50.77%↑)	71.52%(51.11%↑)
LSTM+TFI	88.83%(35.69%↑)	87.87%(38.87%↑)	82.76%(37.49%↑)	82.77%(41.60%↑)	74.03%(38.50%↑)	72.94%(42.46%↑)
GRU+TFI	85.14%(33.91%↑)	83.18%(34.36%↑)	81.19%(39.67%↑)	80.95%(39.18%↑)	73.40%(40.99%↑)	72.29%(40.03%↑)
TST+TFI	88.05%(29.58%↑)	86.52%(34.46%↑)	81.60%(34.77%↑)	81.17%(38.90%↑)	69.31%(39.36%↑)	66.08%(43.51%↑)
SDAE+TFI	68.53%(12.08%↑)	61.27%(13.13%↑)	66.48%(12.85%↑)	58.98%(15.58%↑)	64.13%(14.17%↑)	56.60%(16.55%↑)
FS-Net+TFI	86.46%(1.99%↑)	84.98%(2.55%↑)	81.87%(9.58%↑)	79.68%(12.40%↑)	76.60%(20.64%↑)	73.53%(23.89%↑)
Average	**84.49%(25.09%↑)**	**82.29%(27.25%↑)**	**79.13%(30.41%↑)**	**77.32%(32.84%↑)**	**71.73%(34.07%↑)**	**68.83%(36.25%↑)**

TABLE XIX
CLASSIFICATION RESULTS OF REAL-WORD SCENARIO d_3 WITH IMPUTATION LOSS SIDE-CHANNEL FEATURES.

Model	Imputed Loss 10%		Imputed Loss 20%		Imputed Loss 30%	
	Acc	F1	Acc	F1	Acc	F1
CNN+TFI	80.92%(28.91%↑)	80.19%(28.28%↑)	77.85%(39.59%↑)	76.77%(39.73%↑)	74.61%(42.34%↑)	72.75%(43.31%↑)
LSTM+TFI	81.23%(34.62%↑)	80.81%(35.90%↑)	78.70%(45.45%↑)	78.02%(48.23%↑)	75.06%(42.67%↑)	73.75%(45.33%↑)
GRU+TFI	80.27%(34.68%↑)	79.52%(35.25%↑)	77.71%(42.72%↑)	76.64%(43.46%↑)	74.23%(44.74%↑)	72.38%(45.11%↑)
TST+TFI	81.65%(24.23%↑)	81.12%(27.50%↑)	78.59%(36.37%↑)	77.72%(37.81%↑)	74.22%(38.54%↑)	72.67%(42.03%↑)
SDAE+TFI	66.43%(19.27%↑)	59.58%(14.81%↑)	65.44%(30.16%↑)	58.58%(29.85%↑)	64.31%(31.15%↑)	57.42%(29.13%↑)
FS-Net+TFI	81.47%(8.44%↑)	82.89%(7.12%↑)	80.10%(17.40%↑)	81.04%(16.25%↑)	77.44%(28.76%↑)	77.35%(28.99%↑)
Average	**78.66%(25.02%↑)**	**77.35%(24.81%↑)**	**76.40%(35.28%↑)**	**74.80%(35.89%↑)**	**73.31%(38.03%↑)**	**71.05%(38.98%↑)**

APPENDIX F
ADDITIONAL RESULTS OF DIFFERENT SEQUENCE LENGTHS

The results of sequence length 256 and 1024 are shown in Tables XXXIII, XXXIV, XXXV, XXXVI. Additionally, our model demonstrates superior reconstruction results across various sequence lengths, emphasizing its robust applicability.

APPENDIX G
ADDITIONAL RESULTS OF VARIOUS MASK RATIO

We conducted four sets of ablation experiments with mask ratios set at 15%, 30%, 50%, and 75%. And the additional experiment results are shown in the Tables XXIII, XXIV.

APPENDIX H
ADDITIONAL RESULTS OF PERFORMANCE ANALYSIS OF NÜWA

The results of average performance variation are shown in Table XXXVII.

TABLE XX
CLASSIFICATION RESULTS OF REAL-WORD SCENARIO d_4 WITH IMPUTATION LOSS SIDE-CHANNEL FEATURES.

Model	Imputed Loss 10%		Imputed Loss 20%		Imputed Loss 30%	
	Acc	F1	Acc	F1	Acc	F1
CNN	80.91%(28.90%↑)	79.86%(29.41%↑)	77.89%(30.46%↑)	76.43%(39.73%↑)	74.68%(40.28%↑)	72.51%(43.95%↑)
LSTM	81.05%(34.02%↑)	80.45%(35.26%↑)	78.55%(44.06%↑)	77.56%(45.32%↑)	74.98%(43.05%↑)	73.26%(45.02%↑)
GRU	80.22%(35.40%↑)	79.54%(36.29%↑)	77.78%(41.97%↑)	76.68%(42.47%↑)	74.14%(40.82%↑)	72.16%(43.08%↑)
TST	81.87%(25.38%↑)	81.34%(28.07%↑)	79.39%(39.14%↑)	78.56%(40.21%↑)	75.28%(40.00%↑)	73.71%(43.27%↑)
SDAE	66.89%(19.25%↑)	59.34%(16.87%↑)	65.85%(26.39%↑)	58.11%(21.05%↑)	63.87%(26.31%↑)	55.92%(21.97%↑)
FS-Net	80.47%(10.39%↑)	82.63%(10.02%↑)	79.43%(21.26%↑)	80.89%(22.17%↑)	76.90%(29.52%↑)	77.26%(32.43%↑)
Average	**78.57%(25.56%↑)**	**77.19%(25.98%↑)**	**76.48%(33.88%↑)**	**74.71%(35.15%↑)**	**73.31%(36.66%↑)**	**70.80%(38.28%↑)**

TABLE XXI
CLASSIFICATION RESULTS WITH DIFFERENT MASK RATIO OF INPUT SEQUENCES ON d_1.

Packet Loss	Loss 10%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	85.02%	84.97%	85.19%	85.14%	85.41%	85.37%	84.41%	84.34%
LSTM	86.96%	86.90%	86.88%	86.82%	86.75%	86.69%	86.23%	86.15%
GRU	85.40%	85.36%	85.5%	85.46%	85.32%	85.28%	84.92%	84.87%
TST	88.89%	88.73%	88.67%	88.51%	88.53%	88.36%	87.47%	87.24%
SDAE	72.14%	65.27%	72.10%	65.24%	71.99%	65.14%	71.84%	65.00%
FS-Net	90.33%	89.29%	90.15%	89.26%	89.82%	88.95%	90.05%	89.13%
Average	**84.79%**	**83.42%**	**84.75%**	**83.41%**	**84.64%**	**83.30%**	**84.15%**	**82.79%**
Packet Loss	Loss 20%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	80.49%	80.07%	81.02%	80.70%	80.94%	80.55%	80.04%	79.63%
LSTM	82.78%	82.49%	82.31%	81.96%	81.67%	81.28%	82.32%	81.95%
GRU	80.71%	80.48%	81.21%	81.03%	80.90%	80.70%	80.40%	80.16%
TST	83.3%	82.44%	83.69%	82.85%	83.00%	82.19%	81.92%	80.94%
SDAE	71.51%	64.66%	71.57%	64.72%	71.75%	64.90%	71.35%	64.53%
FS-Net	88.58%	87.12%	87.88%	86.68%	88.23%	87.06%	87.76%	86.55%
Average	**81.23%**	**79.54%**	**81.28%**	**79.66%**	**81.08%**	**79.45%**	**80.63%**	**78.96%**
Packet Loss	Loss 30%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	77.10%	76.24%	77.32%	76.51%	77.14%	76.33%	76.27%	75.41%
LSTM	78.16%	77.30%	79.13%	78.34%	78.49%	77.65%	77.88%	77.01%
GRU	76.87%	76.32%	77.39%	76.90%	77.25%	76.73%	76.66%	76.14%
TST	78.47%	76.78%	79.43%	77.86%	78.38%	76.75%	77.09%	75.23%
SDAE	70.57%	63.74%	70.88%	64.07%	70.73%	63.93%	70.39%	63.61%
FS-Net	85.75%	83.57%	86.23%	84.67%	85.81%	84.09%	85.12%	83.38%
Average	**77.82%**	**75.66%**	**78.40%**	**76.39%**	**77.97%**	**75.91%**	**77.24%**	**75.13%**

TABLE XXIII
CLASSIFICATION RESULTS WITH DIFFERENT MASK RATIO OF INPUT SEQUENCES ON d_3.

Packet Loss	Loss 10%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	81.19%	81.20%	81.27%	81.27%	80.96%	80.98%	80.45%	80.50%
LSTM	88.60%	88.62%	88.75%	88.77%	88.48%	88.50%	87.67%	87.71%
GRU	81.29%	81.24%	81.39%	81.33%	81.18%	81.13%	80.57%	80.53%
TST	91.95%	91.96%	92.24%	92.24%	91.77%	91.77%	90.73%	90.73%
SDAE	73.78%	73.57%	73.76%	73.54%	73.65%	73.42%	73.46%	73.22%
FS-Net	81.05%	77.78%	81.45%	78.24%	81.18%	77.07%	81.08%	77.81%
Average	**82.98%**	**82.40%**	**83.14%**	**82.57%**	**82.87%**	**82.15%**	**82.33%**	**81.75%**
Packet Loss	Loss 20%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	78.42%	78.46%	78.51%	78.55%	78.09%	78.15%	77.11%	77.19%
LSTM	84.32%	84.34%	84.70%	84.72%	84.46%	84.48%	82.97%	82.99%
GRU	78.65%	78.65%	78.25%	78.18%	77.51%	77.46%	78.40%	78.33%
TST	86.81%	86.78%	87.38%	87.36%	86.60%	86.57%	84.97%	84.93%
SDAE	72.60%	72.35%	72.61%	72.35%	72.46%	72.19%	72.18%	71.91%
FS-Net	80.05%	76.63%	80.55%	77.16%	80.47%	77.07%	80.09%	76.64%
Average	**80.14%**	**79.54%**	**80.33%**	**79.72%**	**79.93%**	**79.32%**	**79.29%**	**78.67%**
Packet Loss	Loss 30%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	75.57%	75.66%	76.25%	76.32%	75.68%	75.77%	74.61%	74.74%
LSTM	80.11%	80.11%	80.69%	80.72%	80.40%	80.42%	79.07%	79.08%
GRU	75.61%	75.52%	76.04%	75.96%	75.85%	75.75%	74.83%	74.76%
TST	81.49%	81.42%	82.41%	82.35%	81.87%	81.82%	80.06%	79.98%
SDAE	71.19%	70.89%	71.57%	71.29%	71.49%	71.20%	71.02%	70.73%
FS-Net	78.52%	74.85%	79.37%	75.81%	78.94%	75.32%	78.74%	75.08%
Average	**77.08%**	**76.41%**	**77.72%**	**77.08%**	**77.37%**	**76.71%**	**76.39%**	**75.73%**

TABLE XXII
CLASSIFICATION RESULTS WITH DIFFERENT MASK RATIO OF INPUT SEQUENCES ON d_2.

Packet Loss	Loss 10%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	99.41%	99.41%	99.03%	99.03%	98.93%	98.93%	98.84%	98.84%
LSTM	97.79%	97.79%	97.52%	97.52%	97.35%	97.35%	97.40%	97.40%
GRU	97.91%	97.91%	97.61%	97.61%	97.49%	97.49%	97.34%	97.35%
TST	99.42%	99.42%	99.08%	99.08%	98.98%	98.98%	98.90%	98.90%
SDAE	95.73%	95.73%	95.26%	95.26%	95.14%	95.15%	95.02%	95.03%
FS-Net	99.87%	99.87%	99.72%	99.72%	99.79%	99.79%	99.53%	99.54%
Average	**98.36%**	**98.36%**	**98.04%**	**98.04%**	**97.95%**	**97.95%**	**97.84%**	**97.84%**
Packet Loss	Loss 20%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	98.52%	98.52%	97.84%	97.84%	97.37%	97.37%	97.25%	97.25%
LSTM	94.24%	94.23%	93.76%	93.74%	94.02%	94.01%	95.12%	95.10%
GRU	94.98%	94.96%	94.26%	94.25%	93.65%	93.64%	93.75%	93.74%
TST	98.71%	98.71%	98.01%	98.01%	97.66%	97.67%	97.55%	97.55%
SDAE	93.95%	93.94%	93.23%	93.23%	92.77%	92.77%	92.75%	92.76%
FS-Net	99.75%	99.75%	99.51%	99.52%	99.59%	99.60%	99.22%	99.24%
Average	**96.69%**	**96.69%**	**96.10%**	**96.10%**	**95.84%**	**95.84%**	**95.94%**	**95.94%**
Packet Loss	Loss 30%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	96.88%	96.87%	95.66%	95.66%	95.02%	95.02%	95.10%	95.10%
LSTM	91.68%	91.57%	90.08%	89.99%	89.24%	89.14%	90.06%	90.03%
GRU	91.31%	91.20%	90.15%	90.07%	89.36%	89.27%	90.00%	89.95%
TST	97.18%	97.17%	95.89%	95.89%	95.31%	95.30%	95.33%	95.33%
SDAE	91.07%	91.00%	90.01%	89.96%	89.42%	89.38%	89.64%	89.62%
FS-Net	99.60%	99.60%	99.21%	99.23%	99.17%	99.19%	98.76%	98.79%
Average	**94.62%**	**94.57%**	**93.50%**	**93.47%**	**92.92%**	**92.88%**	**93.15%**	**93.14%**

TABLE XXIV
CLASSIFICATION RESULTS WITH DIFFERENT MASK RATIO OF INPUT SEQUENCES ON d_4.

Packet Loss	Loss 10%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	82.32%	81.93%	82.84%	82.46%	82.21%	81.82%	82.07%	81.64%
LSTM	82.15%	80.90%	82.76%	81.51%	82.14%	80.85%	82.05%	80.67%
GRU	82.09%	80.97%	82.58%	81.86%	81.75%	81.02%	81.58%	80.80%
TST	82.94%	82.48%	83.33%	82.87%	82.88%	82.41%	82.77%	82.25%
SDAE	65.61%	55.13%	65.94%	55.45%	65.69%	55.21%	65.68%	55.19%
FS-Net	90.33%	89.29%	81.58%	83.58%	81.56%	83.53%	81.56%	83.46%
Average	**80.84%**	**78.45%**	**79.84%**	**77.96%**	**79.37%**	**77.47%**	**79.29%**	**77.34%**
Packet Loss	Loss 20%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	80.52%	80.07%	82.04%	81.62%	80.60%	80.14%	80.52%	80.02%
LSTM	80.65%	79.34%	81.92%	80.62%	80.88%	79.48%	80.70%	79.17%
GRU	79.80%	79.04%	81.43%	80.67%	79.96%	79.15%	79.72%	78.84%
TST	81.50%	80.99%	82.66%	82.15%	81.60%	81.04%	81.32%	80.69%
SDAE	65.17%	54.68%	65.75%	55.26%	65.27%	54.76%	65.24%	54.74%
FS-Net	88.58%	87.12%	80.99%	82.90%	80.99%	82.76%	80.71%	82.40%
Average	**79.37%**	**76.87%**	**79.13%**	**77.20%**	**78.22%**	**76.22%**	**78.04%**	**75.98%**
Packet Loss	Loss 30%							
Mask Rotio	15%		30%		50%		75%	
Model	Acc	F1	Acc	F1	Acc	F1	Acc	F1
CNN	78.99%	78.37%	81.08%	80.47%	79.19%	78.57%	79.15%	78.51%
LSTM	79.34%	77.67%	81.08%	79.49%	79.54%	77.89%	79.41%	77.63%
GRU	78.18%	77.20%	80.27%	79.27%	78.47%	77.48%	78.36%	77.32%
TST	80.04%	79.34%	81.88%	81.15%	80.35%	79.65%	79.97%	79.20%
SDAE	64.62%	54.13%	65.35%	54.85%	64.80%	54.28%	64.80%	54.28%
FS-Net	85.75%	83.57%	80.53%	82.21%	80.28%	81.78%	80.13%	81.63%
Average	**77.82%**	**75.05%**	**78.37%**	**76.24%**	**77.11%**	**74.94%**	**76.97%**	**74.76%**

TABLE XXV
RESULTS ON CLASSIFYING SCENARIO d_1 FLOWS WITH IMPUTED LOSS PACKETS IN SFDA.

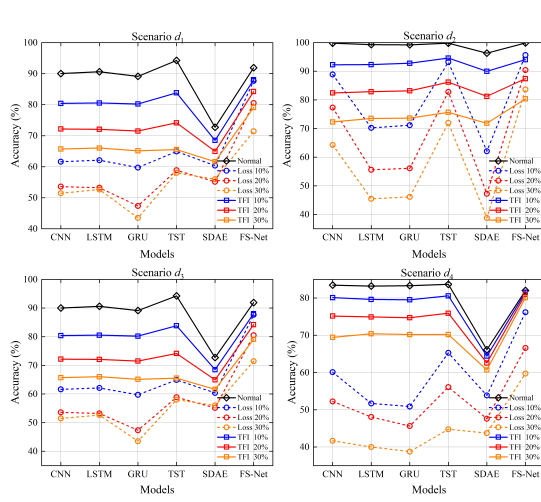| Model	Imputed Loss 10%		Imputed Loss 20%		Imputed Loss 30%	
	Acc	F1	Acc	F1	Acc	F1
CNN	80.40%(18.78%↑)	80.22%(21.65%↑)	72.16%(18.57%↑)	70.91%(20.17%↑)	65.71%(14.26%↑)	63.56%(12.82%↑)
LSTM	80.55%(18.44%↑)	80.36%(22.8%↑)	72.07%(18.84%↑)	71.34%(23.05%↑)	66.04%(13.38%↑)	64.68%(17.52%↑)
GRU	80.22%(20.50%↑)	80.17%(23.24%↑)	71.51%(24.15%↑)	71.01%(24.91%↑)	65.14%(21.62%↑)	64.24%(20.92%↑)
TST	83.83%(18.92%↑)	83.57%(23.06%↑)	74.16%(15.30%↑)	71.74%(17.78%↑)	65.54%(7.53%↑)	61.55%(10.23%↑)
SDAE	68.50%(8.14%↑)	61.75%(8.49%↑)	64.95%(9.81%↑)	58.35%(11.26%↑)	61.62%(5.63%↑)	55.25%(8.67%↑)
FS-Net	88.06%(0.41%↑)	86.53%(0.52%↑)	84.23%(3.71%↑)	81.77%(4.36%↑)	79.09%(7.63%↑)	74.94%(8.82%↑)
Average	**80.26%(14.20%↑)**	**78.77%(16.63%↑)**	**73.18%(15.06%↑)**	**70.85%(16.92%↑)**	**67.19%(11.68%↑)**	**64.04%(13.16%↑)**

Fig. 14. Classification results of packet with intact, loss and Imputed Loss in SFDA.

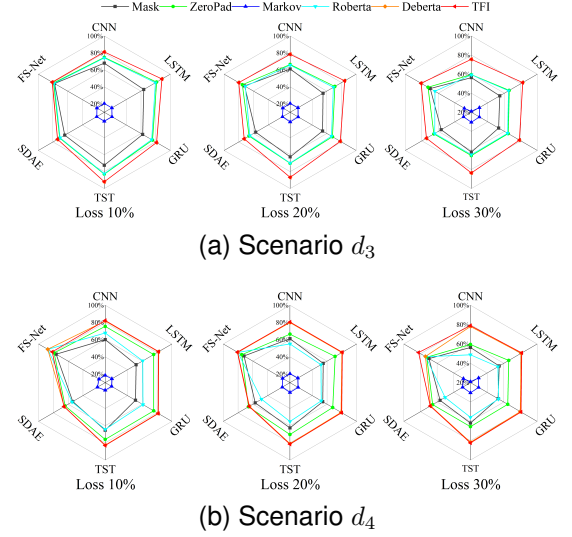(a) Scenario d_3

(b) Scenario d_4

Fig. 15. Classification results with different feature imputation methods in d_3, d_4.

TABLE XXVI
CLASSIFYING RESULTS ON SCENARIO d_3 FLOWS WITH IMPUTED LOSS PACKETS IN SFDA.

Model	Imputed Loss 10%		Imputed Loss 20%		Imputed Loss 30%	
	Acc	F1	Acc	F1	Acc	F1
CNN	73.79%(5.80%↑)	73.76%(5.89%↑)	65.92%(4.77%↑)	65.44%(4.84%↑)	59.80%(3.42%↑)	58.72%(3.45%↑)
LSTM	79.23%(15.44%↑)	79.12%(15.75%↑)	67.72%(12.85%↑)	66.94%(12.96%↑)	59.55%(10.76%↑)	57.78%(9.45%↑)
GRU	74.27%(11.97%↑)	74.08%(12.04%↑)	65.52%(11.30%↑)	64.99%(11.02%↑)	59.36%(12.15%↑)	58.30%(10.91%↑)
TST	78.61%(6.10%↑)	78.25%(6.11%↑)	66.47%(3.87%↑)	64.98%(3.43%↑)	58.68%(1.74%↑)	56.08%(0.81%↑)
SDAE	69.89%(5.93%↑)	69.55%(6.02%↑)	64.70%(7.78%↑)	64.01%(8.08%↑)	60.21%(9.17%↑)	58.98%(9.26%↑)
FS-Net	78.38%(0.54%↑)	74.97%(0.66%↑)	73.49%(1.38%↑)	69.65%(1.94%↑)	67.89%(1.83%↑)	63.84%(3.05%↑)
Average	**75.70%(7.63%↑)**	**74.96%(7.74%↑)**	**67.30%(6.99%↑)**	**66.00%(7.05%↑)**	**60.92%(6.51%↑)**	**58.95%(6.16%↑)**

TABLE XXVII
RESULTS ON CLASSIFYING SCENARIO d_4 FLOWS WITH IMPUTED LOSS PACKETS IN SFDA.

Model	Imputed Loss 10%		Imputed Loss 20%		Imputed Loss 30%	
	Acc	F1	Acc	F1	Acc	F1
CNN	80.11%(20.02%↑)	79.65%(20.86%↑)	75.17%(22.94%↑)	74.73%(24.67%↑)	69.45%(27.79%↑)	69.26%(32.97%↑)
LSTM	79.64%(27.95%↑)	78.07%(28.17%↑)	74.93%(26.88%↑)	73.19%(28.82%↑)	70.41%(30.41%↑)	68.88%(30.94%↑)
GRU	79.54%(28.67%↑)	78.55%(29.55%↑)	74.72%(29.10%↑)	73.44%(28.98%↑)	70.20%(31.45%↑)	68.93%(33.71%↑)
TST	80.59%(15.31%↑)	79.92%(18.84%↑)	75.92%(19.85%↑)	75.02%(23.80%↑)	70.20%(25.45%↑)	69.41%(27.07%↑)
SDAE	64.41%(10.58%↑)	53.93%(9.74%↑)	62.56%(14.97%↑)	52.14%(13.49%↑)	60.69%(16.96%↑)	50.35%(15.16%↑)
FS-Net	81.54%(5.35%↑)	84.21%(5.99%↑)	81.00%(14.41%↑)	83.53%(13.24%↑)	80.11%(20.39%↑)	82.38%(19.89%↑)
Average	**77.64%(17.98%↑)**	**75.72%(18.86%↑)**	**74.05%(21.36%↑)**	**72.01%(22.17%↑)**	**70.18%(25.41%↑)**	**68.20%(26.62%↑)**

TABLE XXVIII
CLASSIFICATION ACCURACY WITH DIFFERENT FEATURE IMPUTATION METHODS IN d_1.

Packet Loss 10%

Model	ZeroPad Acc	ZeroPad F1	Markov Acc	Markov F1	BERT Acc	BERT F1	Roberta Acc	Roberta F1	Deberta Acc	Deberta F1
CNN	77.91%(16.29%↑)	77.4%(18.83%↑)	45.39%(16.23%↓)	43.8%(14.77%↓)	73.75%(12.13%↑)	73.75%(15.18%↑)	77.25%(15.63%↑)	76.71%(18.14%↑)	77.25%(15.63%↑)	76.71%(18.14%↑)
LSTM	79.10%(16.99%↑)	78.76%(21.2%↑)	45.00%(17.11%↓)	43.76%(13.80%↓)	78.79%(16.68%↑)	78.41%(20.85%↑)	78.79%(16.68%↑)	78.41%(20.85%↑)	78.79%(16.68%↑)	78.41%(20.85%↑)
GRU	78.6%(18.88%↑)	78.46%(21.53%↑)	43.34%(16.38%↓)	42.83%(14.10%↓)	78.43%(18.71%↑)	78.26%(21.33%↑)	78.43%(18.71%↑)	78.26%(21.33%↑)	78.43%(18.71%↑)	78.26%(21.33%↑)
TST	78.07%(13.16%↑)	77.2%(16.69%↑)	45.42%(19.49%↓)	42.47%(18.04%↓)	77.66%(12.75%↑)	76.65%(16.14%↑)	77.66%(12.75%↑)	76.65%(16.14%↑)	77.66%(12.75%↑)	76.65%(16.14%↑)
SDAE	68.47%(8.11%↑)	61.5%(8.24%↑)	51.99%(8.37%↓)	44.46%(8.80%↓)	68.44%(8.08%↑)	61.46%(8.20%↑)	68.44%(8.08%↑)	61.46%(8.20%↑)	68.44%(8.08%↑)	61.46%(8.20%↑)
FS-Net	89.35%(1.69%↑)	86.01%(0%)	42.47%(45.18%↓)	33.33%(52.68%↓)	87.21%(0.44%↓)	85.7%(0.31%↓)	87.27%(0.38%↓)	85.81%(0.20%↓)	87.21%(0.44%↓)	85.70%(0.31%↓)
Average	**78.58%(12.52%↑)**	**76.56%(14.42%↑)**	**45.60%(20.46%↓)**	**41.78%(20.37%↓)**	**74.84%(8.78%↑)**	**74.83%(12.69%↑)**	**77.97%(11.91%↑)**	**76.22%(14.08%↑)**	**77.96%(11.9%↑)**	**76.2%(14.06%↑)**

Packet Loss 20%

Model	ZeroPad Acc	ZeroPad F1	Markov Acc	Markov F1	BERT Acc	BERT F1	Roberta Acc	Roberta F1	Deberta Acc	Deberta F1
CNN	69.69%(16.10%↑)	67.82%(17.08%↑)	47.04%(6.55%↓)	44.27%(6.47%↓)	64.97%(11.38%↑)	64.69%(13.95%↑)	68.87%(15.28%↑)	66.94%(16.20%↑)	68.87%(15.28%↑)	66.94%(16.20%↑)
LSTM	70.55%(17.32%↑)	69.39%(21.10%↑)	46.06%(7.17%↓)	44.13%(4.16%↓)	68.41%(15.18%↑)	67.99%(19.70%↑)	70.41%(17.18%↑)	69.20%(20.91%↑)	70.41%(17.18%↑)	69.20%(20.91%↑)
GRU	70.21%(22.85%↑)	69.56%(23.46%↑)	43.82%(3.54%↓)	42.98%(3.12%↓)	67.3%(19.94%↑)	67.07%(20.97%↑)	69.9%(22.54%↑)	69.10%(23.00%↑)	69.90%(22.54%↑)	69.10%(23.00%↑)
TST	70.18%(11.32%↑)	66.72%(12.76%↑)	48.73%(10.13%↓)	42.95%(11.01%↓)	67.55%(8.69%↑)	67.22%(13.26%↑)	70.95%(12.09%↑)	67.24%(13.28%↑)	70.95%(12.09%↑)	67.24%(13.28%↑)
SDAE	65.20%(10.06%↑)	57.78%(10.69%↑)	52.04%(3.10%↓)	44.10%(2.99%↓)	62.99%(7.85%↑)	62.84%(15.75%↑)	65.1%(9.96%↑)	57.66%(10.57%↑)	65.10%(9.96%↑)	57.66%(10.57%↑)
FS-Net	85.20%(4.68%↑)	83.25%(5.84%↑)	43.70%(37.15%↓)	33.64%(43.77%↓)	78.31%(2.21%↑)	77.92%(0.51%↑)	80.28%(0.24%↓)	78.09%(0.68%↑)	80.51%(0.01%↓)	78.39%(0.98%↓)
Average	**71.84%(13.72%↑)**	**69.09%(15.16%↑)**	**46.84%(11.27%↓)**	**42.01%(11.92%↓)**	**68.26%(10.14%↑)**	**67.96%(14.02%↑)**	**70.92%(0.92%↓)**	**68.04%(1.05%↓)**	**70.96%(12.84%↑)**	**68.09%(14.16%↑)**

Packet Loss 30%

Model	ZeroPad Acc	ZeroPad F1	Markov Acc	Markov F1	BERT Acc	BERT F1	Roberta Acc	Roberta F1	Deberta Acc	Deberta F1
CNN	64.40%(12.95%↑)	61.54%(10.80%↑)	49.55%(1.90%↑)	45.59%(5.15%↑)	60.37%(8.92%↑)	60.55%(9.81%↓)	63.47%(12.02%↑)	60.51%(9.77%↑)	63.47%(12.02%↑)	60.51%(9.77%↑)
LSTM	65.95%(13.29%↑)	64.06%(16.90%↑)	46.11%(6.55%↑)	43.78%(3.38%↑)	61.48%(8.82%↓)	61.81%(14.65%↓)	65.19%(12.53%↑)	63.2%(16.04%↑)	65.19%(12.53%↑)	63.2%(16.04%↑)
GRU	64.61%(21.09%↑)	63.48%(20.16%↑)	44.43%(0.91%↓)	43.45%(0.13%↑)	60.89%(17.37%↑)	61.27%(17.95%↓)	64.10%(20.58%↑)	62.81%(19.49%↑)	64.1%(20.58%↑)	62.81%(19.49%↑)
TST	60.94%(2.93%↑)	56.31%(4.99%↑)	49.31%(8.70%↑)	41.65%(9.67%↑)	55.94%(2.07%↑)	55.62%(4.30%↓)	59.84%(1.83%↑)	53.71%(2.39%↑)	59.84%(1.83%↑)	53.71%(2.39%↑)
SDAE	63.14%(7.15%↑)	55.11%(8.53%↑)	52.84%(3.15%↑)	44.02%(2.56%↑)	59.51%(3.52%↓)	59.51%(12.93%↓)	63.21%(7.22%↑)	55.16%(8.58%↑)	63.21%(7.22%↑)	55.16%(8.58%↑)
FS-Net	80.02%(8.56%↑)	76.76%(10.64%↑)	44.22%(27.24%↓)	33.98%(32.14%↓)	66.91%(4.55%↑)	66.76%(0.64%↓)	70.97%(0.49%↑)	68.41%(2.29%↑)	70.32%(1.14%↓)	67.62%(1.50%↑)
Average	**66.51%(11.00%↑)**	**62.88%(12.00%↑)**	**47.74%(7.77%↓)**	**42.08%(8.80%↓)**	**60.85%(5.34%↑)**	**60.92%(10.05%↓)**	**64.46%(8.95%↑)**	**60.63%(9.76%↑)**	**64.36%(8.84%↑)**	**60.5%(9.63%↑)**

TABLE XXIX
CLASSIFICATION ACCURACY WITH DIFFERENT FEATURE IMPUTATION METHODS IN d_2.

Packet Loss 10%

Model	ZeroPad Acc	ZeroPad F1	Markov Acc	Markov F1	BERT Acc	BERT F1	Roberta Acc	Roberta F1	Deberta Acc	Deberta F1
CNN	96.24%(7.36%↑)	96.22%(7.30%↑)	20.06%(68.82%↓)	20.00%(68.92%↓)	88.12%(0.76%↑)	88.12%(0.76%↓)	96.21%(7.33%↑)	96.2%(7.28%↑)	91.19%(2.31%↑)	91.16%(2.24%↑)
LSTM	93.91%(23.68%↑)	93.89%(24.17%↑)	19.92%(50.31%↓)	19.84%(49.88%↓)	84.27%(14.04%↑)	84.27%(14.51%↓)	90.88%(20.65%↑)	90.82%(21.1%↑)	86.17%(15.94%↑)	86.18%(16.46%↑)
GRU	94.79%(23.63%↑)	94.75%(23.99%↑)	19.96%(51.2%↓)	19.88%(50.88%↓)	83.52%(12.36%↑)	83.52%(12.76%↓)	92.37%(21.21%↑)	92.34%(21.58%↑)	85.82%(14.66%↑)	85.81%(15.05%↑)
TST	96.88%(3.66%↑)	96.85%(3.61%↑)	19.89%(73.33%↓)	19.84%(73.40%↓)	90.79%(2.43%↑)	90.79%(2.45%↓)	96.74%(3.52%↑)	96.71%(3.47%↑)	92.39%(0.83%↓)	92.37%(0.87%↓)
SDAE	89.88%(27.80%↑)	89.94%(28.26%↑)	20.01%(42.07%↓)	19.9%(41.78%↓)	80.72%(18.64%↑)	80.72%(19.04%↑)	88.38%(26.3%↑)	88.44%(26.76%↑)	83.32%(21.24%↑)	83.39%(21.71%↑)
FS-Net	97.83%(2.20%↑)	97.84%(2.18%↑)	19.93%(75.70%↓)	19.85%(75.81%↓)	93.19%(2.44%↓)	93.19%(2.47%↓)	92.14%(3.49%↓)	92.3%(3.36%↓)	95.39%(0.24%↓)	95.48%(0.18%↓)
Average	**94.92%(14.72%↑)**	**94.92%(14.92%↑)**	**19.96%(60.24%↓)**	**19.89%(60.11%↓)**	**86.77%(6.77%↑)**	**86.77%(6.77%↑)**	**92.79%(12.59%↑)**	**92.8%(12.81%↑)**	**89.05%(8.85%↑)**	**89.07%(9.07%↑)**

Packet Loss 20%

Model	ZeroPad Acc	ZeroPad F1	Markov Acc	Markov F1	BERT Acc	BERT F1	Roberta Acc	Roberta F1	Deberta Acc	Deberta F1
CNN	91.02%(13.69%↑)	90.94%(13.40%↑)	20.00%(57.33%↓)	19.76%(57.78%↓)	83.00%(5.67%↑)	83.10%(5.56%↑)	91.13%(13.8%↑)	91.05%(13.51%↑)	85.20%(7.87%↑)	85.03%(7.49%↑)
LSTM	85.7%(30.10%↑)	85.61%(30.82%↑)	20.05%(35.55%↓)	19.77%(35.02%↓)	75.32%(19.72%↑)	75.18%(20.39%↑)	78.52%(22.92%↑)	78.03%(23.24%↑)	77.72%(22.12%↑)	77.63%(22.84%↑)
GRU	87.51%(31.40%↑)	87.38%(32.14%↑)	20.16%(35.95%↓)	19.86%(35.38%↓)	74.09%(17.98%↑)	74.00%(18.76%↑)	80.49%(24.38%↑)	80.2%(24.96%↑)	76.89%(20.78%↑)	76.74%(21.5%↑)
TST	92.99%(10.18%↑)	92.86%(9.87%↑)	19.98%(62.83%↓)	19.72%(63.27%↓)	82.20%(0.61%↓)	82.16%(0.83%↓)	92.39%(9.58%↑)	92.29%(9.30%↑)	85.00%(2.19%↑)	84.96%(1.97%↑)
SDAE	82.47%(35.22%↑)	82.62%(35.92%↑)	19.95%(27.30%↓)	19.58%(27.12%↓)	72.84%(25.59%↑)	72.74%(26.04%↑)	77.27%(30.02%↑)	77.4%(30.70%↑)	74.94%(27.69%↑)	75.04%(28.34%↑)
FS-Net	95.14%(4.73%↑)	95.16%(4.64%↑)	19.96%(70.45%↓)	19.75%(70.77%↓)	86.56%(3.85%↓)	86.96%(3.56%↓)	79.96%(10.45%↓)	80.41%(10.11%↓)	88.86%(1.55%↓)	89.18%(1.34%↓)
Average	**89.14%(20.89%↑)**	**89.1%(21.13%↑)**	**20.02%(48.24%↓)**	**19.74%(48.22%↓)**	**79.00%(10.75%↑)**	**79.02%(11.06%↑)**	**83.29%(5.85%↑)**	**83.23%(5.87%↓)**	**81.44%(13.18%↑)**	**81.43%(13.47%↑)**

Packet Loss 30%

Model	ZeroPad Acc	ZeroPad F1	Markov Acc	Markov F1	BERT Acc	BERT F1	Roberta Acc	Roberta F1	Deberta Acc	Deberta F1
CNN	84.19%(19.93%↑)	84.03%(19.41%↑)	20.07%(44.19%↓)	19.46%(45.16%↑)	76.56%(12.3%↓)	77.76%(13.14%↓)	84.40%(20.14%↑)	84.22%(19.6%↑)	80.06%(15.80%↑)	79.71%(15.09%↑)
LSTM	76.47%(31.01%↑)	76.38%(31.90%↑)	20.29%(25.17%↓)	19.66%(24.82%↑)	66.67%(21.21%↓)	65.72%(21.24%↓)	65.61%(20.15%↑)	64.55%(20.07%↑)	69.08%(23.62%↑)	68.79%(24.31%↑)
GRU	78.80%(32.66%↑)	78.61%(33.94%↑)	20.42%(25.72%↓)	19.82%(24.85%↑)	65.22%(19.08%↓)	64.38%(19.71%↓)	67.42%(21.28%↑)	66.66%(21.99%↑)	68.72%(22.58%↑)	68.39%(23.72%↑)
TST	86.49%(14.48%↑)	86.32%(13.89%↑)	19.85%(52.16%↓)	19.12%(53.31%↑)	75.43%(3.42%↓)	74.72%(2.29%↑)	85.48%(13.47%↑)	85.33%(12.9%↑)	78.23%(6.22%↑)	78.26%(5.83%↑)
SDAE	74.72%(35.94%↑)	74.99%(36.77%↑)	19.90%(18.88%↓)	19.16%(19.06%↑)	62.61%(23.83%↓)	61.97%(23.75%↓)	64.41%(25.63%↑)	64.43%(26.21%↑)	66.41%(27.63%↑)	66.47%(28.25%↑)
FS-Net	91.06%(7.40%↑)	91.01%(7.14%↑)	19.96%(63.70%↓)	19.49%(64.38%↑)	76.29%(7.37%↑)	76.72%(7.15%↑)	64.91%(18.75%↓)	64.41%(19.46%↓)	80.09%(3.57%↓)	80.71%(3.16%↓)
Average	**81.96%(23.57%↑)**	**81.89%(23.84%↑)**	**20.08%(38.30%↓)**	**19.45%(38.60%↓)**	**70.46%(12.08%↑)**	**70.21%(12.16%↑)**	**72.04%(13.65%↑)**	**71.6%(13.55%↑)**	**73.77%(15.38%↑)**	**73.72%(15.67%↑)**

TABLE XXX
CLASSIFICATION ACCURACY WITH DIFFERENT FEATURE IMPUTATION METHODS IN d_3.

Packet Loss 10%

Model	ZeroPad Acc	ZeroPad F1	Markov Acc	Markov F1	BERT Acc	BERT F1	Roberta Acc	Roberta F1	Deberta Acc	Deberta F1
CNN	74.78%(6.79%↑)	74.97%(7.10%↑)	20.33%(47.66%↓)	20.16%(47.71%↓)	71.06%(3.07%↑)	78.55%(10.68%↑)	74.06%(6.07%↑)	74.05%(6.18%↑)	81.19%(13.2%↑)	81.2%(13.33%↑)
LSTM	81.32%(17.53%↑)	81.31%(17.94%↑)	20.34%(43.45%↓)	19.99%(43.38%↓)	75.84%(12.05%↑)	86.8%(23.43%↑)	79.64%(15.85%↑)	79.55%(16.18%↑)	88.60%(24.81%↑)	88.62%(25.25%↑)
GRU	75.73%(13.43%↑)	75.67%(13.63%↑)	20.45%(41.85%↓)	20.08%(41.96%↓)	70.59%(8.29%↑)	88.21%(16.65%↑)	74.59%(12.29%↑)	74.42%(12.38%↑)	81.29%(18.99%↑)	81.24%(19.20%↑)
TST	83.00%(10.49%↑)	82.85%(10.71%↑)	20.65%(51.86%↓)	20.18%(51.96%↓)	78.70%(6.19%↑)	88.21%(16.07%↑)	82.4%(9.89%↑)	82.26%(10.12%↑)	91.94%(19.43%↑)	91.95%(19.81%↑)
SDAE	70.88%(6.92%↑)	70.70%(7.17%↑)	20.28%(43.68%↓)	20.02%(43.51%↓)	66.56%(2.60%↑)	70.74%(7.21%↑)	70.26%(6.30%↑)	69.94%(6.41%↑)	73.78%(9.82%↑)	73.57%(10.04%↑)
FS-Net	79.21%(1.37%↑)	75.74%(1.43%↑)	20.02%(57.82%↓)	16.68%(57.63%↓)	74.96%(2.88%↑)	78.58%(4.27%↑)	78.26%(0.42%↑)	74.91%(0.59%↑)	80.85%(3.01%↑)	77.55%(3.24%↑)
Average	**77.49%(9.42%↑)**	**76.87%(9.66%↑)**	**20.35%(47.72%↓)**	**19.52%(47.69%↓)**	**72.95%(4.89%↑)**	**80.26%(13.05%↑)**	**76.54%(8.47%↑)**	**75.86%(8.64%↑)**	**82.94%(14.88%↑)**	**82.36%(15.15%↑)**

Packet Loss 20%

Model	ZeroPad Acc	ZeroPad F1	Markov Acc	Markov F1	BERT Acc	BERT F1	Roberta Acc	Roberta F1	Deberta Acc	Deberta F1
CNN	66.39%(5.24%↑)	66.32%(5.72%↑)	20.48%(40.67%↓)	20.05%(40.55%↓)	63.09%(1.94%↑)	63.16%(2.56%↑)	65.60%(3.90%↑)	65.05%(17.82%↑)	78.42%(17.27%↑)	78.46%(17.86%↑)
LSTM	70.99%(16.12%↑)	70.69%(16.71%↑)	20.71%(34.16%↓)	19.91%(34.03%↓)	66.25%(11.38%↑)	66.47%(12.49%↑)	68.96%(13.51%↑)	68.38%(30.34%↑)	84.32%(29.45%↑)	84.34%(30.36%↑)
GRU	67.69%(13.47%↑)	67.46%(13.49%↑)	20.96%(33.26%↓)	20.19%(33.78%↓)	62.99%(8.77%↑)	63.1%(9.13%↑)	66.29%(11.51%↑)	65.73%(24.43%↑)	78.40%(24.18%↑)	78.33%(24.36%↑)
TST	70.24%(7.64%↑)	69.32%(7.77%↑)	21.38%(41.22%↓)	20.22%(41.33%↓)	67.36%(4.76%↑)	66.89%(5.34%↑)	69.86%(6.44%↑)	69.04%(25.22%↑)	86.77%(24.17%↑)	86.75%(25.20%↑)
SDAE	66.03%(9.11%↑)	65.84%(9.91%↑)	20.41%(36.51%↓)	19.96%(35.97%↓)	61.28%(4.36%↑)	61.52%(5.59%↑)	64.99%(7.55%↑)	64.47%(16.67%↑)	72.60%(15.68%↑)	72.35%(16.42%↑)
FS-Net	75.07%(2.96%↑)	71.00%(3.29%↑)	19.93%(52.18%↓)	16.68%(51.03%↓)	67.19%(4.92%↑)	67.53%(0.18%↑)	71.09%(4.17%↑)	67.94%(12.34%↑)	80.05%(7.94%↑)	77.55%(9.84%↑)
Average	**69.4%(9.09%↑)**	**68.44%(9.48%↑)**	**20.65%(39.67%↓)**	**19.50%(39.46%↓)**	**64.69%(4.38%↑)**	**64.78%(5.82%↑)**	**67.8%(7.49%↑)**	**66.77%(7.81%↑)**	**80.09%(19.78%↑)**	**79.63%(20.67%↑)**

Packet Loss 30%

Model	ZeroPad Acc	ZeroPad F1	Markov Acc	Markov F1	BERT Acc	BERT F1	Roberta Acc	Roberta F1	Deberta Acc	Deberta F1
CNN	59.49%(1.66%↓)	58.85%(1.75%↓)	21.04%(35.34%↑)	20.39%(34.88%↑)	57.09%(0.71%↓)	56.64%(1.37%↓)	59.30%(4.023%↑)	58.2%(1.29%↓)	75.57%(19.19%↑)	75.66%(20.39%↑)
LSTM	61.66%(6.79%↑)	60.59%(6.61%↑)	20.97%(27.82%↑)	19.77%(28.56%↑)	57.92%(9.13%↓)	57.98%(9.65%↓)	60.72%(12.39%↑)	59.51%(2.15%↓)	80.11%(31.32%↑)	80.11%(31.78%↑)
GRU	60.35%(6.13%↑)	59.79%(5.82%↑)	20.98%(26.23%↑)	19.92%(27.47%↑)	55.72%(8.51%↓)	55.37%(7.98%↓)	59.42%(12.03%↑)	60.36%(0.01%↑)	75.61%(28.4%↑)	75.52%(28.13%↑)
TST	61.14%(1.46%↓)	59.22%(2.33%↓)	21.79%(35.15%↑)	20.02%(35.25%↑)	56.59%(0.35%↑)	57.06%(1.79%↓)	59.99%(4.72%↑)	59.29%(1.85%↓)	81.58%(24.64%↑)	81.54%(26.27%↑)
SDAE	61.08%(4.16%↑)	60.72%(4.79%↑)	20.66%(30.38%↑)	19.92%(29.80%↑)	57.19%(6.15%↓)	57.52%(7.8%↓)	59.99%(10.27%↑)	59.29%(1.79%↓)	71.19%(20.15%↑)	70.89%(21.17%↑)
FS-Net	69.07%(3.04%↑)	64.33%(3.38%↓)	19.49%(46.57%↓)	16.50%(44.29%↓)	57.21%(8.85%↑)	57.57%(3.22%↑)	59.61%(1.18%↓)	58.00%(11.07%↓)	78.44%(12.38%↑)	74.77%(13.98%↑)
Average	**62.13%(7.73%↑)**	**60.58%(7.79%↑)**	**20.82%(33.58%↑)**	**19.42%(33.38%↓)**	**56.95%(2.55%↑)**	**57.02%(4.23%↑)**	**59.84%(5.44%↑)**	**59.11%(6.31%↑)**	**77.08%(22.68%↑)**	**76.42%(23.62%↑)**

TABLE XXXI
CLASSIFICATION ACCURACY WITH DIFFERENT FEATURE IMPUTATION METHODS IN d_4.

Model												
	Packet Loss 10%
	ZeroPad		Markov		BERT		Roberta		Deberta			
	Acc	F1	Acc	F1	Acc	F1	Acc	F1	Acc	F1		
CNN	75.43%(15.34%↑)	75.00%(16.21%↑)	18.50%(41.59%↓)	18.27%(40.52%↓)	65.13%(5.04%↑)	65.61%(6.82%↑)	67.73%(7.70%↓)	67.70%(7.30%↓)	81.74%(21.65%↑)	81.36%(22.57%↑)		
LSTM	75.39%(23.70%↑)	74.15%(24.25%↑)	18.93%(32.76%↓)	18.04%(31.86%↓)	57.48%(5.79%↑)	57.12%(7.22%↑)	60.68%(14.71%↓)	58.54%(15.61%↓)	81.75%(30.06%↑)	80.48%(30.58%↑)		
GRU	75.41%(24.54%↑)	74.49%(25.49%↑)	18.61%(32.26%↓)	17.99%(31.01%↓)	57.00%(6.13%↑)	56.89%(7.89%↑)	61.00%(14.41%↓)	59.89%(14.60%↓)	81.32%(30.45%↑)	80.59%(31.59%↑)		
TST	75.95%(10.67%↑)	74.78%(13.70%↑)	18.80%(46.48%↓)	18.28%(42.80%↓)	61.51%(3.77%↓)	61.12%(0.03%↓)	64.31%(11.64%↓)	62.78%(12.00%↓)	82.63%(17.35%↑)	82.18%(21.1%↑)		
SDAE	64.09%(10.26%↑)	53.66%(9.47%↑)	20.53%(33.3%↓)	16.32%(27.87%↓)	51.88%(1.95%↓)	51.68%(7.49%↑)	54.78%(9.31%↓)	45.00%(8.66%↓)	65.44%(11.61%↑)	54.96%(10.77%↑)		
FS-Net	79.09%(2.90%↑)	81.15%(2.93%↑)	18.31%(57.88%↓)	16.27%(61.95%↓)	85.41%(9.22%↑)	85.52%(7.30%↑)	87.41%(8.32%↓)	85.99%(4.84%↓)	87.58%(11.39%↑)	86.24%(8.02%↑)		
Average	**74.23%(14.57%↑)**	**72.21%(15.34%↑)**	**18.95%(40.71%↓)**	**17.53%(39.34%↓)**	**63.07%(3.41%↑)**	**62.99%(6.13%↑)**	**65.99%(8.24%↓)**	**63.32%(8.89%↓)**	**80.08%(20.42%↑)**	**77.64%(20.77%↑)**		
	Packet Loss 20%
Model	ZeroPad		Markov		BERT		Roberta		Deberta			
	Acc	F1	Acc	F1	Acc	F1	Acc	F1	Acc	F1		
CNN	66.39%(5.24%↑)	66.32%(5.72%↑)	20.48%(40.67%↓)	20.05%(40.55%↓)	64.02%(2.87%↑)	64.11%(3.51%↑)	54.96%(6.19%↓)	53.86%(6.74%↓)	79.80%(18.65%↑)	79.41%(18.81%↑)		
LSTM	70.99%(16.12%↑)	70.69%(16.71%↑)	20.71%(34.16%↓)	19.91%(34.07%↓)	66.99%(12.12%↑)	66.52%(12.54%↑)	51.87%(3.00%↑)	48.37%(5.61%↓)	80.02%(25.15%↑)	78.76%(24.78%↑)		
GRU	67.69%(13.47%↑)	67.46%(13.49%↑)	20.96%(33.26%↓)	20.19%(33.78%↓)	64.66%(10.44%↑)	65.11%(11.14%↑)	52.18%(2.04%↓)	49.98%(3.99%↓)	79.00%(24.78%↑)	78.28%(24.31%↑)		
TST	70.24%(7.64%↑)	69.32%(7.77%↑)	21.38%(41.22%↓)	20.22%(41.33%↓)	66.22%(3.62%↑)	66.01%(4.46%↑)	55.15%(7.45%↓)	52.33%(9.22%↓)	80.89%(18.29%↑)	80.41%(18.86%↑)		
SDAE	66.03%(9.11%↑)	65.84%(9.91%↑)	20.41%(36.51%↓)	19.96%(35.97%↓)	63.04%(6.12%↑)	63.43%(7.50%↑)	48.39%(8.53%↓)	39.29%(16.64%↓)	64.80%(7.88%↑)	54.30%(1.63%↓)		
FS-Net	75.07%(2.96%↑)	71.00%(3.29%↑)	19.93%(52.18%↓)	16.68%(51.03%↓)	67.10%(5.011%↑)	67.41%(0.23%↑)	80.43%(8.32%↑)	78.46%(10.75%↓)	80.62%(8.51%↑)	78.67%(10.96%↑)		
Average	**69.40%(9.09%↑)**	**68.44%(9.48%↑)**	**20.65%(39.67%↓)**	**19.50%(39.46%↓)**	**65.34%(5.03%↑)**	**65.43%(6.48%↑)**	**57.16%(3.15%↓)**	**53.72%(5.24%↓)**	**77.52%(17.21%↑)**	**74.97%(16.02%↑)**		
	Packet Loss 30%
Model	ZeroPad		Markov		BERT		Roberta		Deberta			
	Acc	F1	Acc	F1	Acc	F1	Acc	F1	Acc	F1		
CNN	59.49%(1.66%↓)	58.85%(1.75%↓)	21.04%(35.34%↑)	20.39%(34.88%↑)	55.69%(0.69%↑)	55.32%(0.05%↓)	48.82%(6.45%↓)	46.11%(13.38%↓)	78.01%(21.63%↑)	77.51%(22.24%↑)		
LSTM	61.66%(6.79%↑)	60.59%(6.61%↑)	20.97%(27.82%↑)	19.77%(28.56%↑)	58.76%(9.97%↓)	59.16%(10.83%↓)	47.04%(1.29%↓)	43.08%(18.58%↓)	78.37%(29.58%↑)	76.86%(28.53%↑)		
GRU	60.35%(6.13%↑)	59.79%(5.82%↑)	20.98%(26.23%↑)	19.92%(27.47%↑)	57.95%(10.74%↓)	58.04%(10.65%↓)	47.89%(0.50%↓)	44.90%(15.45%↓)	77.17%(29.96%↑)	76.33%(28.94%↑)		
TST	61.14%(1.46%↓)	59.22%(2.33%↓)	21.79%(35.15%↑)	20.02%(35.25%↑)	59.04%(2.10%↓)	58.89%(3.62%↓)	44.24%(5.48%↓)	46.90%(14.24%↓)	78.67%(23.40%↑)	78.67%(23.40%↑)		
SDAE	61.08%(4.16%↑)	60.72%(4.79%↑)	20.66%(30.38%↑)	19.92%(29.80%↑)	58.98%(7.94%↓)	59.16%(9.44%↓)	44.24%(5.48%↓)	35.07%(26.01%↓)	63.88%(12.84%↑)	53.36%(3.64%↑)		
FS-Net	69.07%(3.04%↑)	64.33%(3.38%↑)	19.49%(46.57%↑)	16.50%(44.29%↑)	65.27%(0.79%↓)	65.61%(4.82%↓)	70.39%(9.60%↑)	67.64%(1.43%↓)	70.82%(4.76%↑)	68.15%(7.36%↑)		
Average	**62.13%(7.73%↑)**	**60.58%(7.79%↑)**	**20.82%(33.58%↓)**	**19.42%(33.38%↓)**	**59.28%(4.88%↑)**	**59.36%(6.57%↑)**	**51.44%(2.96%↓)**	**47.28%(5.51%↓)**	**74.58%(20.18%↑)**	**71.81%(19.02%↑)**		

TABLE XXXII
CLASSIFICATION ACCURACY WITH TFM SUB-STRATEGIES IN d_1, d_2, d_3 AND d_4.

Scenario d1	Imputed Loss 10%				Imputed Loss 20%				Imputed Loss 30%			
Model	TFM-Mask	TFM-Del	TFM-Span	TFM-PS	TFM-Mask	TFM-Del	TFM-Span	TFM-PS	TFM-Mask	TFM-Del	TFM-Span	TFM-PS
CNN	86.91%	86.42%	83.19%	82.25%	82.56%	82.48%	77.75%	76.06%	78.91%	78.92%	72.80%	71.29%
LSTM	88.04%	87.93%	85.06%	83.78%	84.28%	84.05%	78.92%	77.23%	81.34%	80.85%	73.62%	72.88%
GRU	86.54%	86.57%	83.60%	82.31%	83.13%	82.72%	77.57%	75.86%	79.35%	79.41%	72.94%	71.35%
TST	91.03%	90.88%	86.23%	84.21%	86.11%	86.05%	78.69%	76.45%	71.08%	70.97%	68.41%	68.06%
SDAE	72.29%	72.27%	71.16%	70.97%	71.69%	71.71%	70.32%	69.77%	81.65%	81.74%	72.47%	71.24%
FS-Net	90.23%	90.29%	89.56%	89.27%	88.89%	88.60%	86.70%	86.44%	86.13%	86.48%	82.73%	82.26%
Average	**85.84%**	**85.73%**	**83.13%**	**82.13%**	**82.78%**	**82.60%**	**78.33%**	**76.97%**	**79.74%**	**79.73%**	**73.83%**	**72.85%**
Scenario d2	Imputed Loss 10%				Imputed Loss 10%				Imputed Loss 10%			
Model	TFM-Mask	TFM-Del	TFM-Span	TFM-PS	TFM-Mask	TFM-Del	TFM-Span	TFM-PS	TFM-Mask	TFM-Del	TFM-Span	TFM-PS
CNN	99.29%	99.36%	98.6%	96.26%	97.95%	98.33%	96.77%	96.26%	95.45%	96.35%	93.69%	96.26%
LSTM	97.68%	98.08%	97.19%	93.35%	94.75%	95.89%	93.31%	93.35%	90.82%	92.13%	87.34%	93.35%
GRU	97.89%	98.24%	97.27%	93.59%	94.83%	95.65%	93.49%	93.59%	91%	91.99%	89.11%	93.59%
TST	99.24%	99.2%	98.71%	98.05%	98.18%	98.33%	97.08%	98.05%	96.32%	96.7%	94.16%	98.05%
SDAE	95.6%	95.65%	94.84%	91.32%	93.59%	94.03%	92.09%	91.32%	90.81%	91.5%	87.66%	91.32%
FS-Net	99.85%	99.84%	99.69%	98.05%	99.63%	99.64%	99.38%	96.31%	99.39%	99.36%	98.59%	94.87%
Average	**98.26%**	**98.4%**	**97.72%**	**95.1%**	**96.49%**	**96.98%**	**95.35%**	**94.81%**	**93.97%**	**94.67%**	**91.76%**	**94.57%**
Scenario d3	Imputed Loss 10%				Imputed Loss 20%				Imputed Loss 30%			
Model	TFM-Mask	TFM-Del	TFM-Span	TFM-PS	TFM-Mask	TFM-Del	TFM-Span	TFM-PS	TFM-Mask	TFM-Del	TFM-Span	TFM-PS
CNN	82.40%	82.45%	80.24%	78.5%	79.93%	80.22%	76.25%	73.99%	77.48%	77.91%	72.64%	69.88%
LSTM	89.51%	89.61%	87.24%	85.08%	85.85%	86.09%	81.39%	78.57%	82.11%	82.46%	75.76%	72.69%
GRU	82.15%	82.23%	80.53%	78.93%	79.70%	79.93%	76.22%	74.30%	77.18%	77.59%	72.81%	70.07%
TST	93.05%	93.06%	90.36%	87.39%	88.87%	89.14%	83.49%	79.22%	84.09%	84.66%	76.94%	72.23%
SDAE	73.96%	74.05%	73.22%	72.54%	73.11%	73.27%	71.23%	70.64%	71.98%	72.18%	69.26%	68.05%
FS-Net	81.61%	81.43%	80.90%	80.10%	80.75%	80.69%	79.44%	77.99%	79.59%	79.40%	76.93%	75.11%
Average	**83.78%**	**83.81%**	**82.08%**	**80.42%**	**81.37%**	**81.56%**	**78.00%**	**75.79%**	**78.74%**	**79.03%**	**74.06%**	**71.34%**
Scenario d4	Imputed Loss 10%				Imputed Loss 20%				Imputed Loss 30%			
Model	TFM-Mask	TFM-Del	TFM-Span	TFM-PS	TFM-Mask	TFM-Del	TFM-Span	TFM-PS	TFM-Mask	TFM-Del	TFM-Span	TFM-PS
CNN	82.51%	82.57%	81.65%	81.22%	81.31%	81.30%	79.50%	78.83%	79.97%	80.07%	77.19%	76.66%
LSTM	82.50%	82.50%	81.69%	81.27%	81.35%	81.29%	79.58%	79.23%	79.99%	80.08%	77.84%	77.36%
GRU	82.18%	82.10%	81.19%	80.93%	80.42%	80.38%	78.78%	78.34%	78.90%	79.04%	76.60%	76.09%
TST	83.17%	83.18%	82.43%	82.03%	82.12%	82.20%	80.55%	79.66%	80.90%	80.90%	78.07%	77.38%
SDAE	65.74%	65.72%	65.47%	65.28%	65.51%	65.49%	64.65%	64.61%	64.84%	64.83%	63.68%	63.52%
FS-Net	81.60%	81.61%	81.29%	81.34%	81.02%	81.07%	80.50%	80.34%	80.41%	80.44%	79.29%	79.19%
Average	**79.62%**	**79.61%**	**78.95%**	**78.68%**	**78.62%**	**78.62%**	**77.26%**	**76.84%**	**77.5%**	**77.56%**	**75.45%**	**75.03%**

TABLE XXXIII
CLASSIFICATION ACCURACY OF DIFFERENT SEQUENCE LENGTH IN SCENARIO d_1.

Model	Sequence length: 256						
	Normal	Loss 10%	Imputed Loss 10%	Loss 20%	Imputed Loss 20%	Loss 30%	Imputed Loss 30%
CNN	90.67%	62.89%	85.13%(22.24%↑)	54.27%	85.40%(20.81%↑)	52.03%	76.01%(23.98%↑)
LSTM	89.88%	60.61%	86.43%(25.82%↑)	51.16%	82.47%(31.31%↑)	50.67%	77.78%(27.11%↑)
GRU	87.61%	58.14%	84.76%(26.62%↑)	44.79%	80.46%(35.67%↑)	40.26%	76.60%(36.34%↑)
TST	94.50%	69.95%	88.2%(18.25%↑)	61.29%	81.84%(20.55%↑)	57.01%	77.64%(20.63%↑)
SDAE	70.86%	61.34%	70.17%(8.83%↑)	55.67%	69.5%(13.83%↑)	56.35%	68.53%(12.18%↑)
FS-Net	82.16%	79.75%	80.89%(1.14%↑)	76.27%	79.35%(3.08%↑)	71.12%	77.53%(6.41%↑)
Average	**85.95%**	**65.45%**	**82.60%(17.15%↑)**	**57.24%**	**78.98%(21.74%↑)**	**54.57%**	**75.68%(21.11%↑)**
Model	Sequence length: 1024						
	Normal	Loss 10%	Imputed Loss 10%	Loss 20%	Imputed Loss 20%	Loss 30%	Imputed Loss 30%
CNN	90.31%	64.59%	85.40%(20.81%↑)	56.76%	80.72%(23.96%↑)	54.26%	76.58%(22.32%↑)
LSTM	89.26%	61.03%	85.8%(24.77%↑)	51.80%	81.76%(29.96%↑)	51.07%	78.16%(27.09%↑)
GRU	87.21%	59.63%	84.16%(24.53%↑)	45.67%	80.28%(34.61%↑)	40.84%	76.44%(35.60%↑)
TST	94.46%	70.08%	87.88%(17.8%↑)	61.53%	81.54%(20.01%↑)	57.50%	77.23%(19.73%↑)
SDAE	74.61%	62.07%	73.89%(11.82%↑)	55.78%	73.20%(17.42%↑)	56.39%	72.13%(15.74%↑)
FS-Net	94.49%	91.59%	92.77%(1.18%↑)	87.12%	90.35%(3.23%↑)	81.33%	87.64%(6.31%↑)
Average	**88.39%**	**68.17%**	**84.98%(16.81%↑)**	**59.78%**	**81.31%(21.53%↑)**	**56.90%**	**78.03%(21.13%↑)**

TABLE XXXIV
CLASSIFICATION ACCURACY OF DIFFERENT SEQUENCE LENGTH IN SCENARIO d_2.

Model	Sequence length: 256						
	Normal	Loss 10%	Imputed Loss 10%	Loss 20%	Imputed Loss 20%	Loss 30%	Imputed Loss 30%
CNN	99.73%	86.35%	97.85%(11.50%↑)	71.17%	99.14%(9.93%↑)	56.42%	91.89%(35.47%↑)
LSTM	99.07%	69.69%	96.90%(27.21%↑)	55.13%	94.59%(39.46%↑)	45.94%	91.21%(45.27%↑)
GRU	99.05%	72.21%	97.74%(25.53%↑)	56.85%	95.52%(38.67%↑)	46.79%	92.85%(46.06%↑)
TST	99.93%	93.07%	99.87%(6.80%↑)	82.80%	99.76%(16.96%↑)	70.72%	99.42%(28.70%↑)
SDAE	94.71%	56.32%	93.58%(37.26%↑)	41.82%	91.39%(49.57%↑)	35.06%	88.32%(53.26%↑)
FS-Net	99.95%	99.11%	99.93%(0.82%↑)	97.27%	99.86%(2.59%↑)	93.72%	99.73%(6.01%↑)
Average	**98.74%**	**79.46%**	**97.65%(18.19%↑)**	**67.51%**	**95.98%(28.47%↑)**	**58.11%**	**93.9%(35.79%↑)**
Model	Sequence length: 1024						
	Normal	Loss 10%	Imputed Loss 10%	Loss 20%	Imputed Loss 20%	Loss 30%	Imputed Loss 30%
CNN	99.75%	89.21%	99.14%(9.93%↑)	78.58%	97.38%(18.8%↑)	67.72%	94.35%(26.63%↑)
LSTM	99.06%	69.94%	98.11%(28.17%↑)	56.47%	95.48%(39.01%↑)	47.97%	91.54%(43.57%↑)
GRU	99.00%	70.61%	98.22%(27.61%↑)	56.00%	95.95%(39.95%↑)	46.17%	92.47%(46.30%↑)
TST	99.84%	93.20%	99.40%(6.20%↑)	99.4%	99.4%(17.35%↑)	68.74%	96.27%(27.53%↑)
SDAE	94.41%	57.12%	93.73%(36.61%↑)	42.24%	92.12%(49.88%↑)	34.83%	89.66%(54.83%↑)
FS-Net	99.92%	98.64%	99.89%(1.25%↑)	95.79%	99.77%(3.98%↑)	90.70%	99.57%(8.87%↑)
Average	**98.66%**	**79.79%**	**98.08%(18.29%↑)**	**68.52%**	**96.68%(28.16%↑)**	**59.36%**	**93.98%(34.62%↑)**

TABLE XXXV
CLASSIFICATION ACCURACY OF DIFFERENT SEQUENCE LENGTH IN SCENARIO d_3.

Model	Sequence length: 256						
	Normal	Loss 10%	Imputed Loss 10%	Loss 20%	Imputed Loss 20%	Loss 30%	Imputed Loss 30%
CNN	83.91%	67.76%	80.3%(12.54%↑)	60.35%	81.1%(13.93%↑)	55.42%	74.94%(19.52%↑)
LSTM	93.22%	63.75%	89.23%(25.48%↑)	54.91%	84.41%(29.5%↑)	47.4%	80.11%(32.71%↑)
GRU	85.6%	61.2%	81.88%(20.68%↑)	53.55%	78.25%(24.7%↑)	46.86%	75.55%(28.69%↑)
TST	95.47%	73.36%	91.62%(18.26%↑)	63.41%	86.51%(23.1%↑)	57.22%	81.33%(24.11%↑)
SDAE	77.39%	64.42%	76.23%(11.81%↑)	57.1%	74.6%(17.5%↑)	50.72%	73.05%(22.33%↑)
FS-Net	84.08%	80.55%	83.16%(2.61%↑)	75.2%	81.77%(6.57%↑)	69.04%	80.08%(11.04%↑)
Average	**86.61%**	**68.51%**	**83.74%(15.23%↑)**	**60.75%**	**80.49%(19.74%↑)**	**54.44%**	**77.51%(23.07%↑)**
Model	Sequence length: 1024						
	Normal	Loss 10%	Imputed Loss 10%	Loss 20%	Imputed Loss 20%	Loss 30%	Imputed Loss 30%
CNN	84.3%	67.17%	81.1%(13.93%↑)	60.2%	78.06%(17.86%↑)	55.13%	75.24%(20.11%↑)
LSTM	93.52%	63.33%	89.77%(26.44%↑)	54.5%	84.85%(30.35%↑)	47.29%	80.47%(33.18%↑)
GRU	85.68%	62.19%	82.29%(20.1%↑)	54.22%	78.73%(24.51%↑)	48.38%	75.86%(27.48%↑)
TST	95.95%	70.14%	91.99%(21.85%↑)	60.69%	86.44%(25.75%↑)	55.32%	81%(25.68%↑)
SDAE	72.01%	59.78%	70.96%(11.18%↑)	53.22%	69.51%(16.29%↑)	48.58%	68.31%(19.73%↑)
FS-Net	83.77%	80.3%	82.82%(2.52%↑)	74.89%	81.52%(6.63%↑)	69.63%	80.02%(10.39%↑)
Average	**85.87%**	**67.15%**	**83.16%(16.01%↑)**	**59.62%**	**79.85%(20.23%↑)**	**54.06%**	**76.82%(22.76%↑)**

TABLE XXXVI
CLASSIFICATION ACCURACY OF DIFFERENT SEQUENCE LENGTH IN SCENARIO d_4.

Model	Sequence length: 256						
	Normal	Loss 10%	Imputed Loss 10%	Loss 20%	Imputed Loss 20%	Loss 30%	Imputed Loss 30%
CNN	83.46%	59.70%	82.01%(22.31%↑)	50.74%	82.22%(22.13%↑)	41.01%	78.70%(37.69%↑)
LSTM	83.46%	51.32%	82.21%(30.89%↑)	48.63%	80.86%(32.23%↑)	39.28%	79.19%(39.91%↑)
GRU	83.35%	48.93%	81.73%(32.80%↑)	43.48%	79.71%(36.23%↑)	37.97%	77.93%(39.96%↑)
TST	83.66%	65.72%	82.76%(17.04%↑)	55.41%	81.48%(26.07%↑)	43.00%	79.91%(36.91%↑)
SDAE	69.69%	54.54%	69.21%(14.67%↑)	46.87%	68.53%(21.66%↑)	36.69%	67.50%(30.81%↑)
FS-Net	82.22%	79.70%	81.76%(2.06%↑)	71.6%	81.09%(9.49%↑)	65.49%	80.45%(14.96%↑)
Average	**80.97%**	**59.99%**	**79.95%(19.96%↑)**	**52.79%**	**78.72%(25.93%↑)**	**43.91%**	**77.28%(33.37%↑)**
Model	Sequence length: 1024						
	Normal	Loss 10%	Imputed Loss 10%	Loss 20%	Imputed Loss 20%	Loss 30%	Imputed Loss 30%
CNN	83.61%	60.09%	82.22%(22.13%↑)	51.68%	80.68%(29.00%↑)	41.67%	78.83%(37.16%↑)
LSTM	83.45%	50.64%	82.26%(31.62%↑)	48.05%	80.88%(32.83%↑)	38.67%	79.44%(40.77%↑)
GRU	83.23%	49.40%	81.62%(32.22%↑)	44.58%	79.92%(35.34%↑)	38.15%	78.28%(40.13%↑)
TST	83.61%	65.22%	91.99%(26.77%↑)	60.69%	86.44%(25.75%↑)	55.32%	81.00%(25.68%↑)
SDAE	67.91%	55.09%	67.54%(12.45%↑)	47.94%	67.09%(19.15%↑)	37.00%	66.32%(29.32%↑)
FS-Net	83.77%	80.30%	82.82%(2.52%↑)	74.89%	81.52%(6.63%↑)	69.63%	80.02%(10.39%↑)
Average	**80.93%**	**60.12%**	**81.41%(21.29%↑)**	**54.64%**	**79.42%(24.78%↑)**	**46.74%**	**77.32%(30.58%↑)**

TABLE XXXVII
AVERAGE PERFORMANCE VARIATION WITH DIFFERENT MAIN STRUCTURE.

Structure	Imputed Loss 10%		Imputed Loss 10%		Imputed Loss 10%	
	Acc	F1	Acc	F1	Acc	F1
RepFNN	90.63%(5.69%↓)	90.55%(5.75%↓)	79.16%(12.20%↓)	78.6%(12.60%↓)	64.07%(19.81%↓)	64.83%(19.10%↓)
RepCNN	94.77%(1.55%↓)	94.74%(1.56%↓)	88.16%(3.20%↓)	88.19%(3.01%↓)	74.05%(9.83%↓)	74.53%(9.40%↓)
RepLSTM	94.41%(1.91%↓)	94.37%(1.93%↓)	88.54%(2.82%↓)	88.36%(2.84%↓)	78.19%(5.69%↓)	78.21%(5.720%↓)