

Supplementary Information for “SPP-CNN: An Efficient Framework for Network Robustness Prediction”

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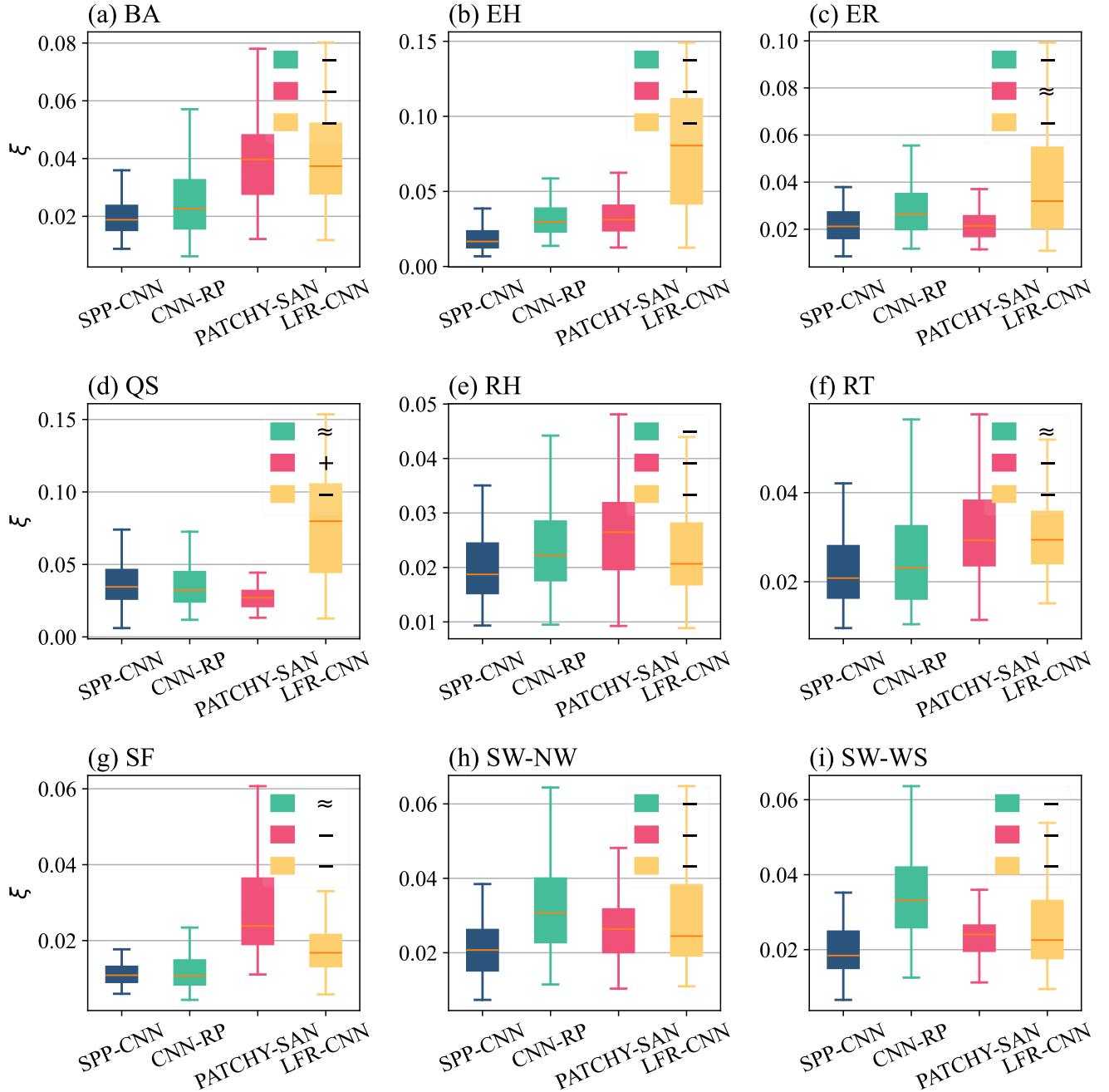


Fig. S1: Boxplots of prediction errors obtained by SPP-CNN, CNN-RP, PATCHY-SAN, and LFR-CNN. Networks of S_1 and $N_a \in [700, 1300]$ are used for both training and test datasets. Connectivity robustness of directed networks under maximum-degree node attacks is predicted.

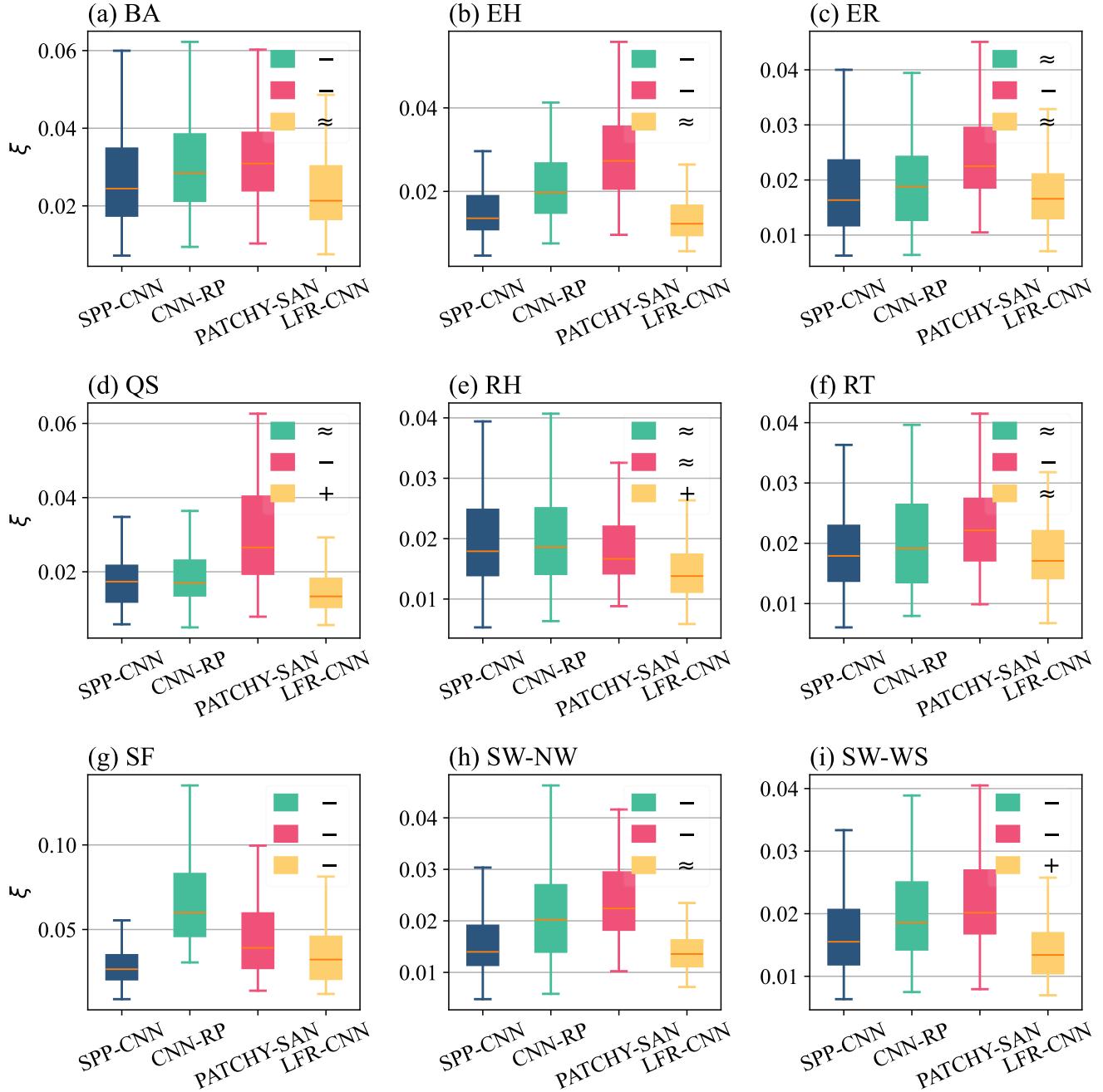


Fig. S2: Boxplots of prediction errors obtained by SPP-CNN, CNN-RP, PATCHY-SAN, and LFR-CNN. Networks of S_1 and $N_a \in [700, 1300]$ are used for both training and test datasets. Controllability robustness of directed networks under random node attacks is predicted.

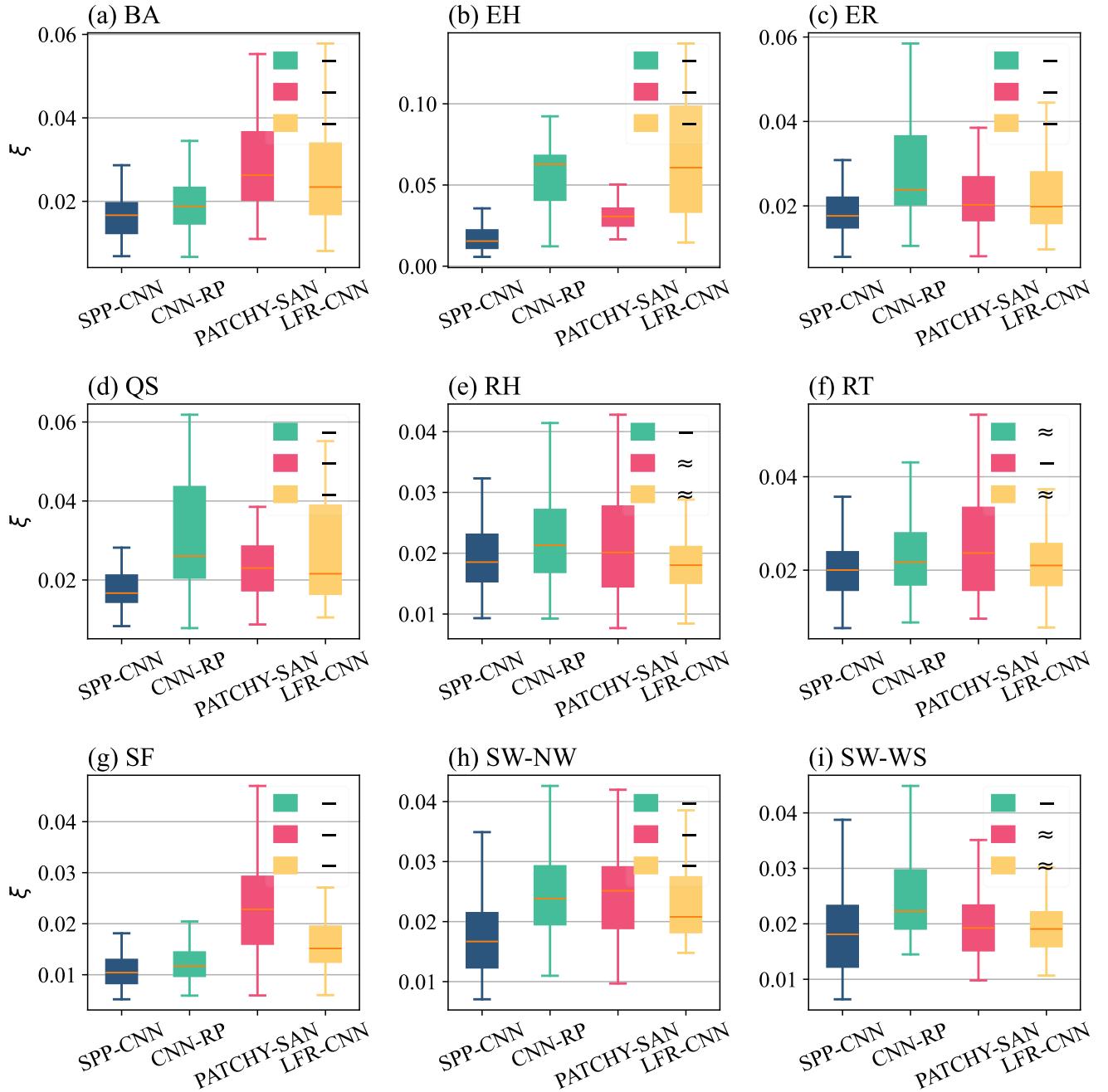


Fig. S3: Boxplots of prediction errors obtained by SPP-CNN, CNN-RP, PATCHY-SAN, and LFR-CNN. Networks of S_1 and $N_a \in [700, 1300]$ are used for both training and test datasets. Connectivity robustness of undirected networks under maximum-degree node attacks is predicted.

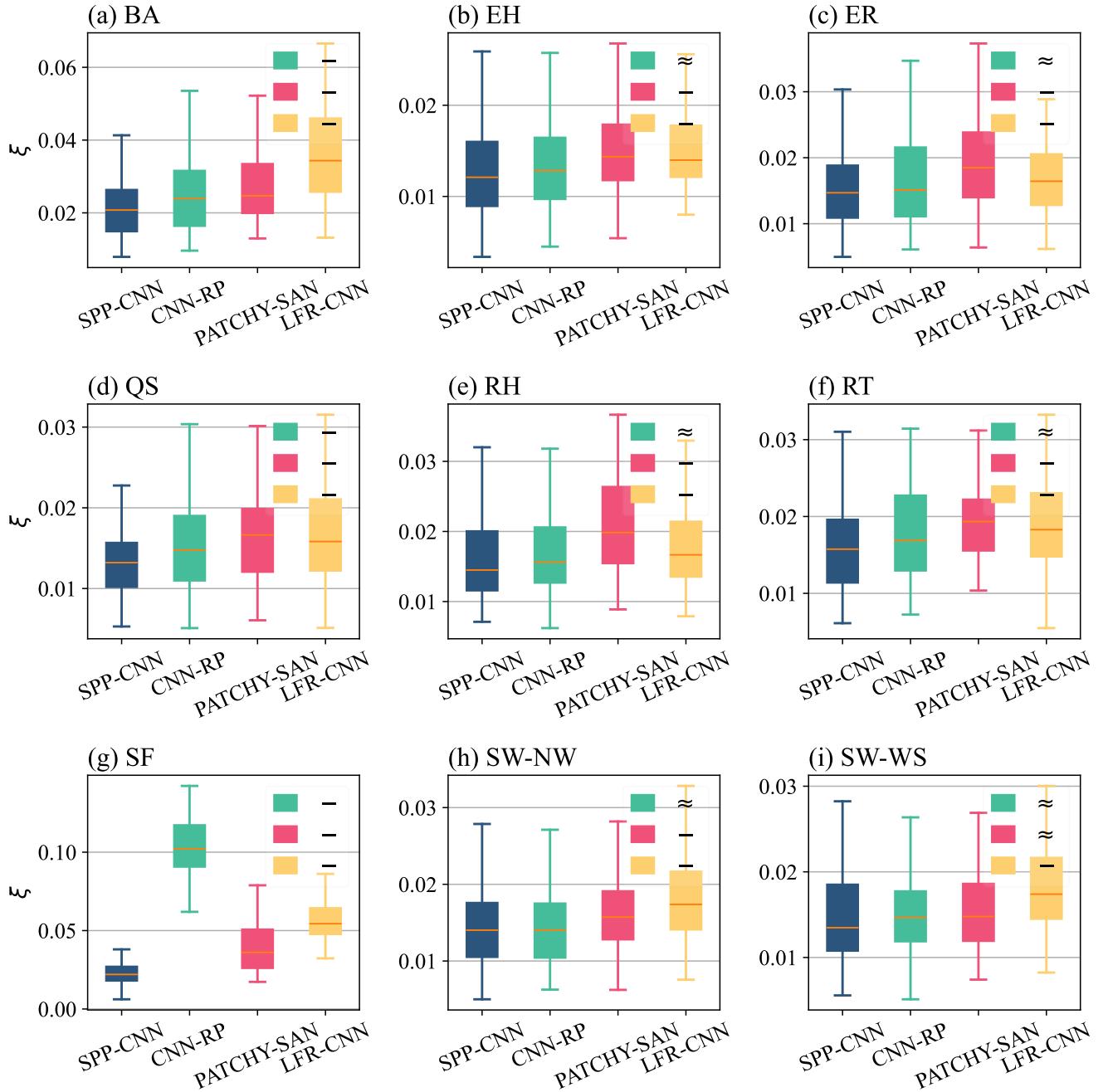


Fig. S4: Boxplots of prediction errors obtained by SPP-CNN, CNN-RP, PATCHY-SAN, and LFR-CNN. Networks of S_1 and $N_a \in [700, 1300]$ are used for both training and test datasets. Controllability robustness of undirected networks under random node attacks is predicted.

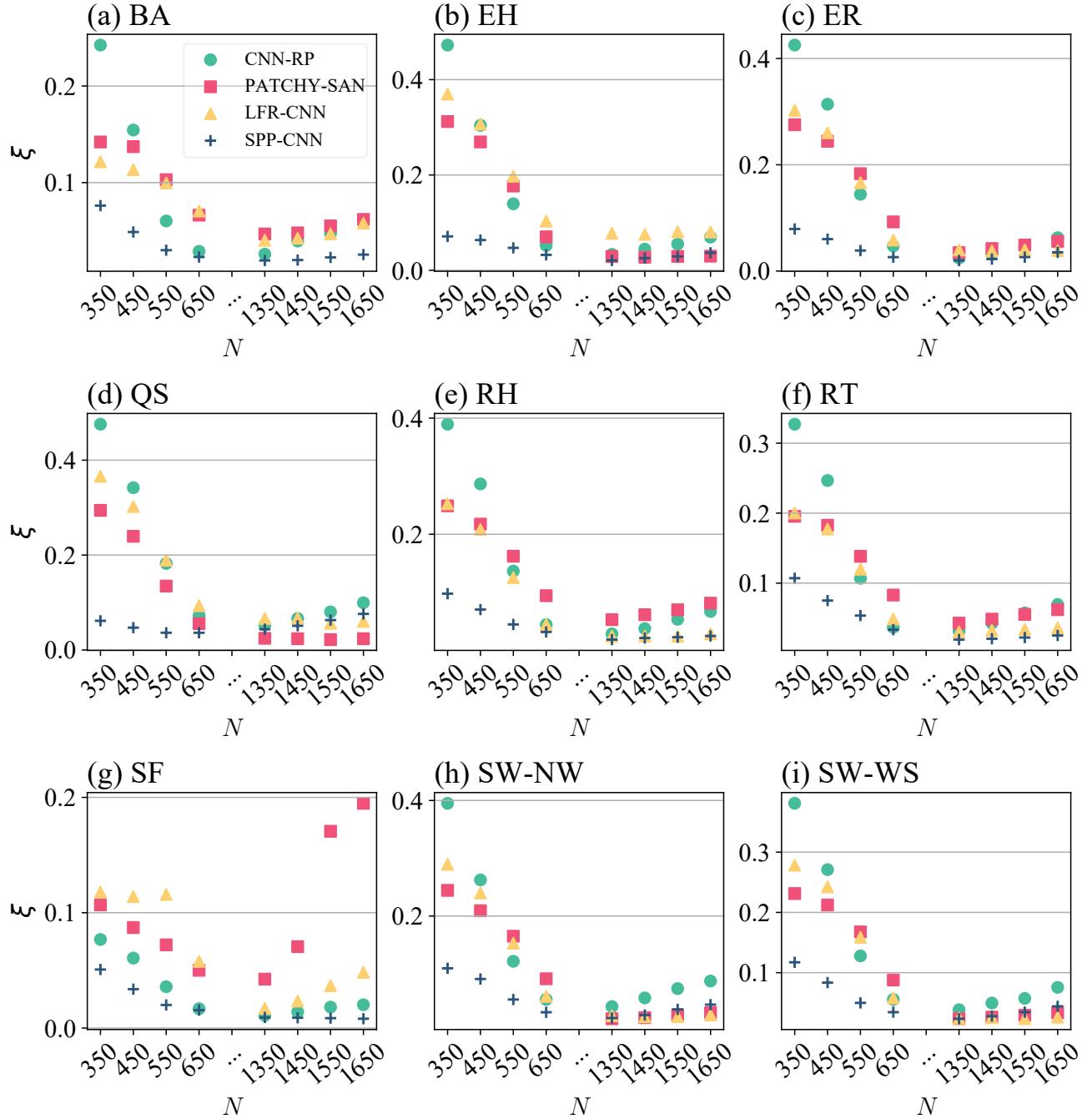


Fig. S5: Prediction errors obtained by SPP-CNN, CNN-RP, PATCHY-SAN, and LFR-CNN for unseen network sizes (UNS). Connectivity robustness of directed networks under maximum-degree node attacks is predicted.

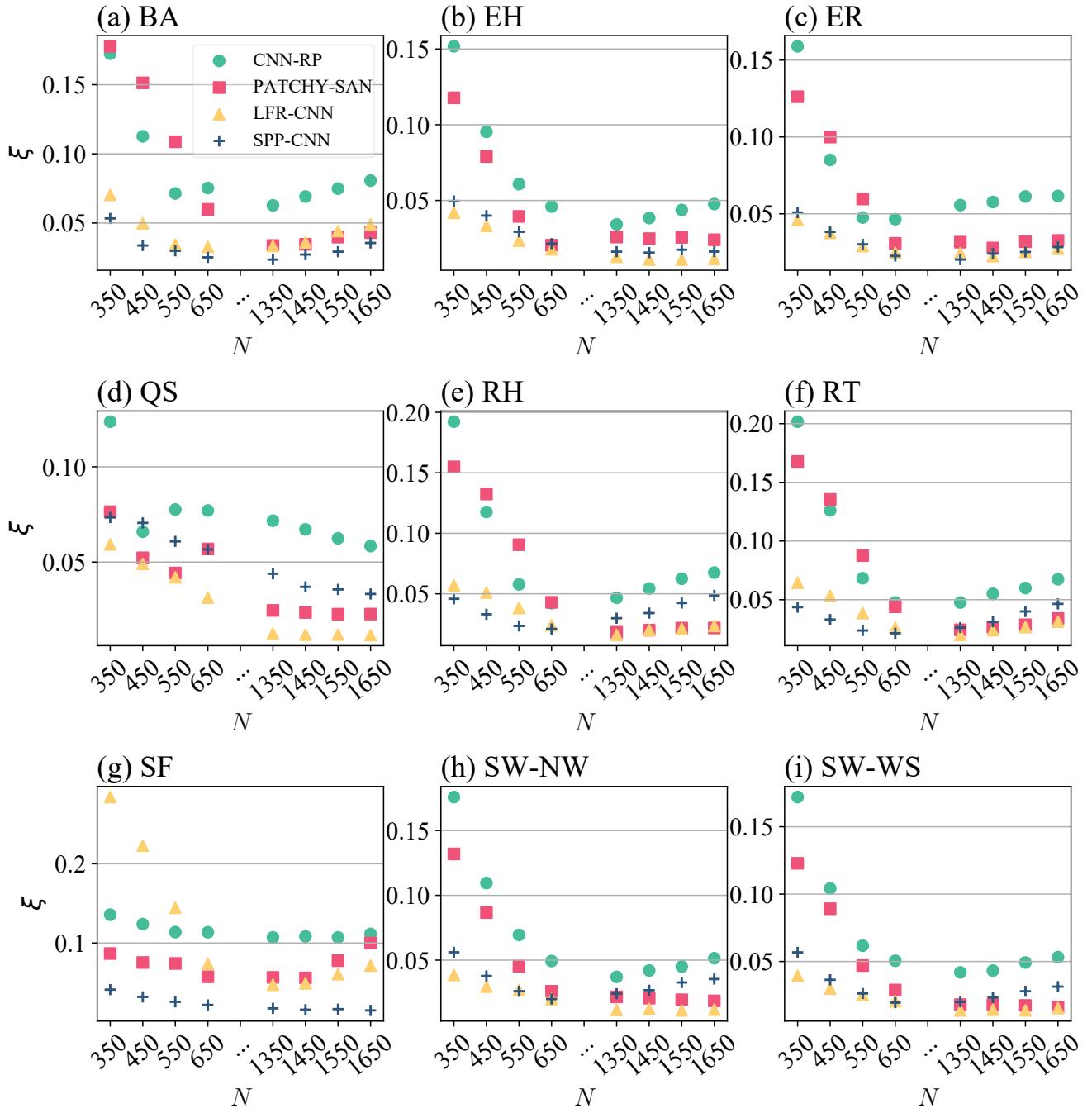


Fig. S6: Prediction errors obtained by SPP-CNN, CNN-RP, PATCHY-SAN, and LFR-CNN for unseen network sizes (UNS). Controllability robustness of directed networks under random node attacks is predicted.

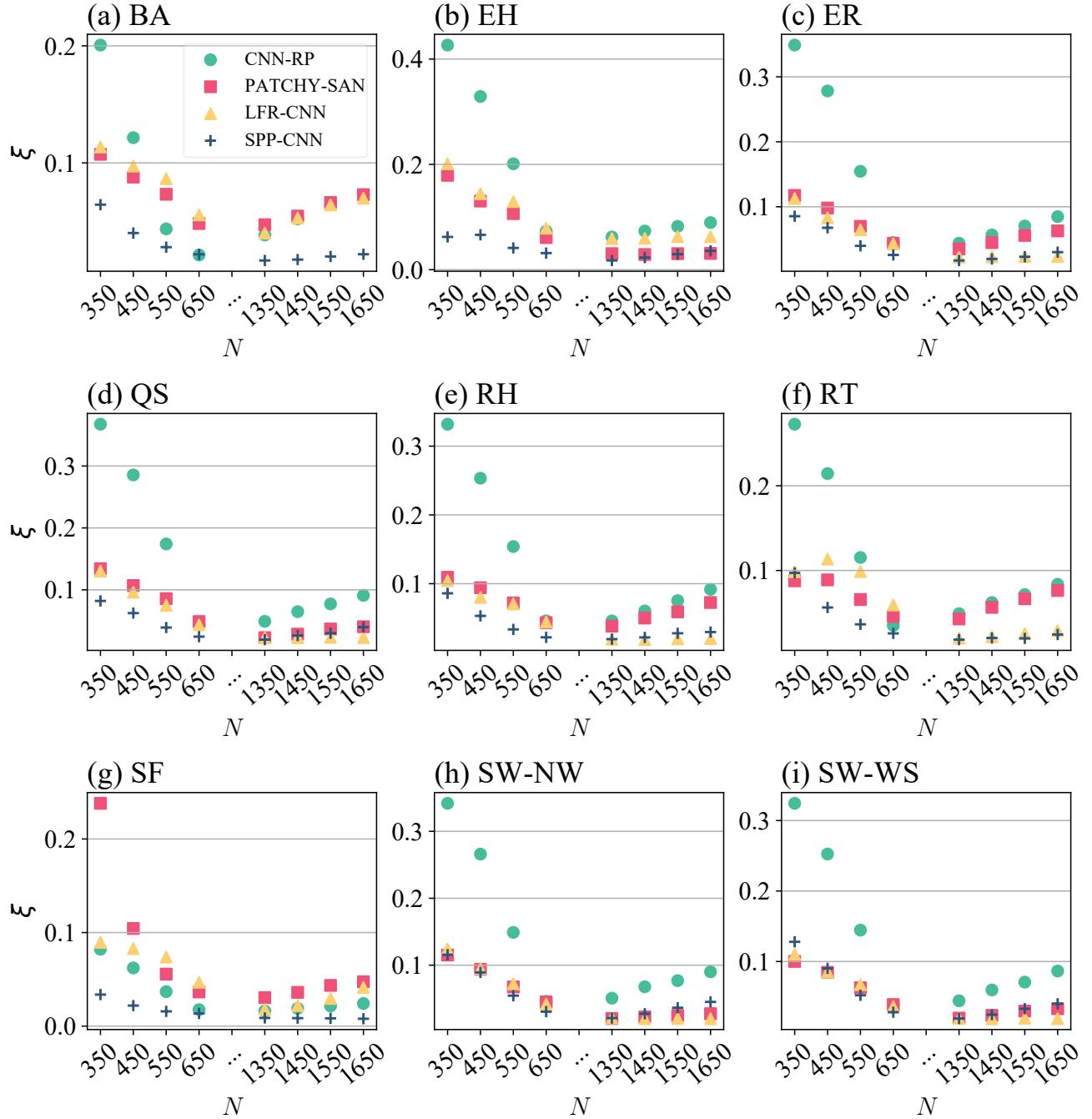


Fig. S7: Prediction errors obtained by SPP-CNN, CNN-RP, PATCHY-SAN, and LFR-CNN for unseen network sizes (UNS). Connectivity robustness of undirected networks under maximum-degree node attacks is predicted.

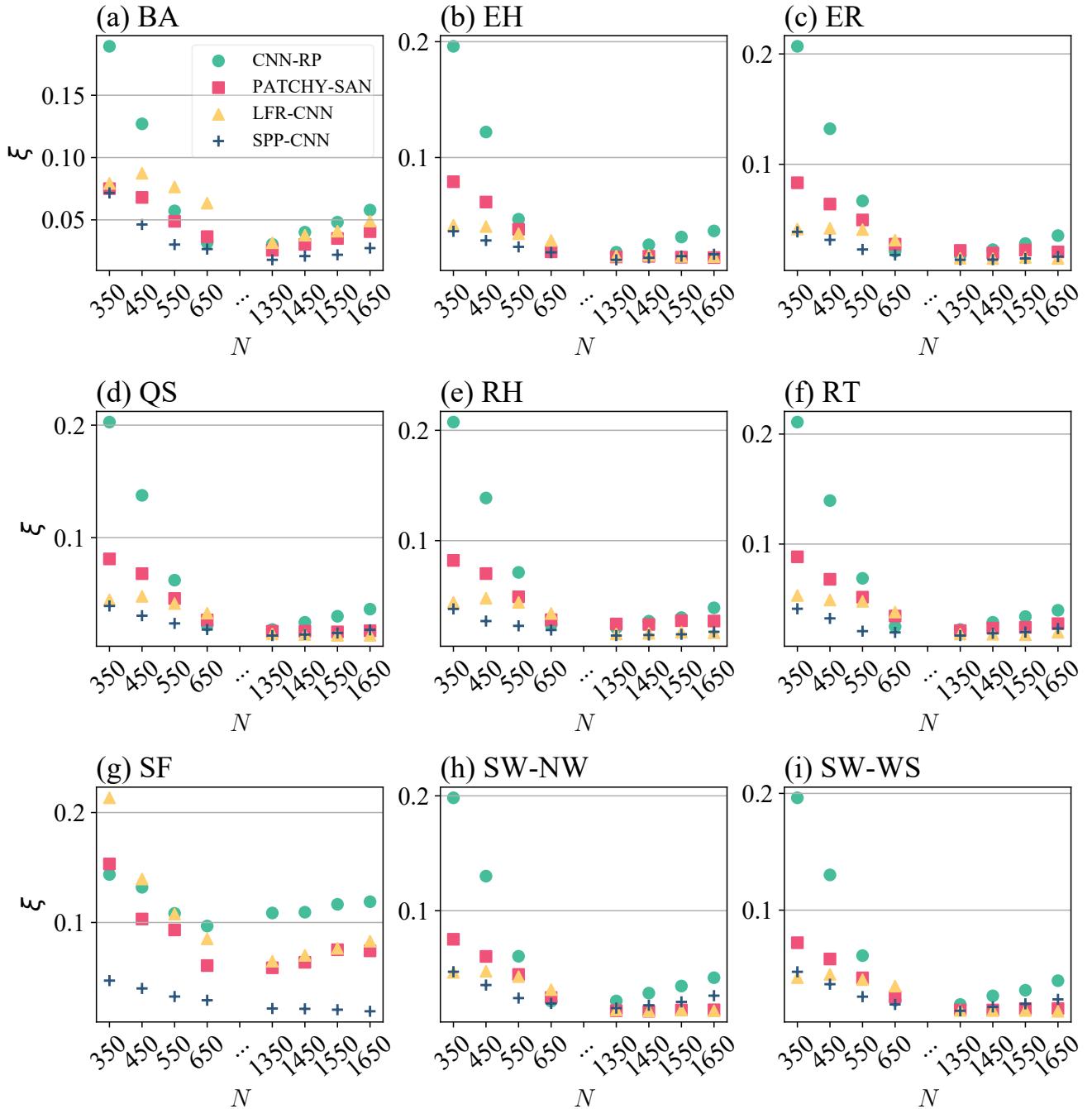


Fig. S8: Prediction errors obtained by SPP-CNN, CNN-RP, PATCHY-SAN, and LFR-CNN for unseen network sizes (UNS). Controllability robustness of undirected networks under random node attacks is predicted.

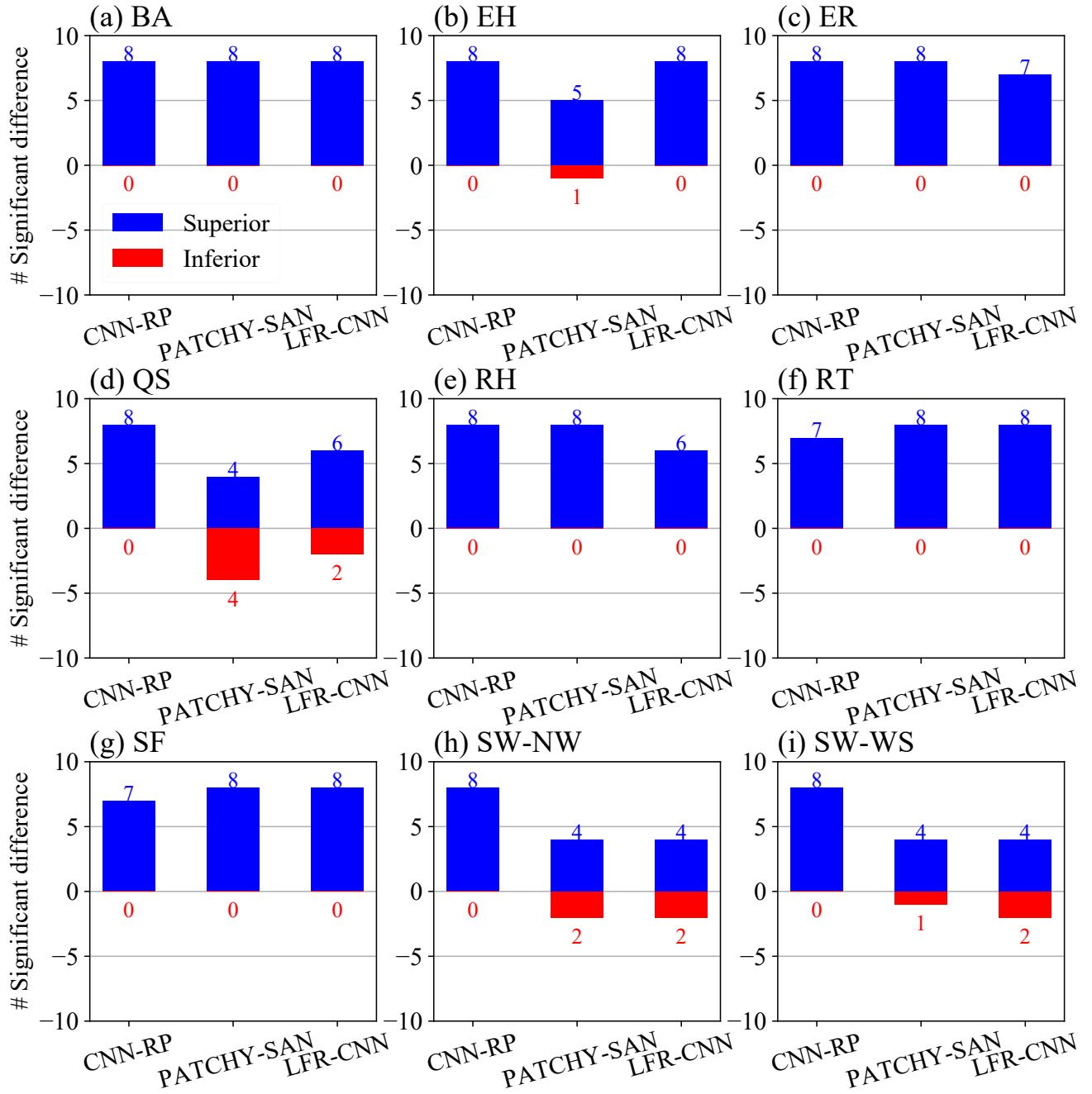


Fig. S9: Numbers of superiors and inferiors obtained by SPP-CNN, compared to each one of CNN-RP, PATCHY-SAN, and LFR-CNN. Connectivity robustness of directed networks under maximum-degree node attacks is predicted.

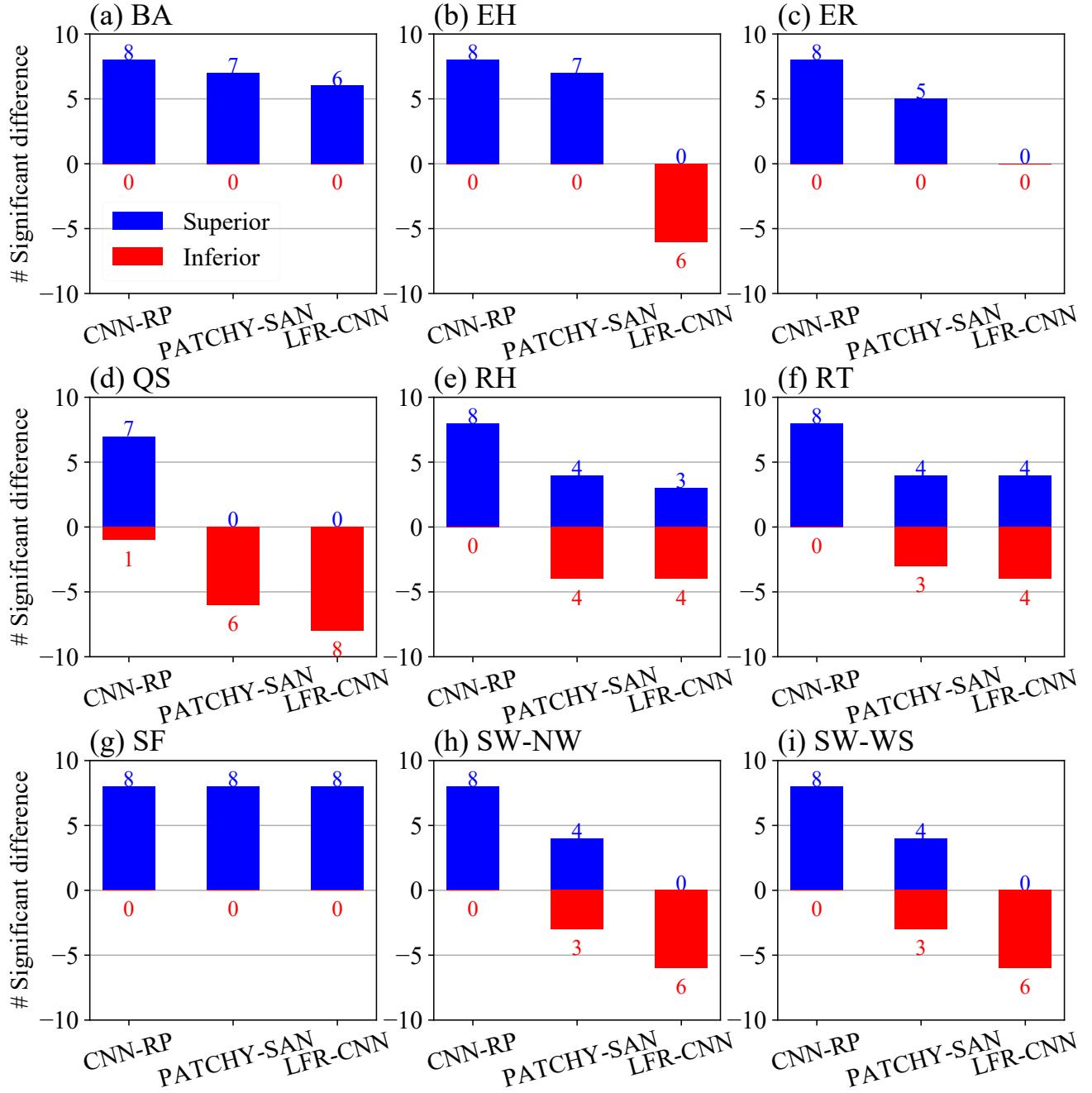


Fig. S10: Numbers of superiors and inferiors obtained by SPP-CNN, compared to each one of CNN-RP, PATCHY-SAN, and LFR-CNN. Controllability robustness of directed networks under random node attacks is predicted.

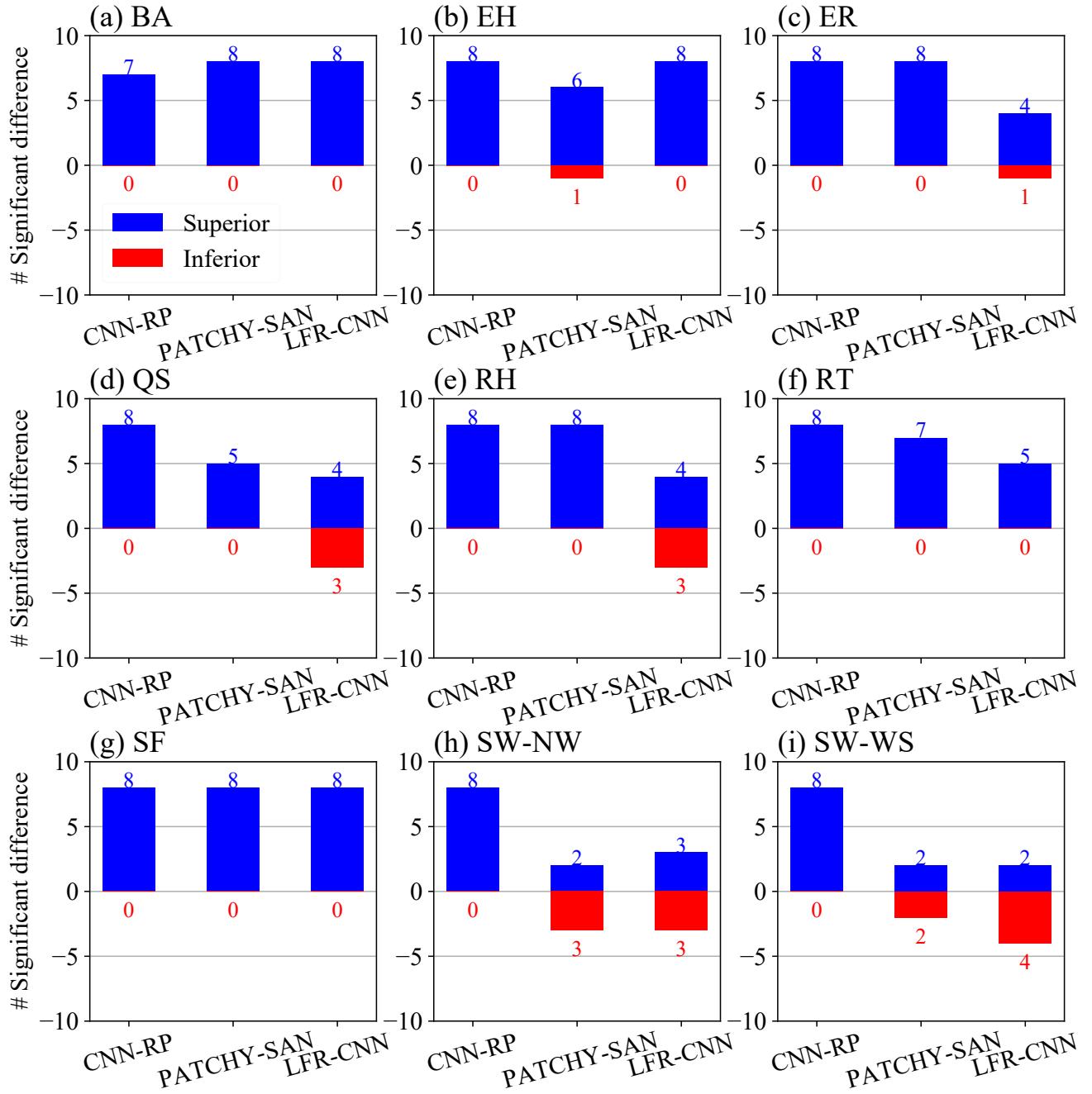


Fig. S11: Numbers of superiors and inferiors obtained by SPP-CNN, compared to each one of CNN-RP, PATCHY-SAN, and LFR-CNN. Connectivity robustness of undirected networks under maximum-degree node attacks is predicted.

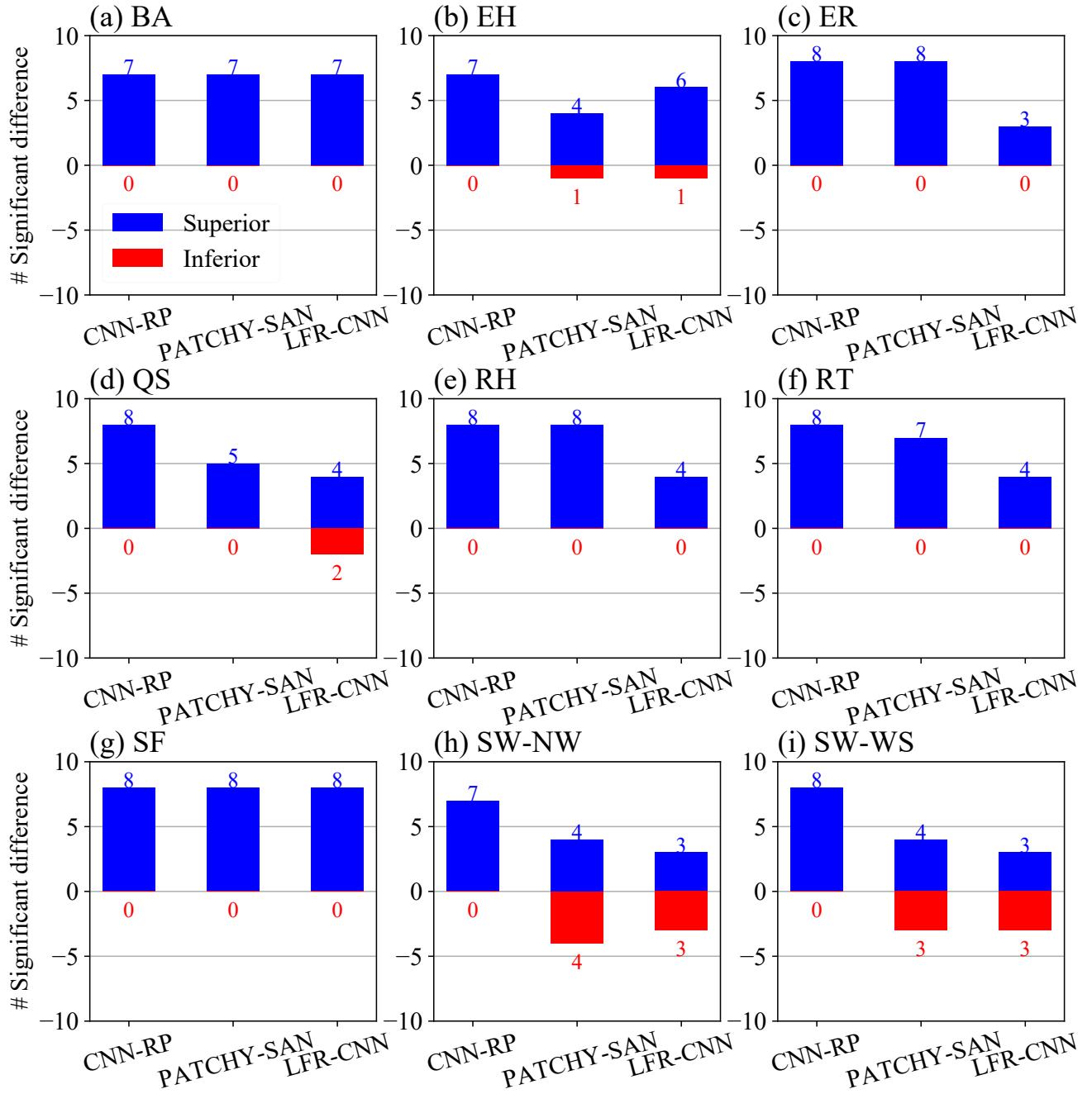
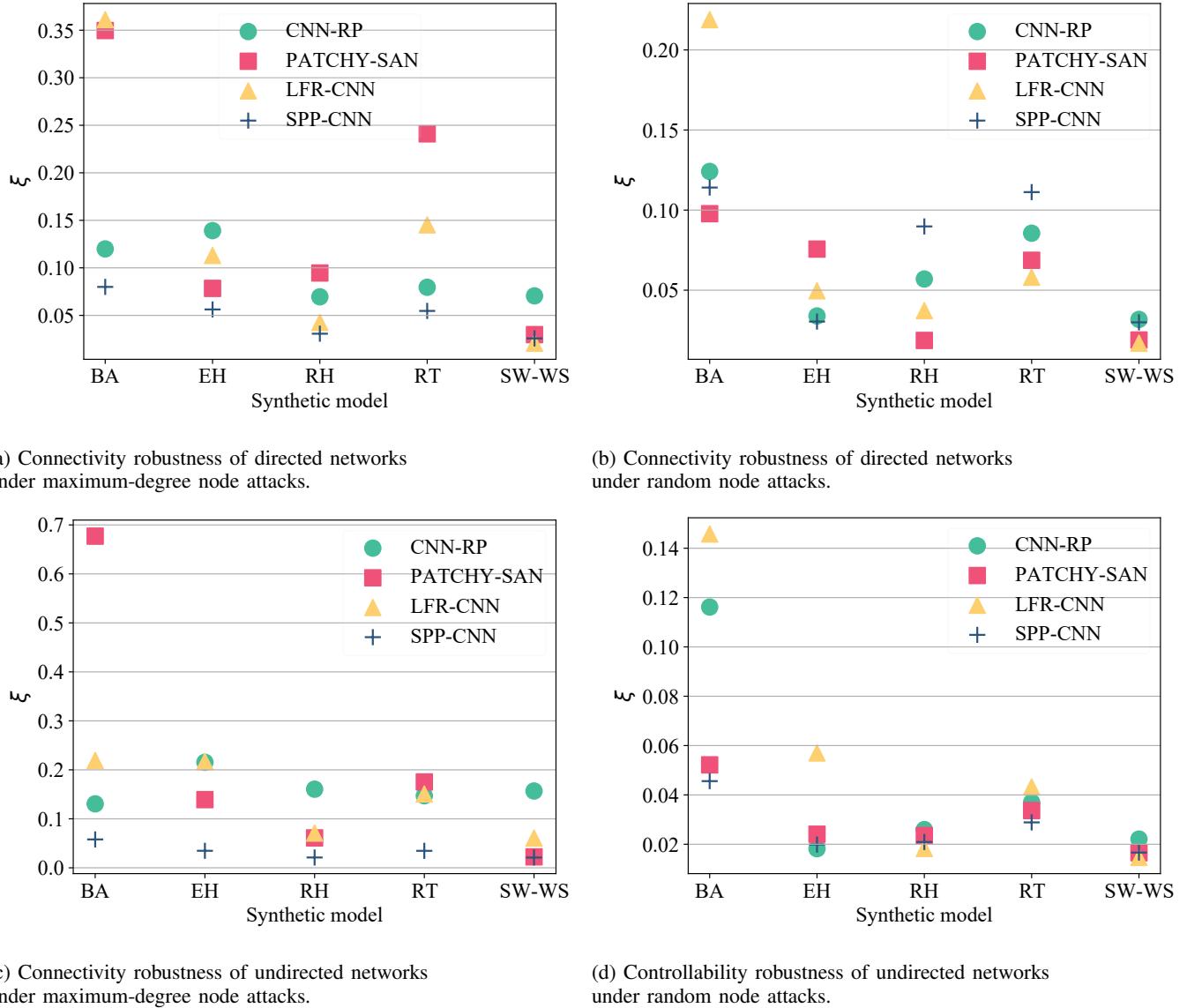


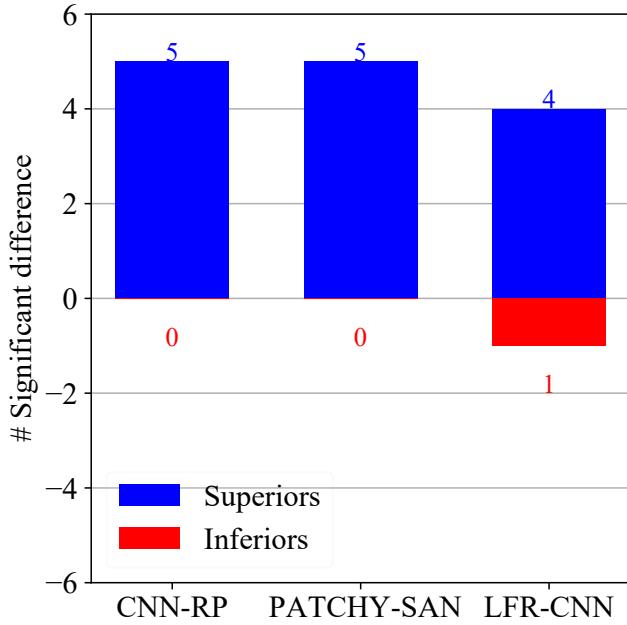
Fig. S12: Numbers of superiors and inferiors obtained by SPP-CNN, compared to each one of CNN-RP, PATCHY-SAN, and LFR-CNN. Controllability robustness of undirected networks under random node attacks is predicted.



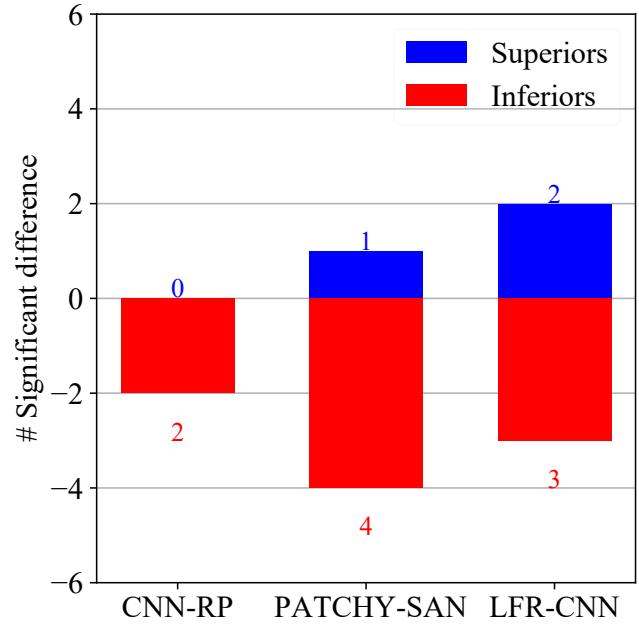
(c) Connectivity robustness of undirected networks under maximum-degree node attacks.

(b) Connectivity robustness of directed networks under random node attacks.

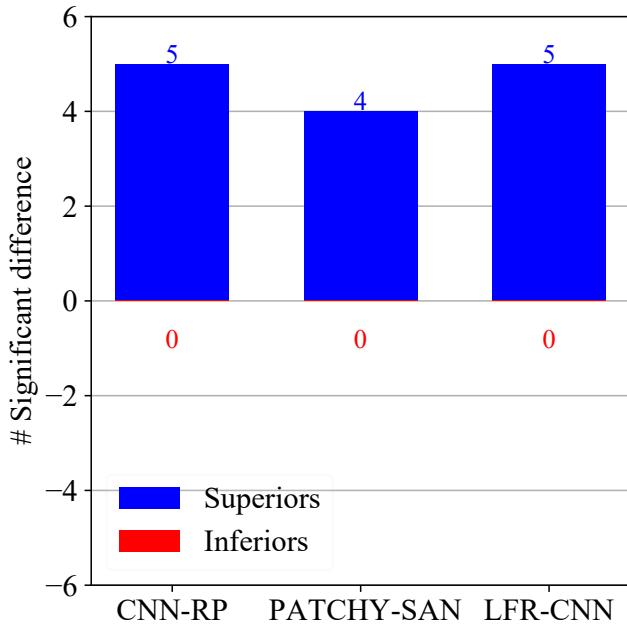
Fig. S13: Prediction errors obtained by SPP-CNN, CNN-RP, PATCHY-SAN, and LFR-CNN for unseen network topology (UNT).



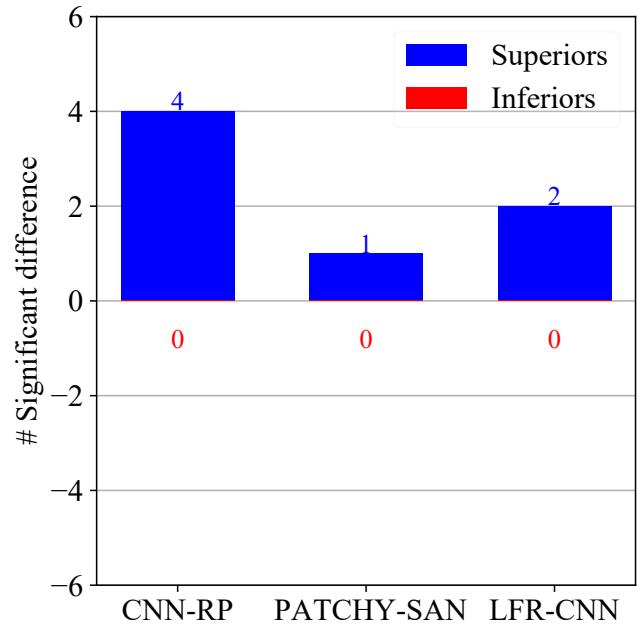
(a) Connectivity robustness of directed networks under maximum-degree node attacks.



(b) Controllability robustness of directed networks under random node attacks.



(c) Connectivity robustness of undirected networks under maximum-degree node attacks.



(d) Controllability robustness of undirected networks under random node attacks.

Fig. S14: Numbers of superiors and inferiors obtained by SPP-CNN, compared to each one of CNN-RP, PATCHY-SAN, and LFR-CNN for unseen network topology (UNT).

Table. S1: For the unseen network size (UNS) networks: the detailed number of significant performance differences (in terms of Kruskal-Wallis H-test) between SPP-CNN and any one of CNN-RP, PATCHY-SAN, and LFR-CNN. ‘(+)’ denotes the number of cases that SPP-CNN is inferior to the other methods with higher errors; ‘(−)’ denotes the number of cases that SPP-CNN is superior to the other methods with lower errors. Non-significant cases are not counted here.

UNS: Unseen Network Size			BA	EH	ER	QS	RH	RT	SF	SW-NW	SW-WS	Σ
Directed	Connectivity Robustness	CNN-RP	(+)	0	0	0	0	0	0	0	0	0
			(−)	8	8	8	8	7	7	8	8	70
		PATCHY-SAN	(+)	0	1	0	4	0	0	0	2	1
			(−)	8	5	8	4	8	8	8	4	57
		LFR-CNN	(+)	0	0	0	2	0	0	0	2	6
			(−)	8	8	7	6	6	8	8	4	59
	Controllability Robustness	CNN-RP	(+)	0	0	0	1	0	0	0	0	1
			(−)	8	8	8	7	8	8	8	8	71
		PATCHY-SAN	(+)	0	0	0	6	4	3	0	3	19
			(−)	7	7	5	0	4	4	8	4	43
		LFR-CNN	(+)	0	6	0	8	4	4	0	6	6
			(−)	6	0	0	0	3	4	8	0	21
Undirected	Connectivity Robustness	CNN-RP	(+)	0	0	0	0	0	0	0	0	0
			(−)	7	8	8	8	8	8	8	8	71
		PATCHY-SAN	(+)	0	1	0	0	0	0	0	3	2
			(−)	8	6	8	5	8	7	8	2	54
		LFR-CNN	(+)	0	0	1	3	3	0	0	3	4
			(−)	8	8	4	4	4	5	8	3	46
	Controllability Robustness	CNN-RP	(+)	0	0	0	0	0	0	0	0	0
			(−)	7	7	8	8	8	8	8	7	69
		PATCHY-SAN	(+)	0	1	0	0	0	0	0	4	3
			(−)	7	4	8	5	8	7	8	4	55
		LFR-CNN	(+)	0	1	0	2	0	0	0	3	9
			(−)	7	6	3	4	4	4	8	3	42

Table. S2: For the unseen network topology (UNT) networks: the detailed number of significant performance differences (in terms of Kruskal-Wallis H-test) between SPP-CNN and any one of CNN-RP, PATCHY-SAN, and LFR-CNN. ‘(+)’ denotes the number of cases that SPP-CNN is inferior to the other methods with higher errors; ‘(−)’ denotes the number of cases that SPP-CNN is superior to the other methods with lower errors; Non-significant cases are not counted here.

UNT: Unseen Network Topology			CNN-RP	PATCHY-SAN	LFR-CNN	Σ
Directed	Connectivity Robustness	(+)	0	0	1	1
		(−)	5	5	4	14
	Controllability Robustness	(+)	2	4	3	9
		(−)	0	1	2	3
Undirected	Connectivity Robustness	(+)	0	0	0	0
		(−)	5	4	5	14
	Controllability Robustness	(+)	0	0	0	0
		(−)	4	1	2	7