MixLVMM: A Mixture of Lightweight Vision Mamba Model for Enhancing Skin Lesion Segmentation Across High Tone Variability

Mohamed Lamine Allaoui and Mohand Saïd Allili

A Additional materials

In this additional material, we provide further insights into the performance of our proposed MixLVMM model by presenting both additional quantitative and qualitative results. These results further validate the effectiveness and generalizability of the model across several benchmark datasets, specifically ISIC 2016, PH2, and DermaQuest. This extends the analysis provided in the main document, where the results of the ISIC 2017 and ISIC 2018 datasets were already shown. Moreover, we include K-Folds cross-validation results to offer a comprehensive evaluation of the model's performance and its ability to generalize across various data splits.

A.1 Additional Quantitative Results

Table 1: Comparison of different methods on ISIC 2016 dataset.

Method	Year	DSC(%)	JC(%)	Sens(%)	Spec(%)	Acc(%)	HD95	ASSD	Params(M)	IT(ms)
CNN based methods										
UNet	2015	87.63	78.85	88.55	94.86	92.29	32.95	15.25	34.4	527.17
nnUNet	2018	90.94	85.02	92.03	94.41	94.60	30.86	14.88	11.2	438.76
CA-Net	2021	89.93	83.25	90.65	94.78	94.33	32.47	14.93	2.8	21.1
EIU-Net	2023	91.35	85.91	93.23	95.37	94.62	29.60	12.73	14.1	201.43
I^2UNet	2024	92.64	86.54	93.35	96.21	95.21	27.63	10.20	7.0	71.98
Transformer based methods										
SwinUNet	2021	91.38	84.93	90.83	95.02	93.67	29.21	12.81	43.9	615.94
TransUNet	2021	90.52	84.44	92.19	94.35	92.94	34.22	14.97	91.4	1044.1
SLT-Net	2022	89.16	82.00	90.60	93.12	92.17	28.70	12.19	60.3	735.21
FTN	2022	90.59	85.10	92.96	95.73	93.88	27.86	11.36	19.9	281.66
XBound-Former	2023	92.95	86.71	93.88	96.14	95.32	22.13	9.16	35.3	748.99
Hybrid based methods										
TransFuse	2021	91.09	85.62	92.92	95.36	93.80	26.96	9.22	34.5	621.43
FATNet	2022	90.47	84.90	92.61	93.30	92.88	32.30	13.48	28.8	229.23
DEUNet	2023	91.93	85.92	93.72	95.76	94.16	29.99	12.30	31.7	130.99
UCM-NET	2024	89.56	82.39	93.96	91.12	93.34	36.23	15.06	**0.049**	**20.97**
SSM's based methods										
Swin-UMamba†	2024	92.59	85.81	91.63	95.42	94.11	28.12	10.53	28	38.5
VM-UNet-V2	2024	90.52	84.92	92.20	93.13	92.58	29.83	14.41	17.9	526.42
H-vmunet	2025	92.29	85.36	94.24	**96.73**	95.60	26.55	9.24	8.97	152.79
MixLVMM (Ours)	2025	**93.77**	**86.99**	**95.21**	**96.73**	**95.72**	**20.77**	**8.69**	2.5	22.73

Table 2: Comparison of different methods on PH2 dataset.

Method	Year	DSC(%)	JC(%)	Sens(%)	Spec(%)	Acc(%)	HD95	ASSD	Params(M)	IT(ms)
CNN based methods										
UNet	2015	89.51	82.72	90.14	93.63	92.25	32.66	16.24	34.4	527.17
nnUNet	2018	92.27	84.22	93.21	96.45	95.03	30.86	14.28	11.2	438.76
CA-Net	2021	92.48	85.51	91.12	96.43	94.24	33.49	16.00	2.8	21.1
EIU-Net	2023	93.19	86.64	92.33	96.87	94.54	30.67	15.08	14.1	201.43
I^2UNet	2024	94.69	87.88	94.28	96.51	96.11	29.59	13.99	7.0	71.98
Transformer based methods										
SwinUNet	2021	93.59	87.37	93.67	94.21	93.83	31.01	14.27	43.9	615.94
TransUNet	2021	93.94	86.20	93.73	92.41	93.01	33.15	15.45	91.4	1044.1
SLT-Net	2022	91.45	85.24	90.55	93.17	91.68	30.91	15.74	60.3	735.21
FTN	2022	91.40	85.13	92.52	95.19	94.87	30.41	16.26	19.9	281.66
XBound-Former	2023	94.85	87.64	94.58	97.22	96.81	27.61	12.42	35.3	748.99
Hybrid based methods										
TransFuse	2021	94.50	87.09	92.84	95.82	93.94	29.04	13.48	34.5	621.43
FATNet	2022	93.10	87.63	92.41	95.72	93.33	34.82	15.47	28.8	229.23
DEUNet	2023	92.88	86.67	93.24	94.81	93.55	33.19	16.64	31.7	130.99
UCM-NET	2024	89.32	84.37	90.12	90.88	91.23	40.10	18.36	**0.049**	**20.97**
SSM's based methods										
Swin-UMamba†	2024	93.60	87.21	93.24	96.57	95.78	30.66	14.41	28	38.5
VM-UNet-V2	2024	92.53	85.91	94.29	95.51	95.28	32.42	16.18	17.9	526.42
H-vmunet	2025	94.18	87.52	94.28	97.10	96.33	29.42	12.96	8.97	152.79
MixLVMM (Ours)	2025	**95.67**	**88.24**	**94.93**	**97.89**	**96.96**	**26.62**	**12.15**	2.5	22.73

Table 3: Comparison of different methods on Dermquest dataset.

Method	Year	DSC(%)	JC(%)	Sens(%)	Spec(%)	Acc(%)	HD95	ASSD	Params(M)	IT(ms)
CNN based methods										
UNet	2015	89.81	82.61	90.77	93.73	92.41	24.32	13.57	34.4	527.17
nnUNet	2018	91.31	84.51	93.84	94.37	94.91	22.48	11.73	11.2	438.76
CA-Net	2021	92.27	86.55	93.97	95.13	95.31	21.87	11.68	2.8	21.1
EIU-Net	2023	93.09	86.45	94.62	94.37	93.49	19.80	10.36	14.1	201.43
I^2UNet	2024	94.28	87.95	94.32	97.00	95.84	18.91	9.84	7.0	71.98
Transformer based methods										
SwinUNet	2021	93.52	86.83	92.71	94.67	93.88	20.49	10.26	43.9	615.94
TransUNet	2021	94.13	87.24	93.31	96.43	94.77	24.19	12.39	91.4	1044.1
SLT-Net	2022	92.72	85.48	90.37	94.94	92.64	19.59	10.78	60.3	735.21
FTN	2022	92.28	85.27	93.61	94.43	93.76	19.82	10.81	19.9	281.66
XBound-Former	2023	94.86	88.34	95.48	97.11	96.42	16.81	8.34	35.3	748.99
Hybrid based methods										
TransFuse	2021	93.62	87.32	94.51	96.93	95.89	17.60	9.11	34.5	621.43
FATNet	2022	93.22	86.94	93.34	95.68	94.48	20.30	10.02	28.8	229.23
DEUNet	2023	93.52	86.96	94.44	95.71	94.84	18.76	9.82	31.7	130.99
UCM-NET	2024	90.41	83.72	92.96	91.49	92.55	24.42	13.39	**0.049**	**20.97**
SSM's based methods										
Swin-UMamba†	2024	93.69	87.14	93.61	95.84	94.64	18.16	10.23	28	38.5
VM-UNet-V2	2024	92.98	86.16	94.61	94.88	93.43	19.26	11.55	17.9	526.42
H-vmunet	2025	94.09	88.14	95.22	96.92	96.00	16.94	8.67	8.97	152.79
MixLVMM (Ours)	2025	**95.34**	**88.76**	**95.66**	**97.26**	**96.60**	**16.74**	**8.05**	2.5	22.73

Table 4: K-Folds cross-validation on ISIC datasets with K=4.

Data	**Folds**	**Dice(%)**	**IOU(%)**	**Sens(%)**	**Spec(%)**	**Acc(%)**	**HD95**	**ASSD**
ISIC 16	Fold 1	93.24	86.28	95.35	96.33	95.08	21.77	9.84
	Fold 2	94.52	86.45	95.41	96.17	95.64	20.23	8.60
	Fold 3	93.37	86.81	94.73	96.53	95.40	20.36	8.57
	Fold 4	94.66	87.12	95.90	97.92	95.90	20.20	8.13
ISIC 17	Fold 1	92.98	86.70	93.49	95.16	94.32	25.88	9.67
	Fold 2	92.50	86.11	94.94	95.42	95.69	25.83	9.55
	Fold 3	93.73	87.18	94.39	96.62	95.90	24.28	8.58
	Fold 4	91.61	85.10	92.74	96.91	94.37	25.43	9.64
ISIC 18	Fold 1	94.23	87.31	95.86	96.65	95.46	24.70	9.97
	Fold 2	93.30	86.54	94.85	95.48	95.35	24.50	9.17
	Fold 3	93.99	86.92	94.21	95.78	95.56	25.40	10.23
	Fold 4	93.76	86.85	95.12	95.89	95.53	24.77	9.30

A.2 Additional Qualitative Results

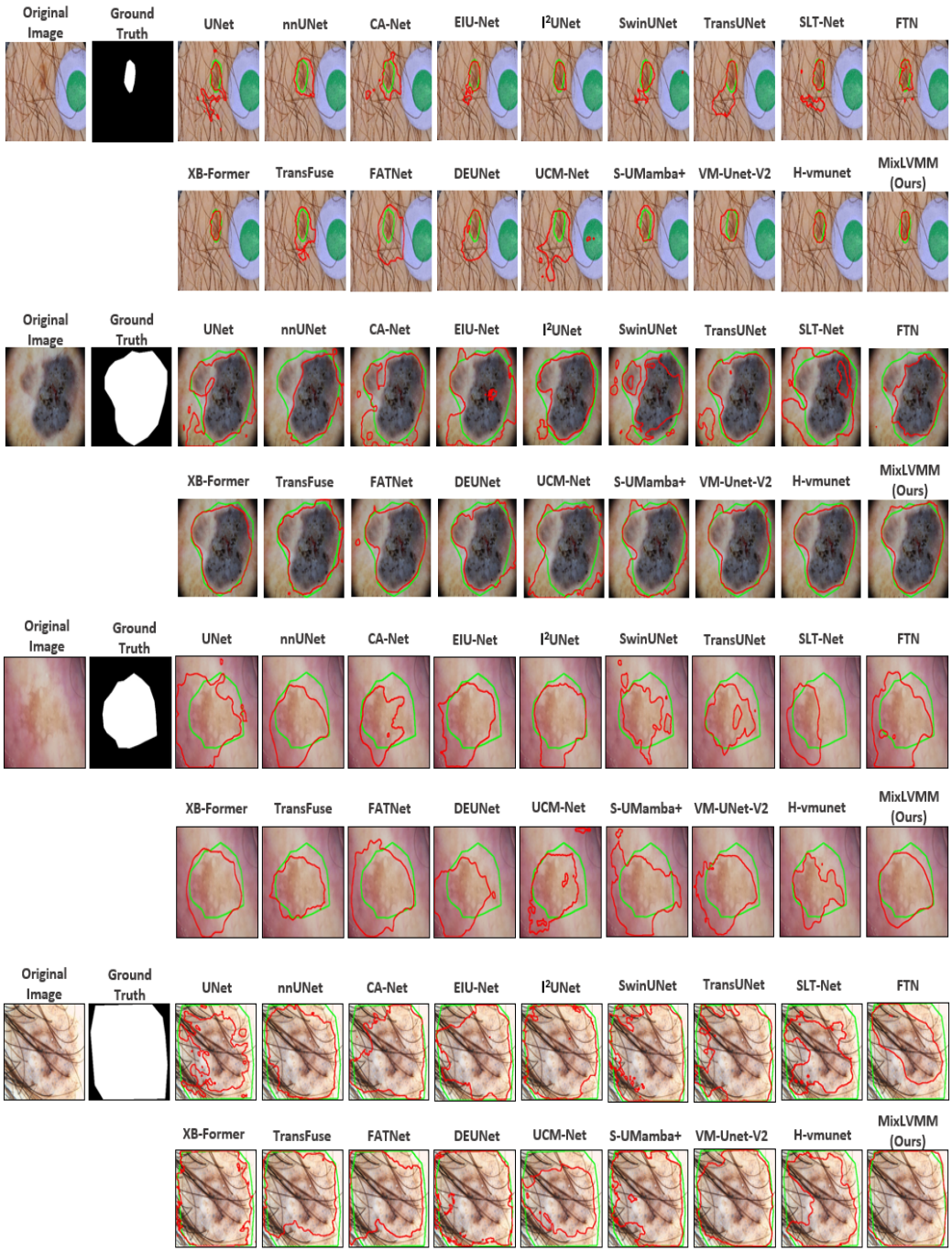

Figure 1: Qualitative comparison of MixLVMM against competing methods on ISIC 2016 testset, highlighting segmentation accuracy in challenging cases.

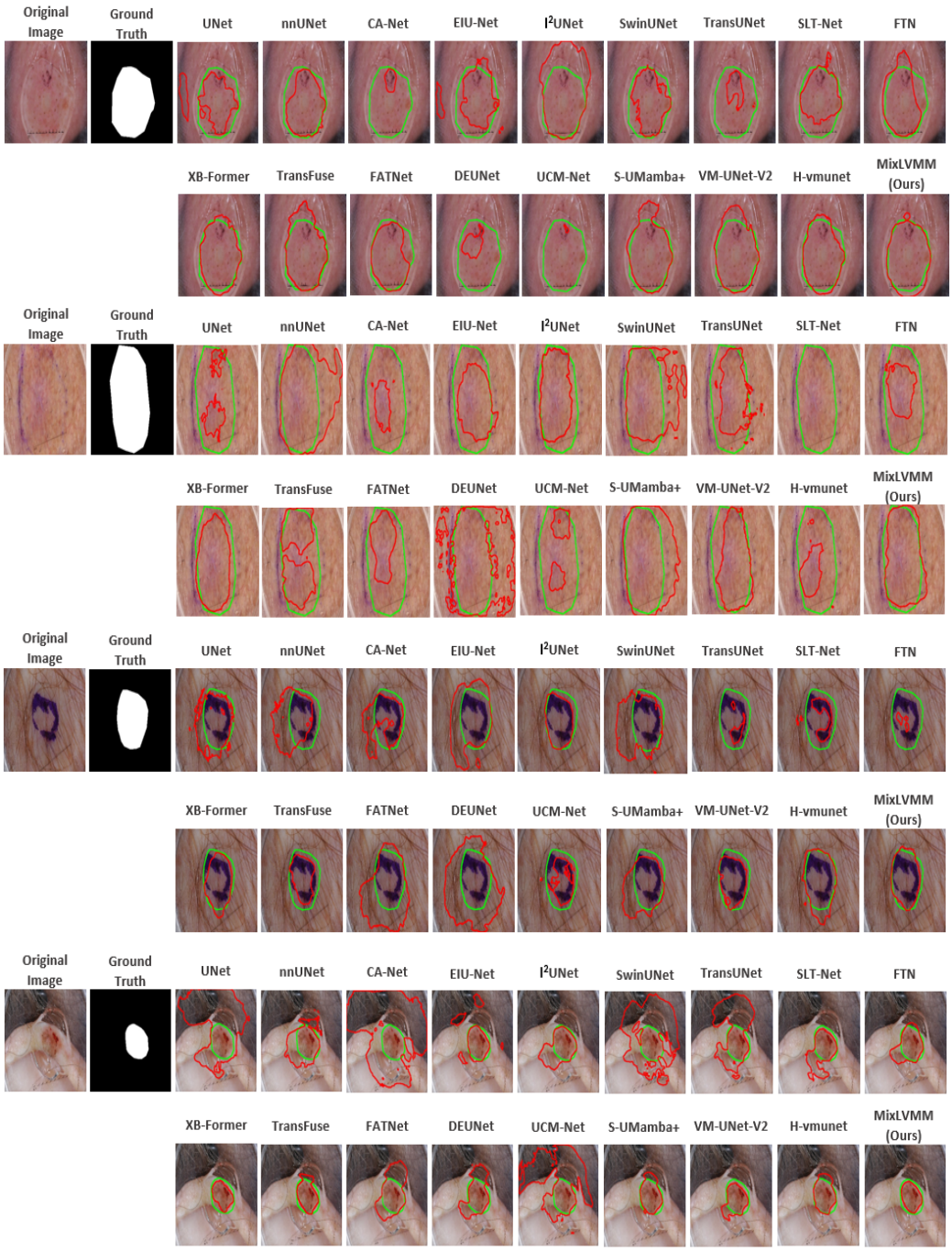

Figure 2: Qualitative comparison of MixLVMM against competing methods on ISIC 2017.

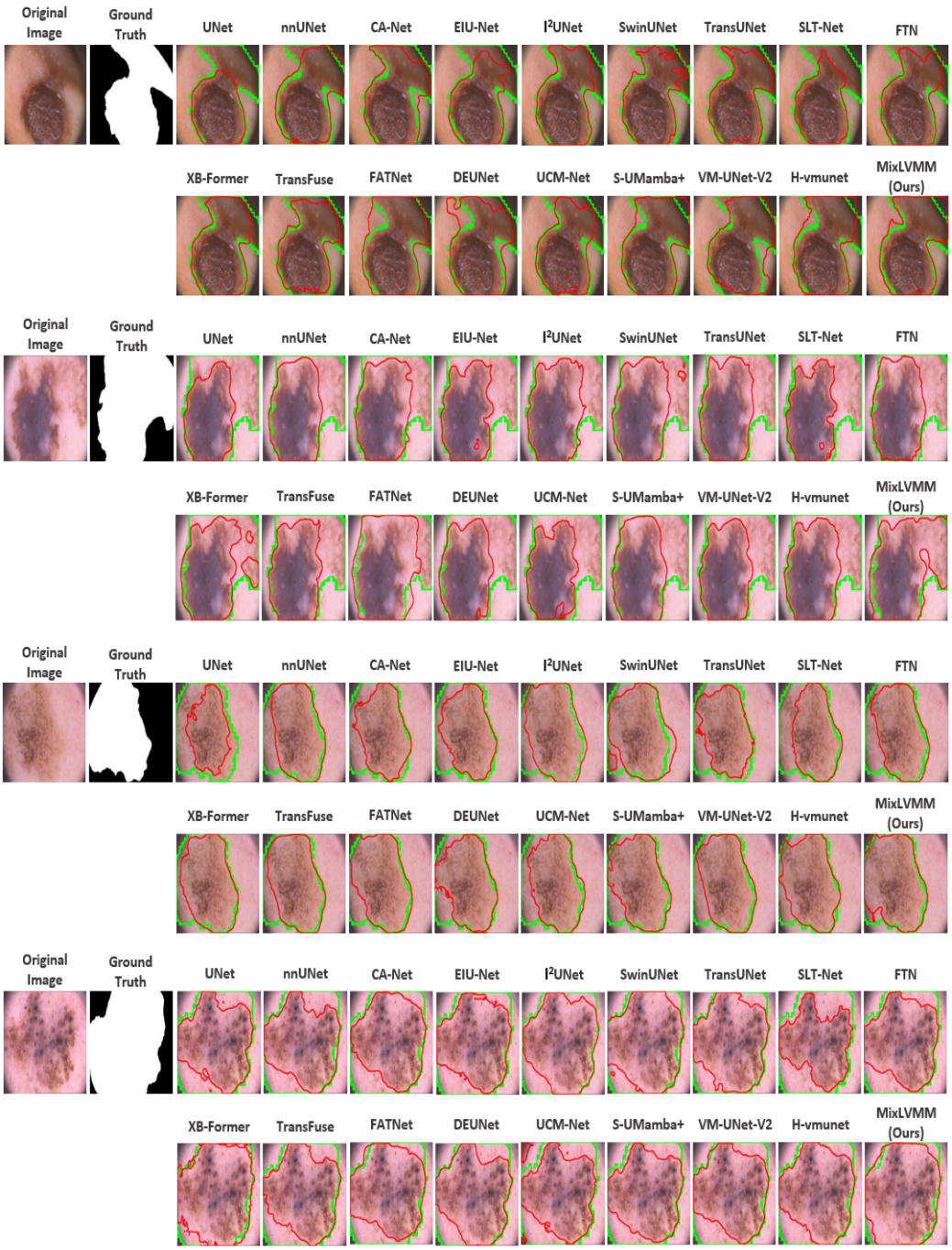

Figure 3: Qualitative results comparison PH2 Dataset.

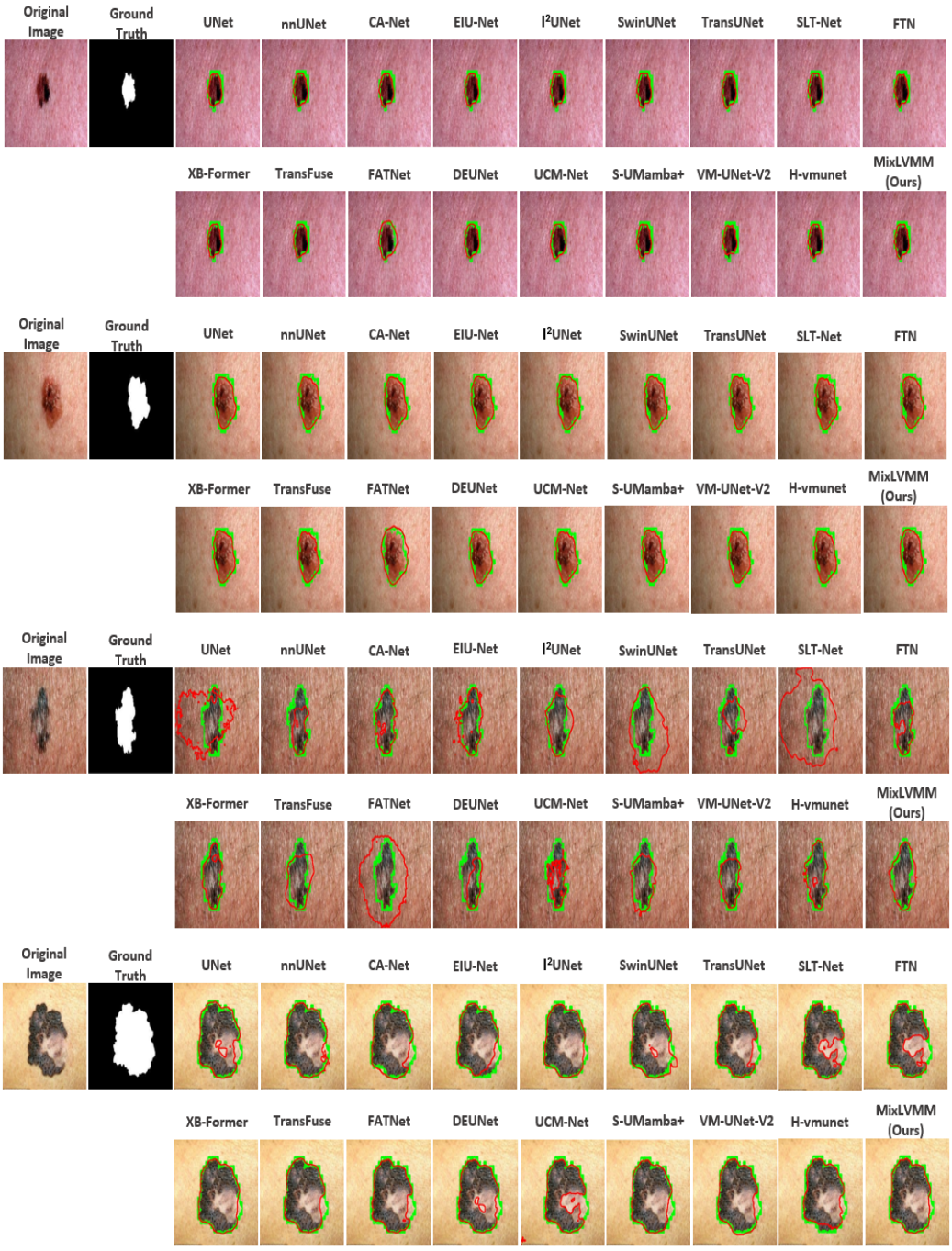

Figure 4: Qualitative results comparison DermQuest Dataset.