



SEMI-SUPERVISED SKIN LESION SEGMENTATION WITH LEARNING MODEL CONFIDENCE

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Zhiqiang Xie, Enmei Tu, Hao Zheng, Yun Gu, Jie Yang
Institute of Image Processing and Pattern Recognition
Shanghai Jiao Tong University



1. Motivation:

The unreliable targets in pseudo label may lead to meaningless guidance for unlabeled data.

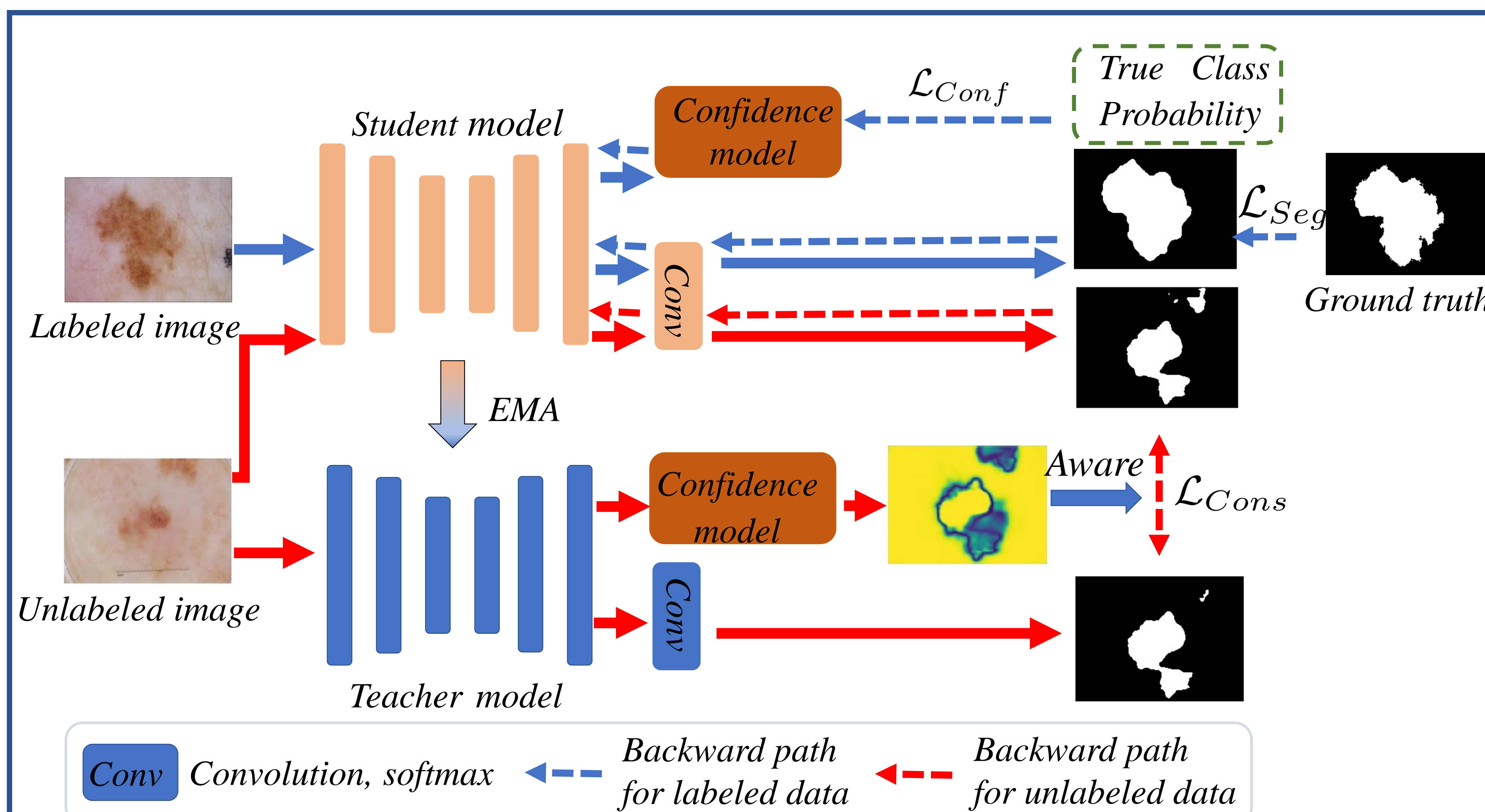
To mine the low confident information, previous works mainly focus on:

- Variational inference (approximate, computationally expensive)
- Adversarial training (not easy to converge, blind-spot attack)
- Multi-time dropout during training



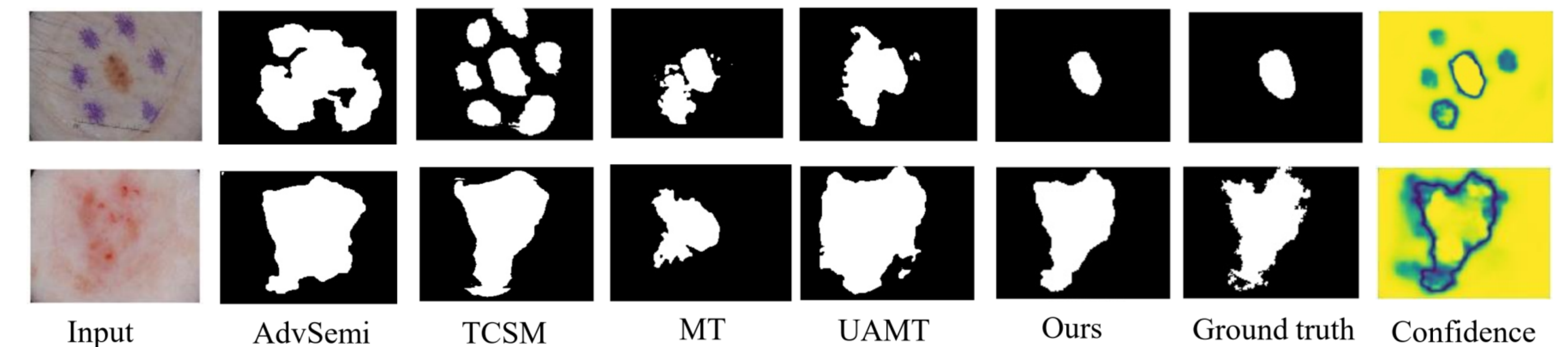
MCDropout[1] fails to detect the erroneous targets in the bottom-left part of the pseudo label.

2. Solution: Confidence-aware mean-teacher framework



3. Experiment and results:

- The Visual comparisons of results with other methods on 2018 ISIC dataset.



- Comparison with other methods by utilizing 5% and 10% labeled data. (Unit: %)

Method	Labeled/Unlabeled	DI	JA	SE	AC
UNet++	1815/0	89.39	82.23	90.88	94.41
AdvSemi	90/1725	83.20	74.44	87.62	91.55
TCSM	90/1725	86.10	78.57	87.67	93.25
MT	90/1725	86.95	79.22	88.87	93.45
UAMT	90/1725	86.48	78.77	87.85	93.16
Ours	90/1725	87.44	79.90	90.84	93.89

Method	Labeled/Unlabeled	DI	JA	SE	AC
UNet++	1815/0	89.39	82.23	90.88	94.41
AdvSemi	181/1634	84.37	75.92	90.38	92.71
TCSM	181/1634	87.23	80.55	89.36	94.33
MT	181/1634	87.90	80.64	88.93	93.83
UAMT	181/1634	87.78	80.31	91.23	94.02
Ours	181/1634	89.28	82.37	90.79	94.60

- Analysis of proposed method. (Unit: %)

Method	Labeled/Unlabeled	DI	JA
UNet++	90/0	74.24	61.90
Ours no fine-tuning	90/1725	86.98	79.35
Ours	90/1725	87.44	79.90
UNet++	181/0	83.25	74.29
Ours no fine-tuning	181/1634	88.69	81.61
Ours	181/1634	89.28	82.37

5. Reference:

[1] L. Yu, S. Wang, X. Li, C. Fu, and P. Heng, "Uncertaintyaware self-ensembling model for semi-supervised 3d left atrium segmentation," ArXiv, vol. abs/1907.07034, 2019

4. Conclusion:

- A novel **confidence module** is designed to learn the model confidence effectively guided by the True Class Probability.
- A novel **confidence-aware mean-teacher framework** is proposed for semi-supervised skin lesion segmentation.
- The proposed method outperforms other state-of-the-art semi-supervised approaches.