



AUEditNet: Dual-Branch Facial Action Unit Intensity Manipulation with Implicit Disentanglement

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Qualcomm
AI research

Background

- Facial Action Units (AUs)
 - A set of facial muscle movements → A displayed emotion [1]
 - Advantages:
 - Objective quantification [2]
 - Ability to generate 7000 facial expressions with 30 AUs [3]
 - Potentials for continuous manipulation



AU 1 (Inner Brow Raiser)



AU 12 (Lip Corner Puller)



AU 41 (Lid Droop)

[1] <https://imotions.com/blog/learning/research-fundamentals/facial-action-coding-system/>

[2] Paul Ekman and Wallace V Friesen. Facial action coding system. Environmental Psychology & Nonverbal Behavior, 1978.

[3] Klaus R Scherer. Emotion as a process: Function, origin and regulation, 1982.

Background

- Challenges

- Limited public datasets with AU intensity annotation (2 datasets)
- Limited number of subjects (45, 27 subjects)
- AU intensity annotation requires experts

- Existing AU Intensity Manipulation Methods

- Other datasets with larger subject pools (337 ^[4], 98 ^[5], and 1000 ^[6] subjects)
- Pretrained intensity estimators for predicted annotations

- Goal

- Accurate AU intensity manipulation with data from very few subjects (< 20)

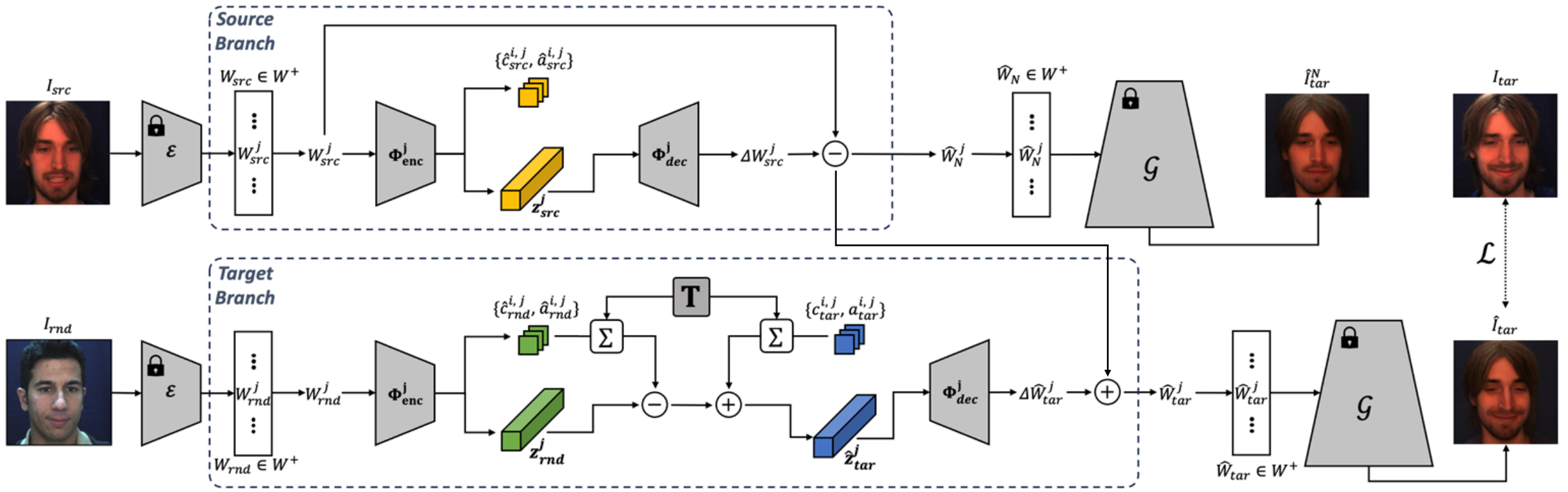
[4] Jun Ling, Han Xue, Li Song, Shuhui Yang, Rong Xie, and Xiao Gu. Toward fine-grained facial expression manipulation. In Computer Vision—ECCV 2020: 16th European Conference, Glasgow, UK, August 23–28, 2020, Proceedings, Part XXVIII 16, pages 37–53. Springer, 2020.

[5] Albert Pumarola, Antonio Agudo, Aleix M Martinez, Alberto Sanfeliu, and Francesc Moreno-Noguer. Ganimation: Anatomically-aware facial animation from a single image. In Proceedings of the European conference on computer vision (ECCV), pages 818–833, 2018.

[6] Soumya Tripathy, Juho Kannala, and Esa Rahtu. Icfac: Interpretable and controllable face reenactment using gans. In Proceedings of the IEEE/CVF winter conference on applications of computer vision, pages 3385–3394, 2020.

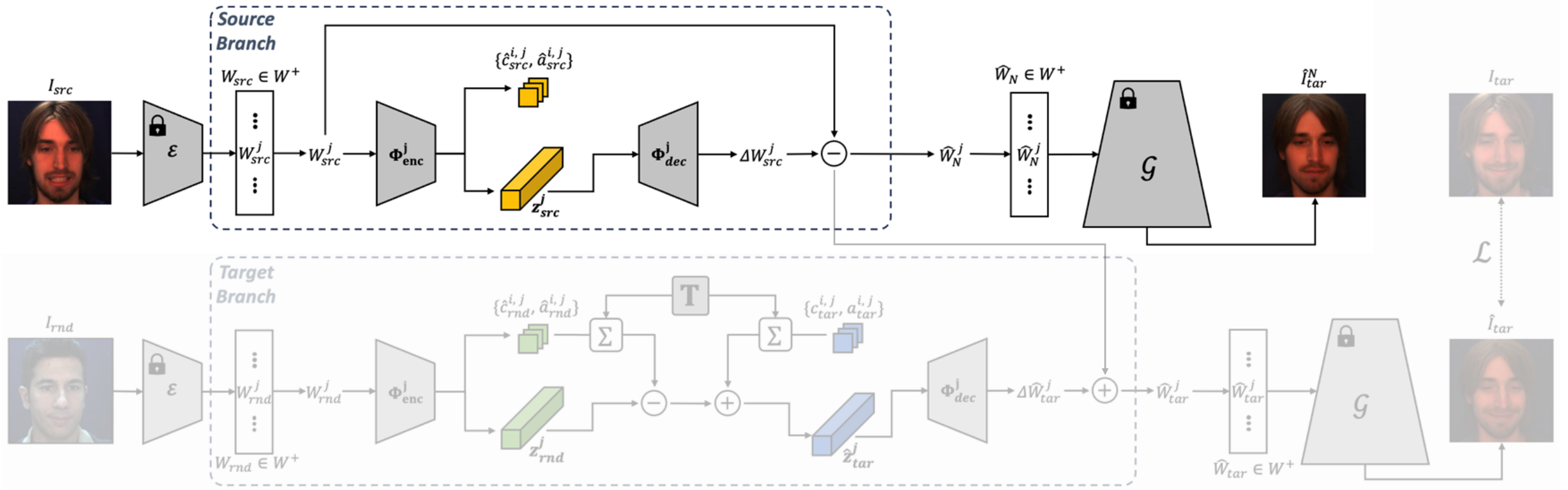
AUEditNet

- Pipeline



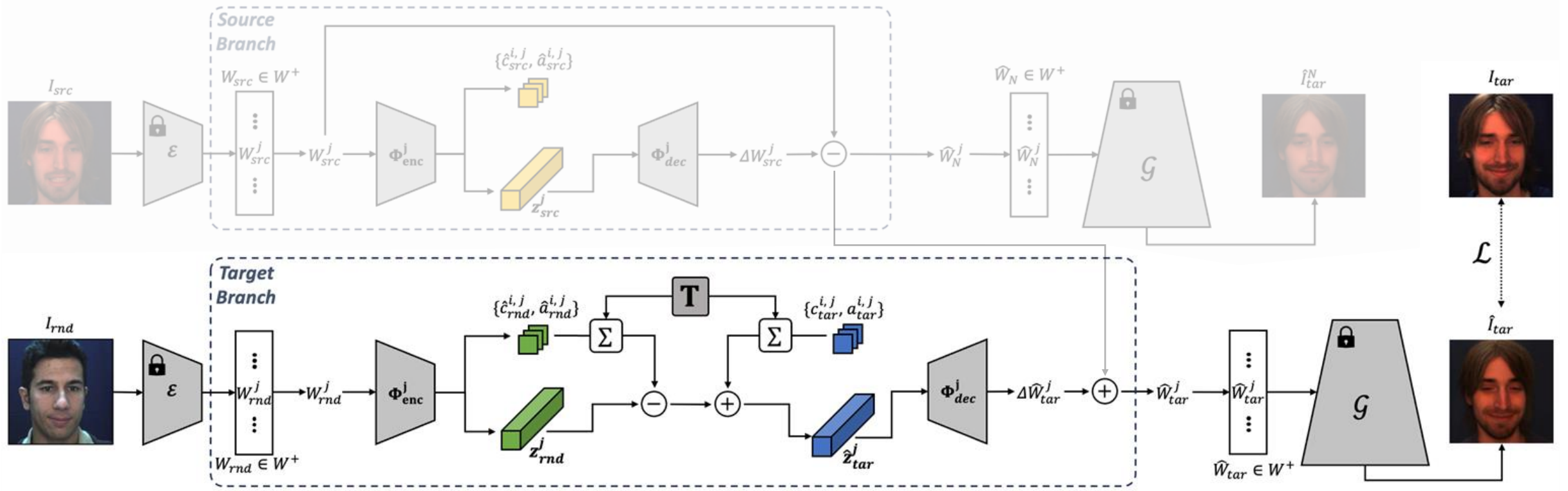
AUEditNet

- Pipeline



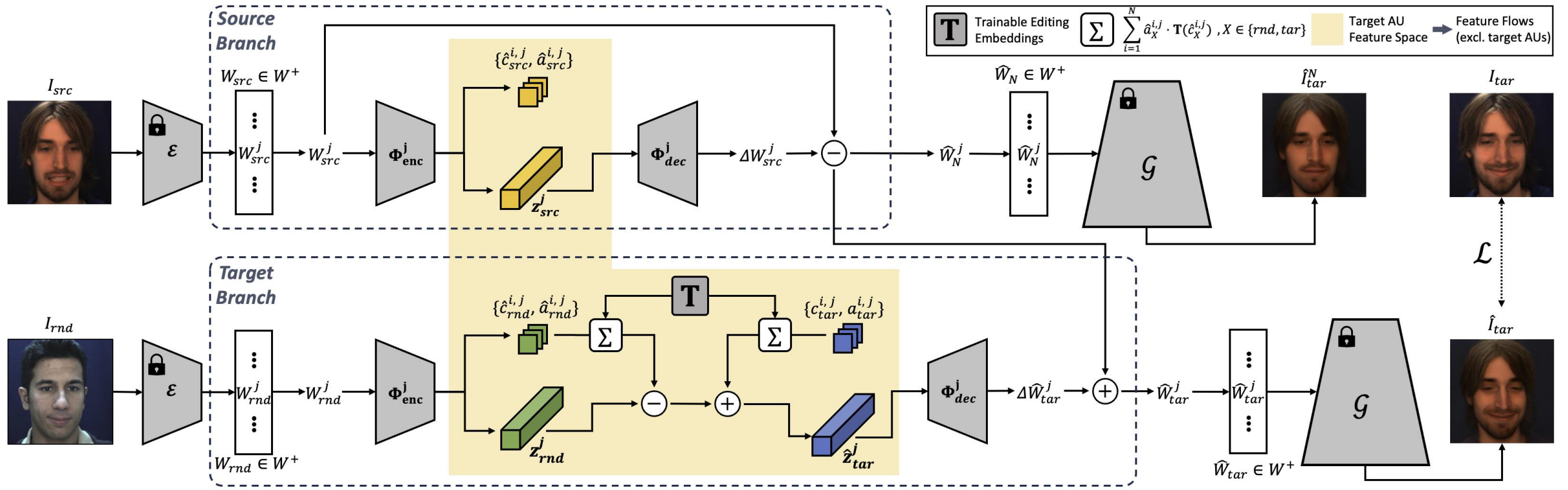
AUEditNet

- Pipeline



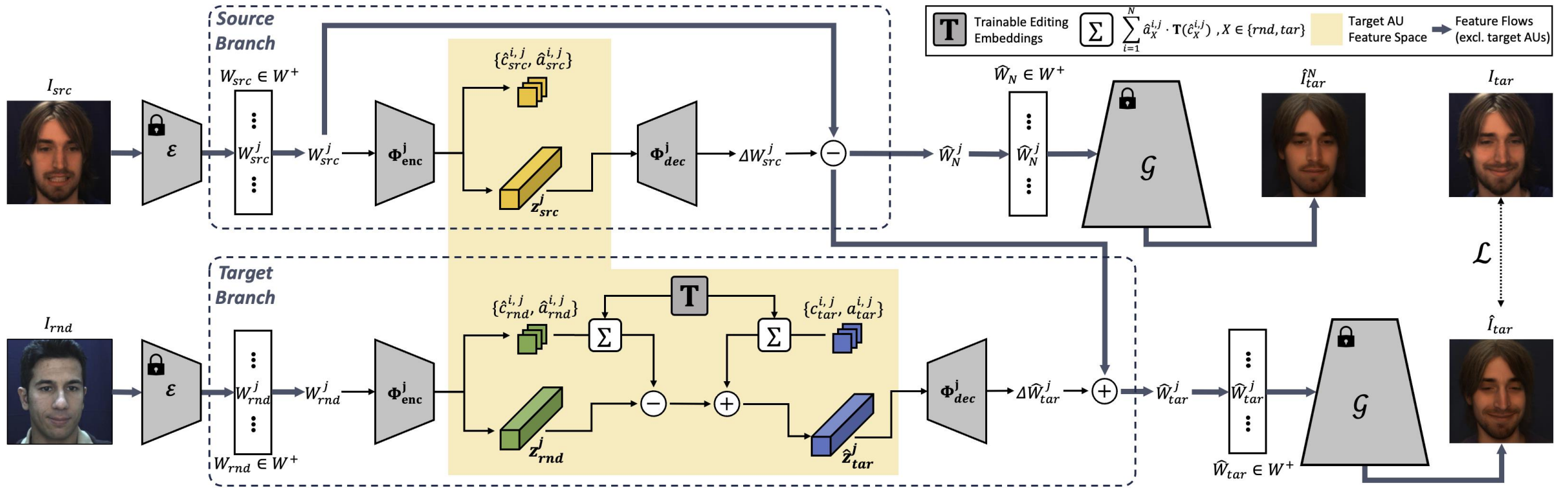
AUEditNet

- Pipeline



AUEditNet

- Pipeline



Results

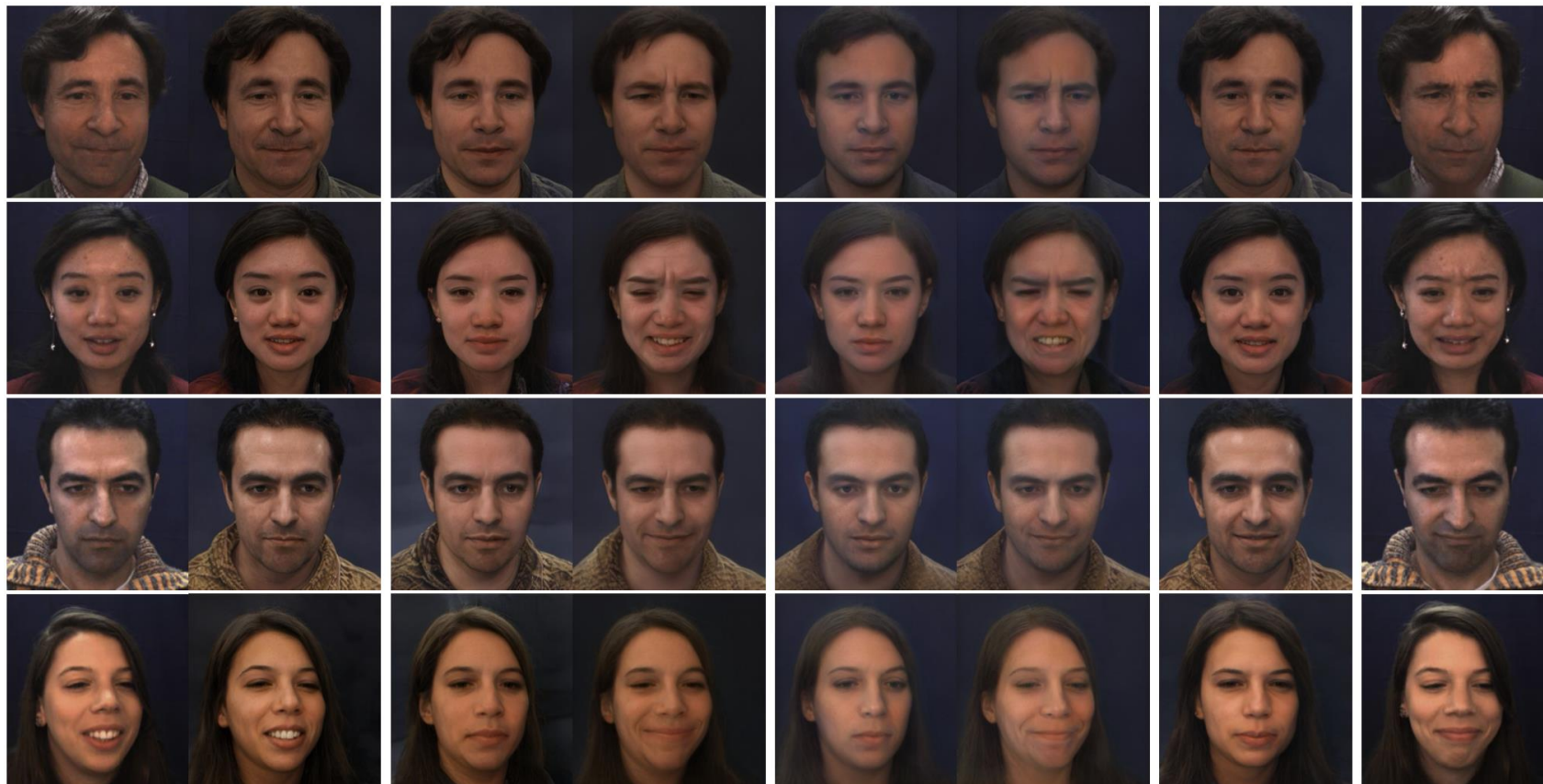
- Quantitative Comparison
 - DISFA Test Subset [7]

	Method	AU1	AU2	AU4	AU5	AU6	AU9	AU12	AU15	AU17	AU20	AU25	AU26	Avg
ICC(3, 1) (\uparrow)	HR [26]	.56	.52	.75	.42	.51	.55	.82	.55	.37	.21	.93	.62	.57
	Aps [32]	.35	.19	.78	.73	.52	.65	.81	.49	.61	.28	.92	.67	.58
	MAE-Face [22]	.740	.688	.754	.666	.653	.584	.877	.527	.589	.331	.952	.721	.674
	DeltaEdit [21]	.091	.058	.114	.034	.383	.065	.694	.008	.004	.041	.581	.166	.179
	ReDirTrans [14]	.856	.631	.851	.436	.634	.278	.862	.364	.602	.481	.927	.480	.617
	AUEditNet	.848	.559	.874	.600	.577	.230	.890	.276	.669	.511	.950	.548	.628
MSE (\downarrow)	HR [26]	.41	.37	.70	.08	.44	.30	.29	.14	.26	.16	.24	.39	.32
	Aps [32]	.68	.59	.40	.03	.49	.15	.26	.13	.22	.20	.35	.17	.30
	MAE-Face [22]	.200	.186	.514	.032	.320	.222	.221	.093	.204	.146	.164	.260	.213
	DeltaEdit [21]	.605	.686	1.311	.031	.513	.485	.570	.080	.424	.454	1.157	.420	.561
	ReDirTrans [14]	.181	.397	.341	.034	.453	.552	.286	.070	.225	.333	.247	.367	.290
	AUEditNet	.191	.445	.309	.029	.492	.579	.228	.080	.188	.322	.169	.367	.283
	ReDirTrans (<i>N</i>)	.045	.117	.025	.019	.024	.009	.300	.032	.177	.032	.803	.427	.167
	AUEditNet (<i>N</i>)	.069	.101	.098	.024	.036	.006	.227	.004	.014	.063	.351	.228	.102

[7] S Mohammad Mavadati, Mohammad H Mahoor, Kevin Bartlett, Philip Trinh, and Jeffrey F Cohn. Disfa: A spontaneous facial action intensity database. IEEE Transactions on Affective Computing, 4(2):151–160, 2013.

Results

- Qualitative Comparison



Source

e4e
Inversion

AUEditNet
(-)

AUEditNet
(+)

ReDirTrans
(-)

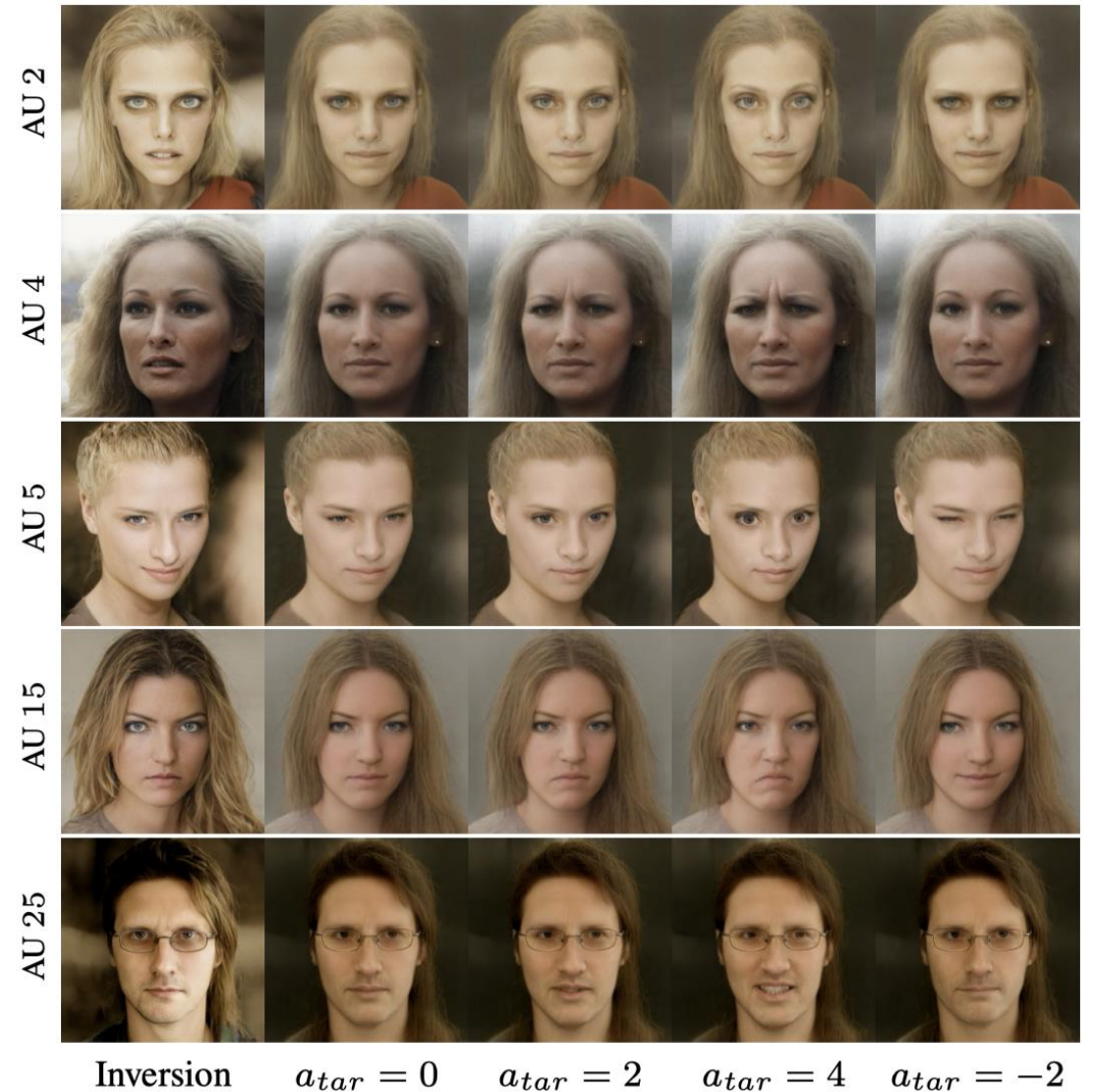
ReDirTrans
(+)

DeltaEdit
(+Δ)

Target

Results

- Qualitative Results
 - Conditional editing based on AU intensity values
 - CelebA-HQ [8]



[8] Tero Karras, Timo Aila, Samuli Laine, and Jaakko Lehtinen. Progressive growing of gans for improved quality, stability, and variation. arXiv preprint arXiv:1710.10196, 2017.

Thank You