Dual-Set Degradation Representation Learning

Set S
(Same face with different synthetic degradation)

Set $\mathcal{R}$
(Face images sampled from any GFIQA dataset)

Degradation Extraction ψ

Degradation Representation $\psi_{\vec{z}}$

1 2 3 ... m

1 2 3 ... n

Soft Proximity Mapping Construction

Soft Proximity Mapping (SPM) $\hat{\psi}$

1 2 3 ... m

1 2 3 ... n

Contrastive Loss

Contrastive Loss — Eq. (5)(6)

$\mathcal{L}_{\text{Con}}(S, \mathcal{R})$

Positive Sample
(Soft Proximity with same index)

i — Attract — i

Negative Sample
(Soft Proximity with different index)

i — Repel —

1 2 ... j ... m

For $j \neq i$

$\mathcal{L}_{\text{Con}}(\mathcal{R}, S)$

Positive Sample
(Soft Proximity with same index)

i — Attract — i

Negative Sample
(Soft Proximity with different index)

i — Repel —

1 2 ... j ... n

For $j \neq i$

Soft Proximity Mapping Construction (SPM) — Eq. (4)

<u>SPM-Set S</u>

i

$\text{sim}(i, 1) \times \boxed{1} + ... + \text{sim}(i, j) \times \boxed{j} + ... + \text{sim}(i, n) \times \boxed{n} = \boxed{i}$

<u>SPM-Set $\mathcal{R}$</u>

i

$\text{sim}(i, 1) \times \boxed{1} + ... + \text{sim}(i, j) \times \boxed{j} + ... + \text{sim}(i, n) \times \boxed{m} = \boxed{i}$