# INVERSE HALFTONE COLORIZATION: MAKING HALFTONE PRINTS COLOR PHOTOS

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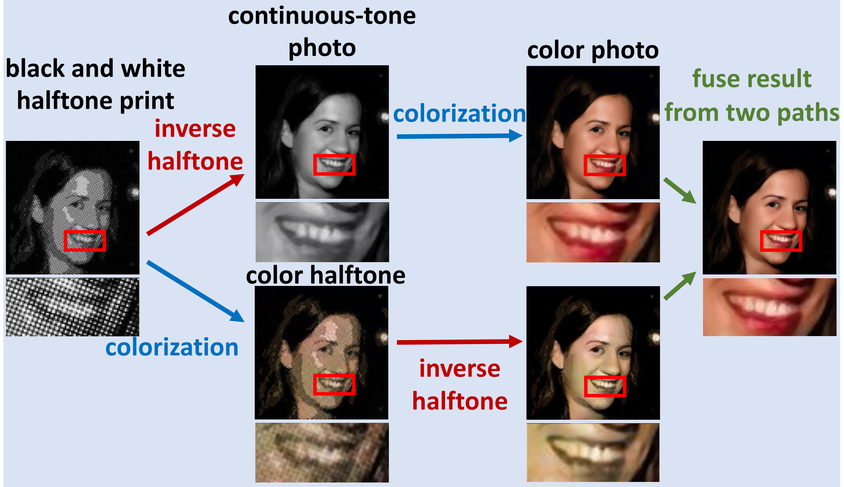
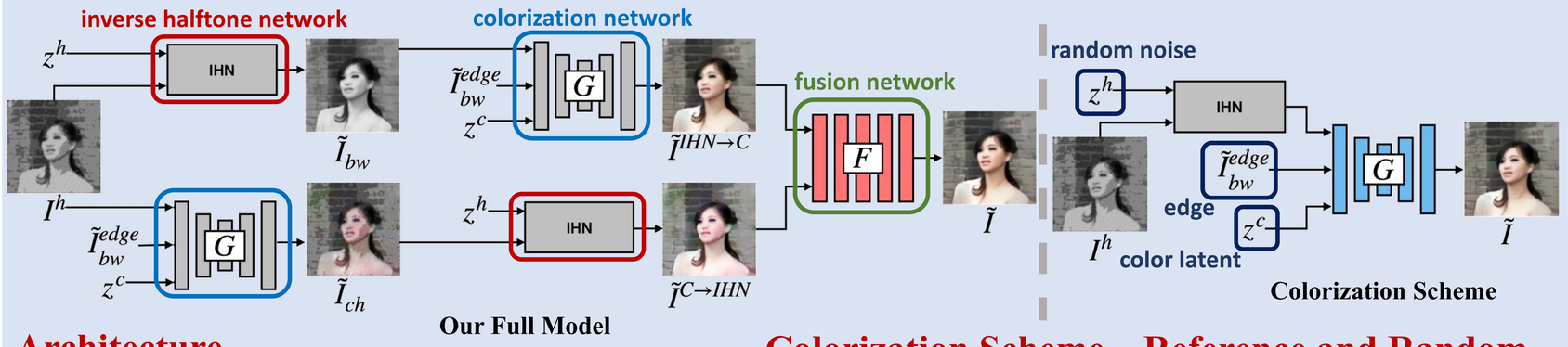
# 1212
Project Page

## Objectives

- **Inverse Halftone Colorization** aims to recover colorful images from black and white halftone prints, and can be treated as a joint problem of inverse halftone and colorization.
- Our model is flexible to support both **exemplar-based** and **random** colorization.
- We discover that the orders of cascading inverse halftone and colorization networks would lead to results with **complementary properties**, hence we propose a fusion scheme to integrate their results.




## Proposed Method




## Architecture

**Inverse Halftone Network (IHN)**

- Goal: turn halftone image $I^h$ to continuous-tone
- Add noise $z^h$ as input to synthesize missing information

**Colorization Network**

- Goal: support exemplar-based and random colorization
- Add edge map $\tilde{I}_{bw}^{edge}$ of $IHN(I^h)$ and color latent $z^c$ as input to support different colorization schemes

**Fusion Network**

- Goal: integrate the results from both orders of cascades and benefit from their complementary property
- Use multiple residual blocks to enhance the feature interactions across two orders of cascades

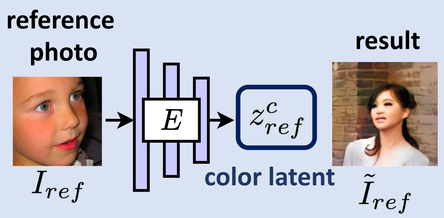
## Colorization Scheme – Reference and Random

**Reference Scheme**

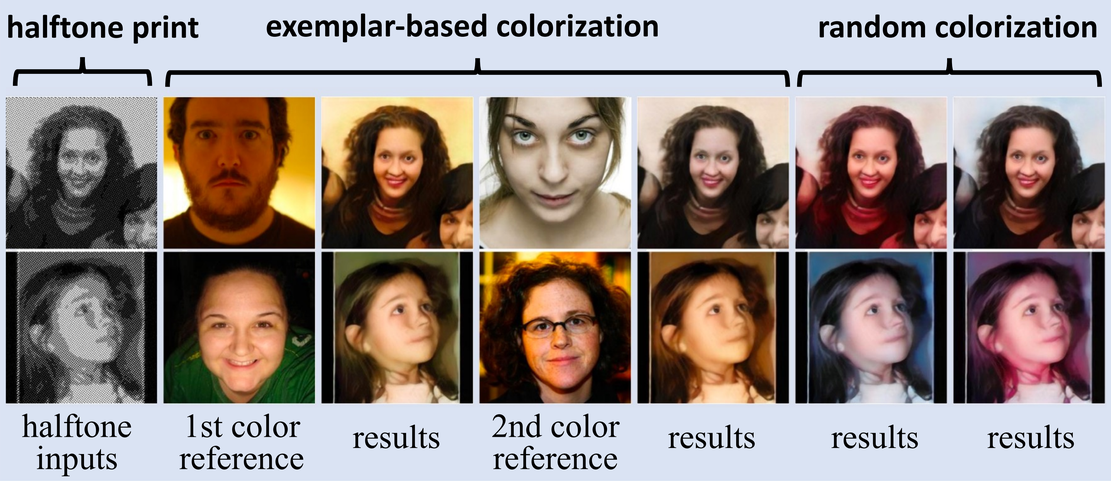
- Goal: support exemplar-based colorization
- $z_{ref}^c$ : obtain from the reference image $I_{ref}$
- $\tilde{I}_{ref} = G(\tilde{I}_{bw}, \tilde{I}_{bw}^{edge}, z_{ref}^c)$

**Random Scheme**

- Goal: support random colorization
- $z_{rand}^c$ : draw from standard Gaussian distribution $N(0, I)$
- $\tilde{I}_{rand} = G(\tilde{I}_{bw}, \tilde{I}_{bw}^{edge}, z_{rand}^c)$




## Results




## Comparison with Cascades of IHN and Various Colorization Models

**Qualitative results**

- These baselines produce artifacts, scattered color blocks, uneven color and diffused contour, and low diversity with grayish color.


**Quantitative Results**

- *Ours* results in better balance between the realness and the diversity.

| Method | Diversity↑ | FID↓ |
|---|---|---|
| $IHN$+[9] | 0.134 | 103.00 |
| $IHN$+[11] | **0.162** | 166.95 |
| $IHN$+[12] | 0.150 | 102.57 |
| $IHN$+[21] | 0.051 | 95.04 |
| Ours | 0.120 | **82.40** |