Generative Adversarial Networks for Automatic Image Colorization

Team: Yet Another Layer - YAL

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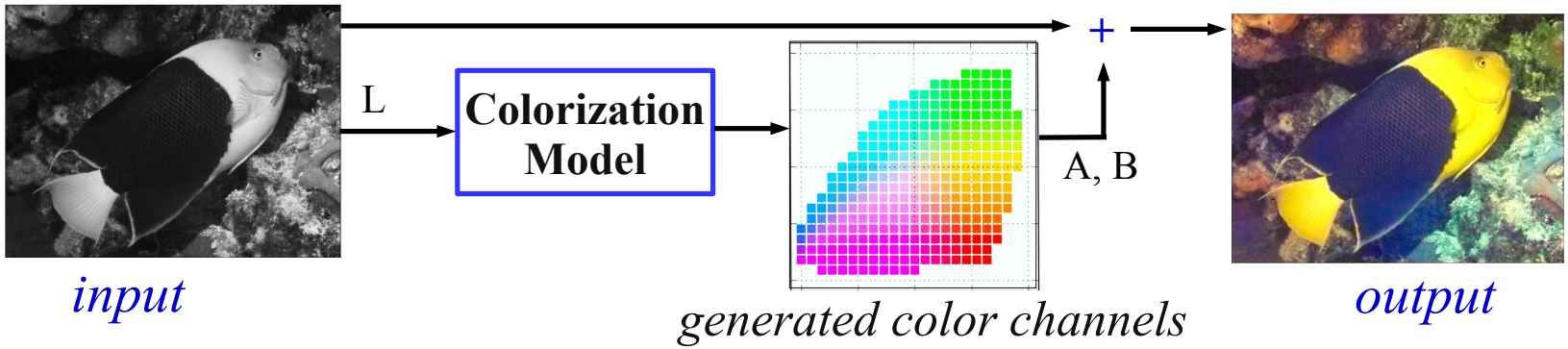
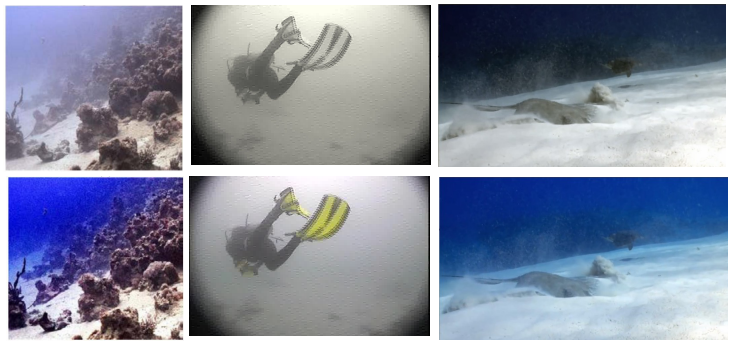
Image Colorization

Problem: produce a *realistic* coloring of gray-scale images



Applications

Colorizing old photos and movies



Colorizing underwater images

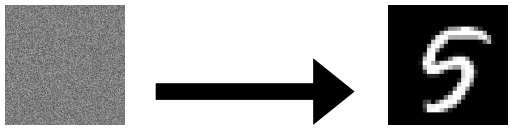
Figure sources: [1], [2], [3]

Background

- Algorithmic choices:
  - **Image-to-image translation**
  - Classification
- Colorspace choices:
  - **LAB**, RGB
- Approaches
  - Classical
  - Deep learning based
    - Generative models
    - **Adversarial model**

Generative Adversarial Networks (GANs)

- Two player minimax game
  - Discriminator **D**
  - Generator **G**



- D is trained to discriminate between a real image and a generated image
- G is trained to generate an image that will fool D
- Both G and D are neural networks

$$\min_G \max_D \mathbb{E}_{x \sim p_{data(x)}}[logD(\mathbf{x})] + \mathbb{E}_{z \sim p_z(z)}[log(1 - D(G(z)))]$$

- Conditional GANs generate images given conditional information, such as a class label.

GAN Variations

- Deep Convolutional GANs (DCGANs)
  - Bridge the gap between GANs and Deep Learning
- Least Squares GANs (LSGANs)
  - Use a least squares loss for the discriminator
- Energy-Based GANs (EBGANs)
  - Model the discriminator as an energy function
- Wasserstein GAN (WGAN)
  - Minimizes the Earth Mover distance between two distributions

References

1. Richard Zhang, Phillip Isola, and Alexei A Efros. Colorful image colorization. In European Conference on Computer Vision, pages 649666. Springer, 2016.
2. Huimin Lu, Yujie Li, and Seiichi Serikawa. Underwater image enhancement using guided trigonometric bilateral filter and fast automatic color correction. In Image Processing (ICIP), 2013 20th IEEE International Conference on, pages 34123416. IEEE, 2013.
3. Luz A Torres-Mendez and Gregory Dudek. Color correction of underwater images for aquatic robot inspection. In International Workshop on Energy Minimization Methods in Computer Vision and Pattern Recognition, pages 6073. Springer, 2005.