

Single Image Enhancement for Underwater Imaging

Jade Deng
Stanford University

Motivation

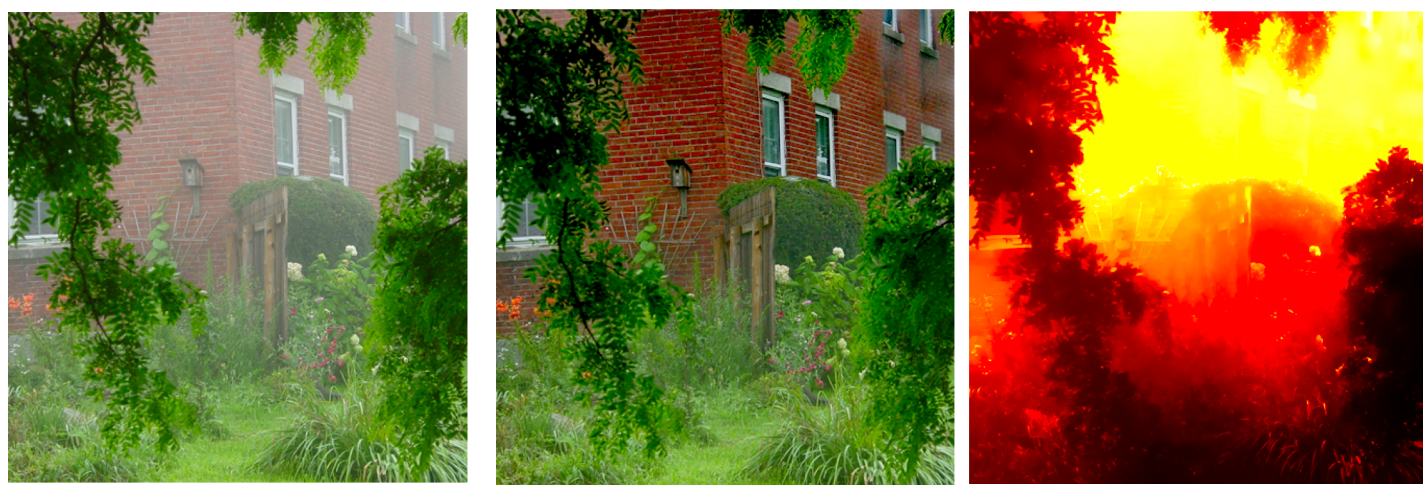
- Underwater images captured with minimum processing are subject to poor image quality due to light scattering and absorption. A method to remove haze and correct for color inaccuracies is desired. For scientific data collection, such as visual surveys in the ocean, advanced computer vision and machine learning algorithms can be applied on accurate and consistent underwater images to open new doors for marine conservation/exploration.

Related Work

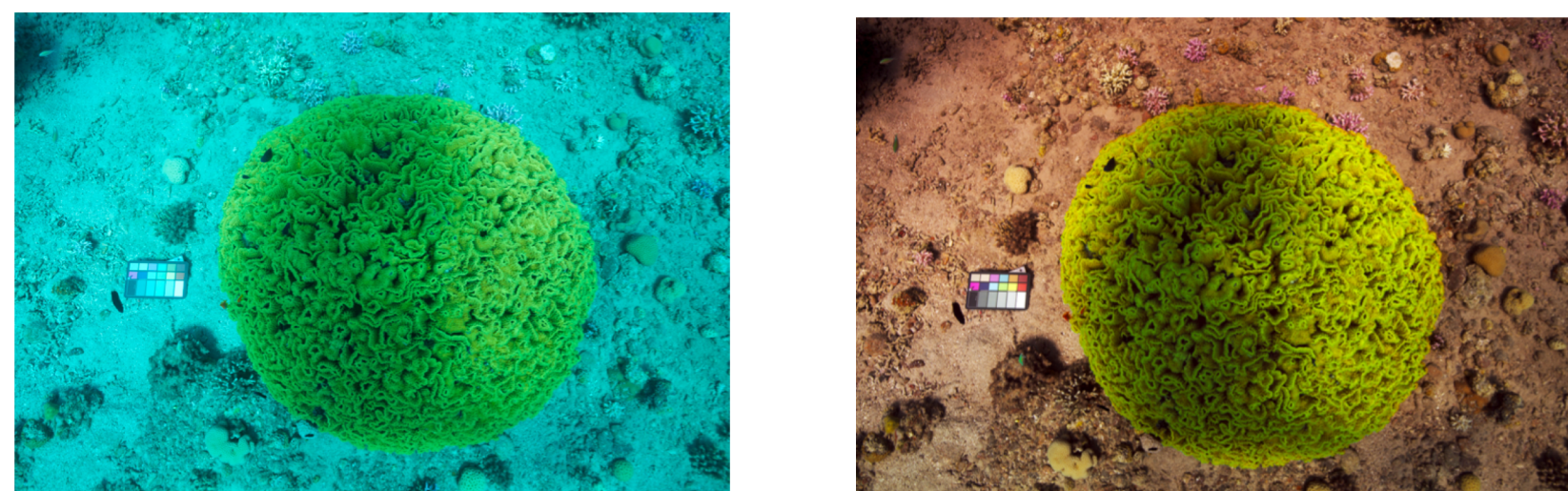
- Image Formation Model

$$I(\mathbf{x}) = J(\mathbf{x})t(\mathbf{x}) + (1 - t(\mathbf{x}))A$$

- Single image dehazing algorithms (Fattal)



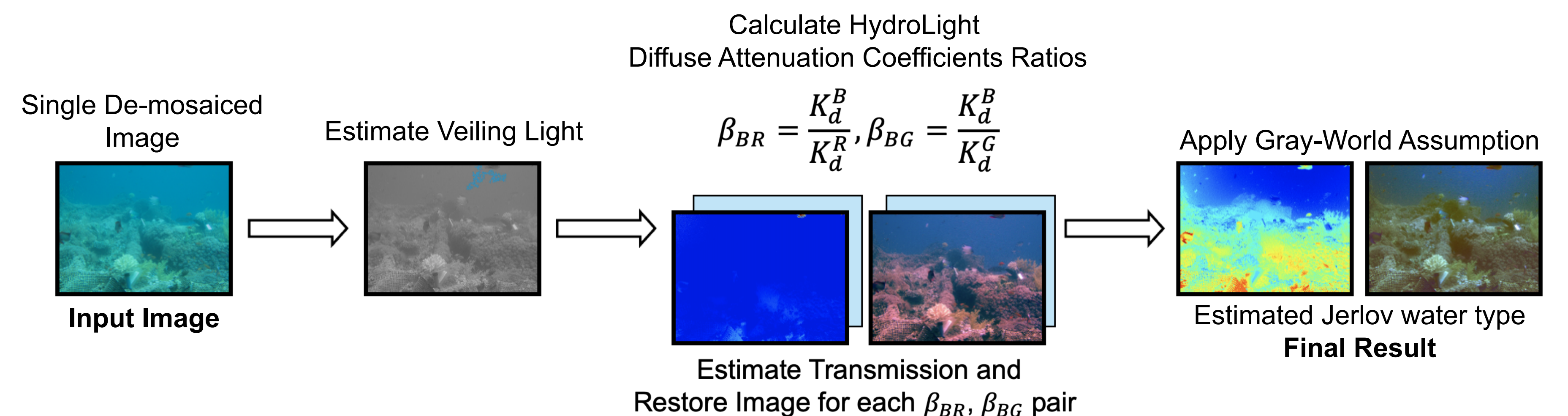
- Underwater image color restoration (Akkaynak)



- [1] Berman, Dana et al. "Underwater Single Image Color Restoration Using Haze-Lines and a New Quantitative Dataset." *ArXiv abs/1811.01343* (2018)
[2] R. Fattal, "Single image dehazing," in *SIGGRAPH '08: ACM SIGGRAPH 2008 papers*. New York, NY, USA: ACM, 2008, pp. 1–9.
[3] Akkaynak, D., & Treibitz, T. (2019). Sea-Thru: A Method for Removing Water From Underwater Images. 2019 CVPR, 1682-1691.
[4] Michael G. Solonenko and Curtis D. Mobley, "Inherent optical properties of Jerlov water types," *Appl. Opt.* 54, 5392-5401 (2015)

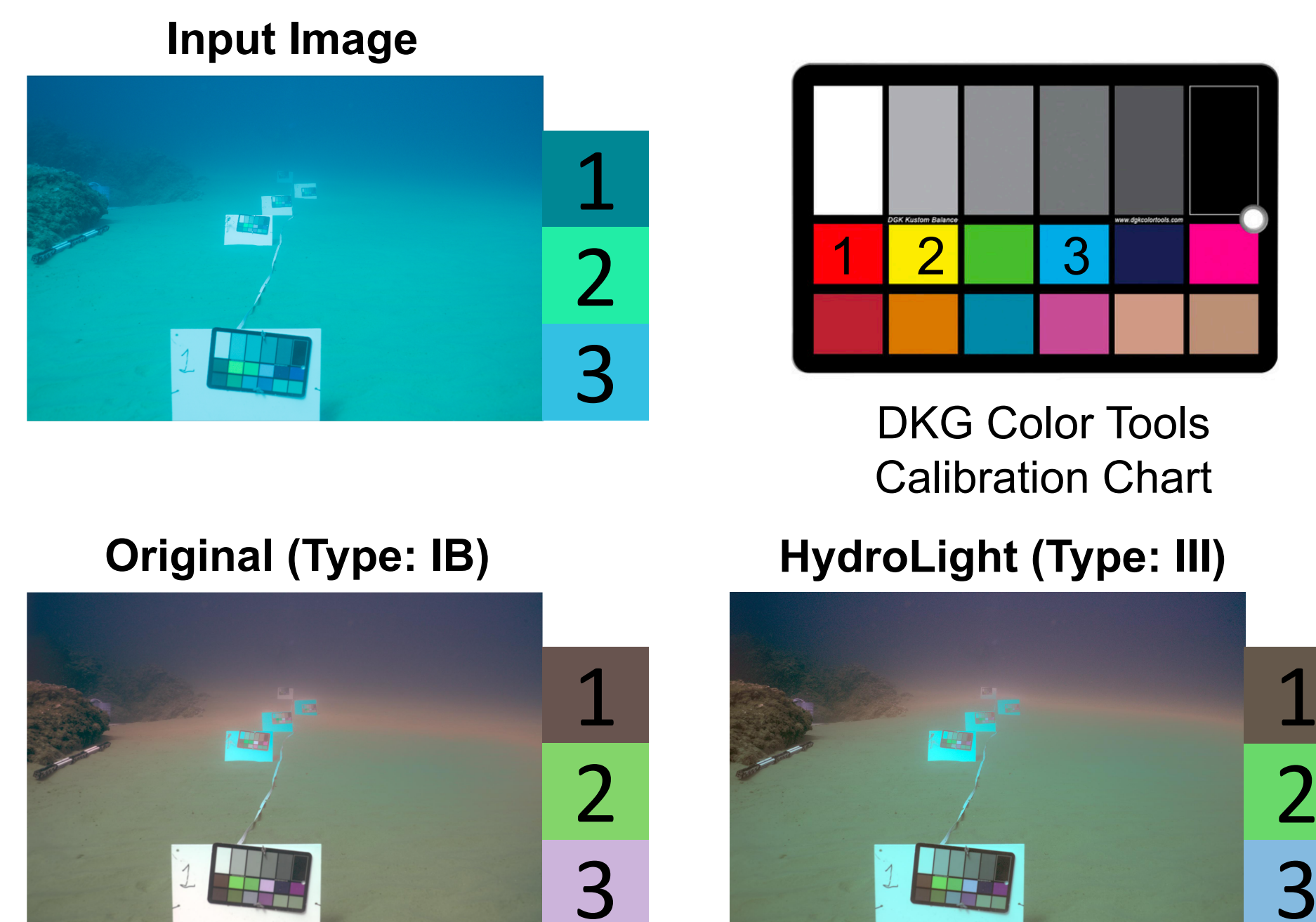
HydroLight Model to Compute Attenuation Coefficients

- Color-dependent transmission is related to distance via attenuation coefficients.
- New Technique: Leverage existing dataset and pipeline from Berman, but use the HydroLight radiative transfer model to determine new attenuation coefficient ratios



Results

Color Charts



Transmission

