

Supplementary Material

Underwater Image Color Correction using Exposure-Bracketing Imaging

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We first show visual comparisons in color correction of underwater images for all of the scenes we recorded: “S1” through “S6”. We compared our method with the following state-of-the-art methods: Wen *et al.* [1], Berman *et al.* [2], Iqbal *et al.* [3], Ancuti *et al.* [4], Fu *et al.* [5], GrayWorld [6], Yang *et al.* [7], and Nomura *et al.* [8]; they are the same as those reported in the submitted paper.

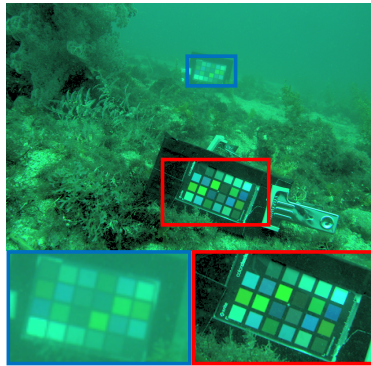
We then show reconstructed images obtained using our method with varying the parameters (S , th and α).

1. Visual Comparisons

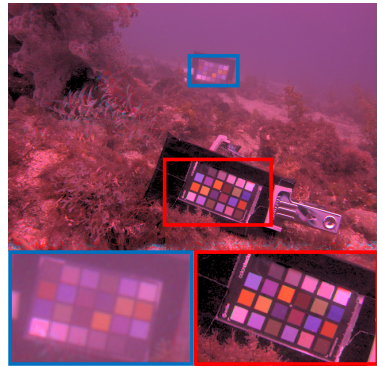
Visual comparisons
in color correction
of underwater images

(scene “S1”)

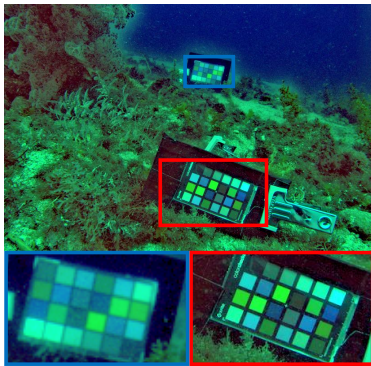
We respectively show the
CIEDE2000 values measured
in “Far” and “Near” regions
in each image.



Input underwater image

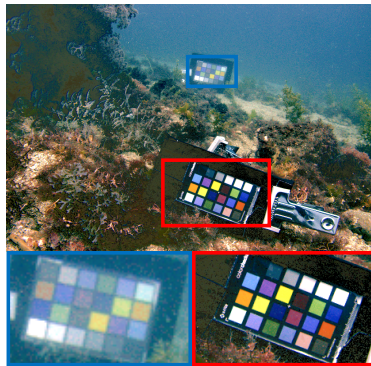


Fused image H



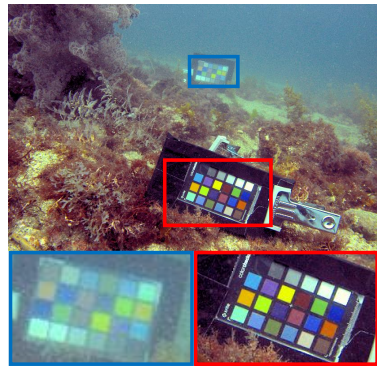
Wen *et al.* [1]

Far : 55.69 Near : 52.13



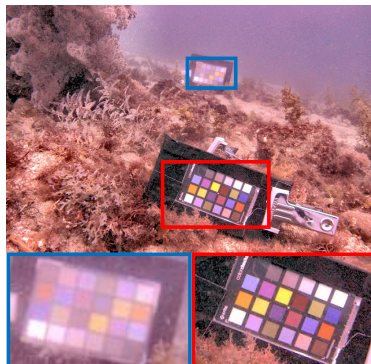
Berman *et al.* [2]

Far : 15.32 Near : 20.63



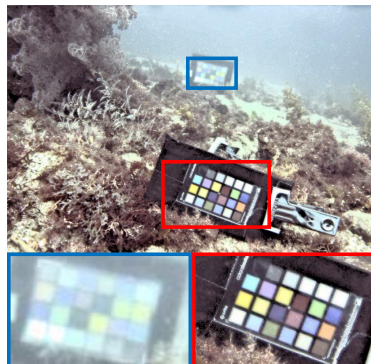
Iqbal *et al.* [3]

Far : 18.98 Near : 17.41



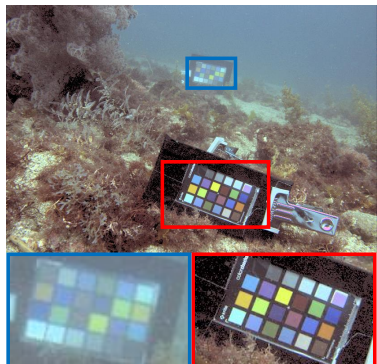
Ancuti *et al.* [4]

Far : 24.08 Near : 22.82



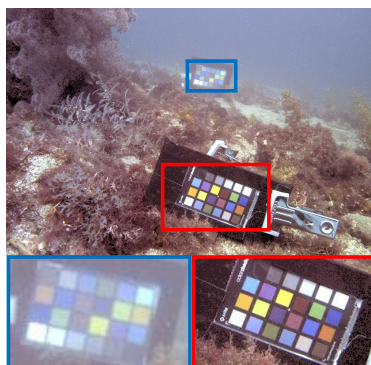
Fu *et al.* [5]

Far : 30.00 Near : 23.84



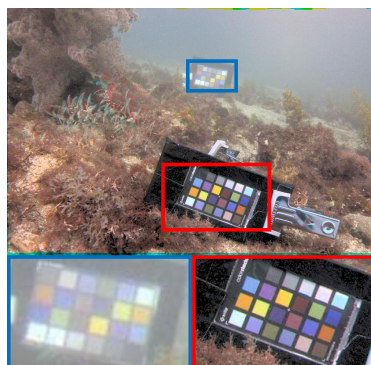
GrayWorld [6]

Far : 17.81 Near : 14.59



Yang *et al.* [9]

Far : 17.48 Near : 16.31



Nomura *et al.* [8]

Far : 14.44 Near : 12.63



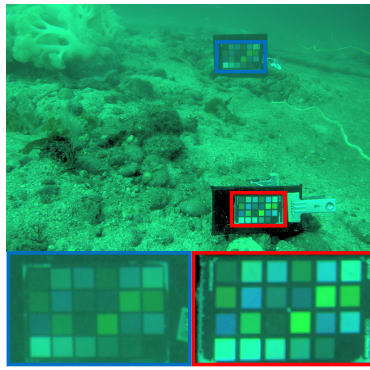
Ours

Far : **13.99** Near : **11.66**

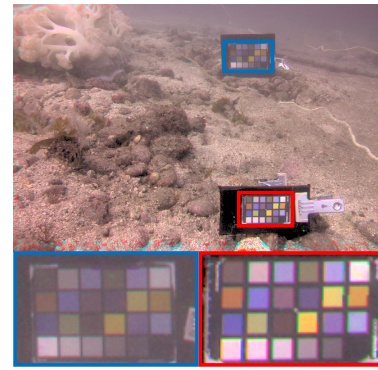
Visual comparisons
in color correction
of underwater images

(scene “S2”)

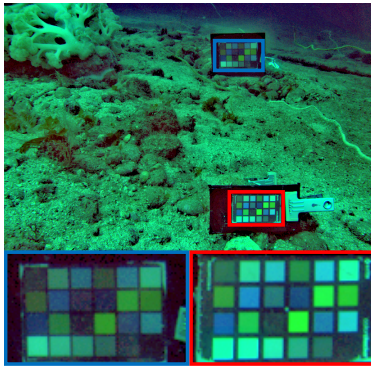
We respectively show the
CIEDE2000 values measured
in “Far” and “Near” regions
in each image.



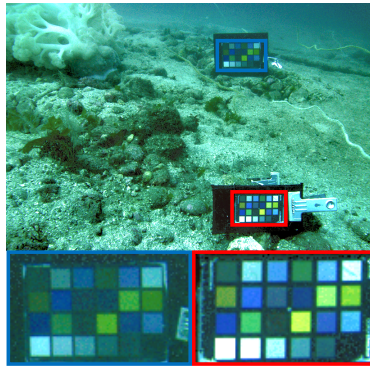
Input underwater image



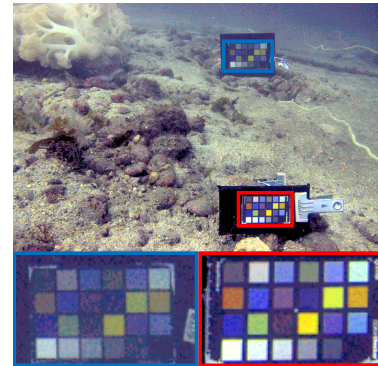
Fused image H



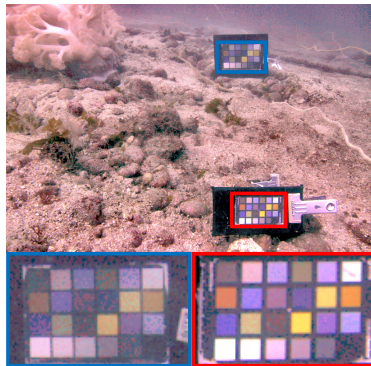
Wen *et al.* [1]
Far : 41.52 Near : 52.34



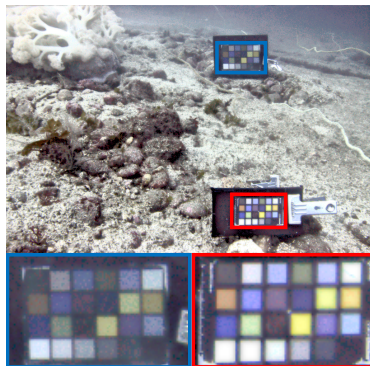
Berman *et al.* [2]
Far : 50.51 Near : 28.23



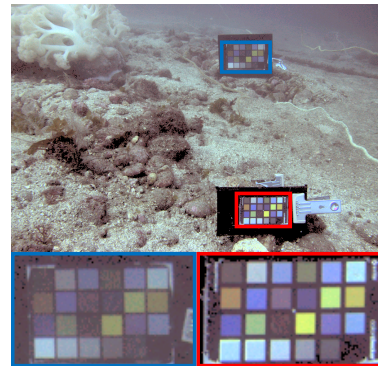
Iqbal *et al.* [3]
Far : 33.53 Near : 20.80



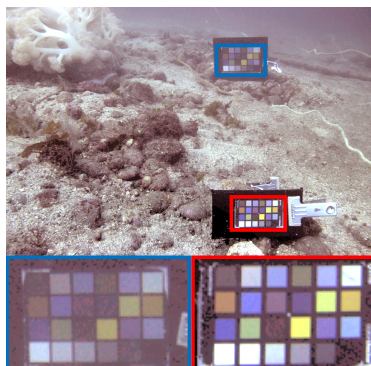
Ancuti *et al.* [4]
Far : 28.00 Near : 22.72



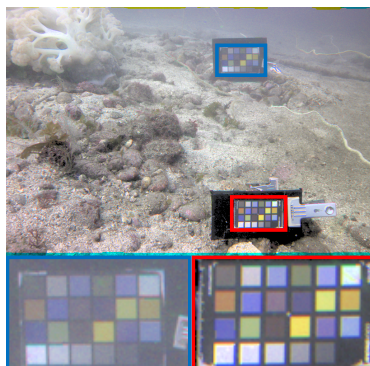
Fu *et al.* [5]
Far : 29.56 Near : 23.13



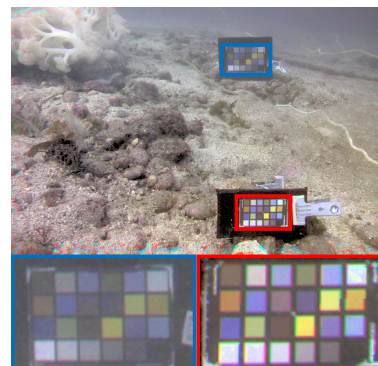
GrayWorld [6]
Far : 27.40 Near : 18.34



Yang *et al.* [9]
Far : 27.05 Near : 19.19



Nomura *et al.* [8]
Far : 27.48 Near : 15.10

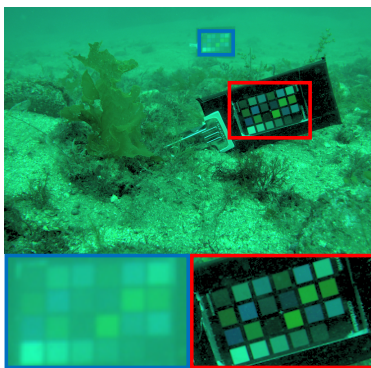


Ours
Far : 27.02 Near : 14.99

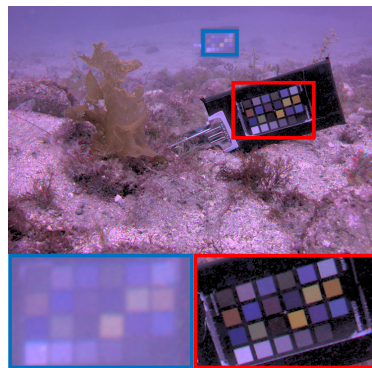
Visual comparisons
in color correction
of underwater images

(scene “S3”)

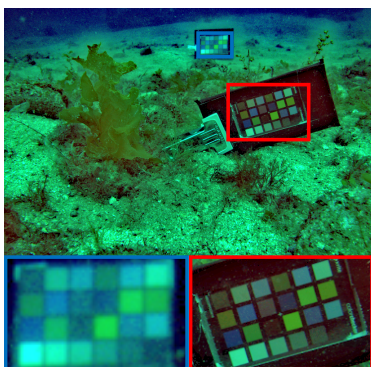
We respectively show the
CIEDE2000 values measured
in “Far” and “Near” regions
in each image.



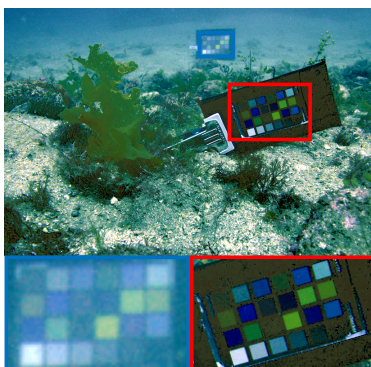
Input underwater image



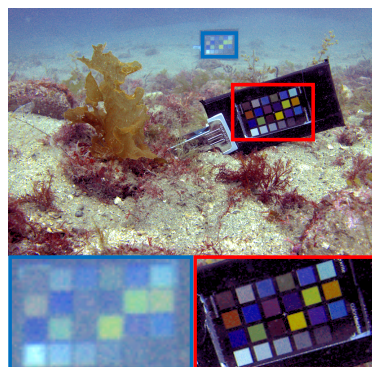
Fused image H



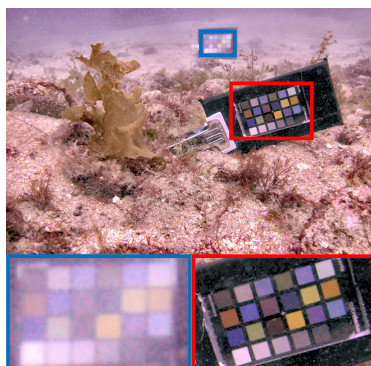
Wen *et al.* [1]
Far : 57.11 Near : 35.52



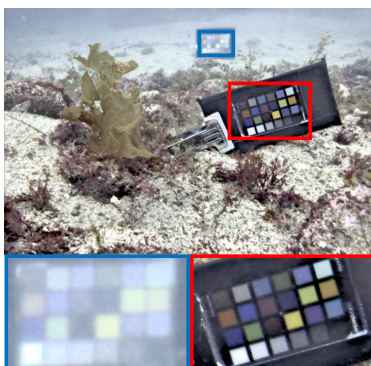
Berman *et al.* [2]
Far : 31.86 Near : 43.03



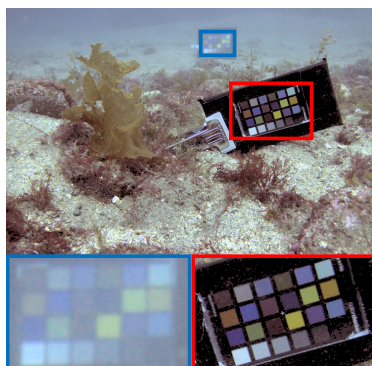
Iqbal *et al.* [3]
Far : 29.37 Near : 26.04



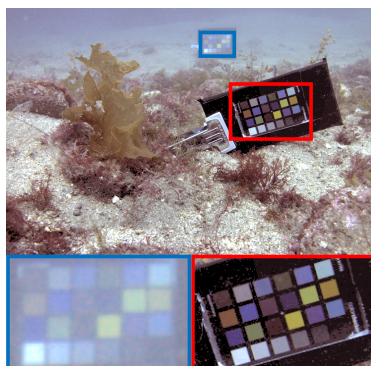
Ancuti *et al.* [4]
Far : 21.66 Near : 16.37



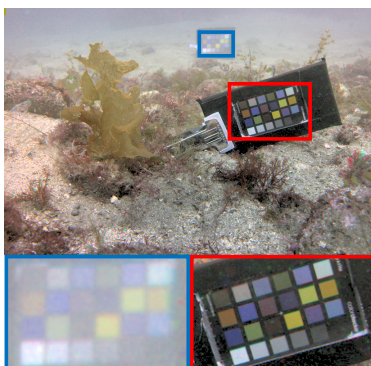
Fu *et al.* [5]
Far : 24.94 Near : 19.66



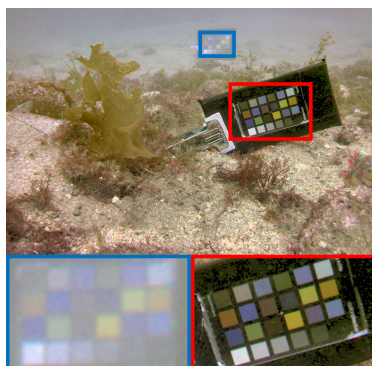
GrayWorld [6]
Far : 24.07 Near : 16.75



Yang *et al.* [9]
Far : 23.84 Near : 16.40



Nomura *et al.* [8]
Far : **18.65** Near : 16.15

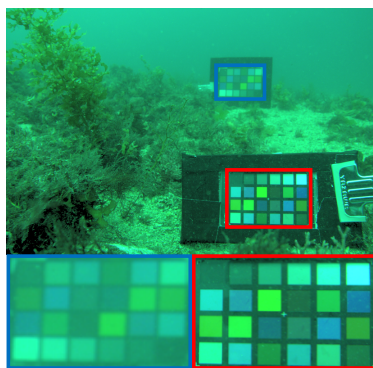


Ours
Far : 19.02 Near : **15.46**

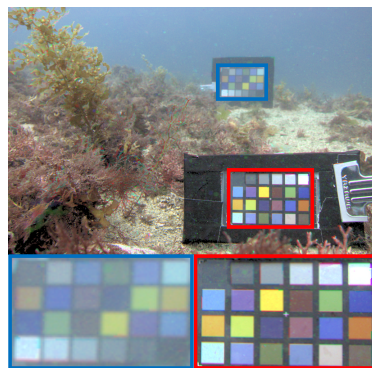
Visual comparisons
in color correction
of underwater images

(scene “S4”)

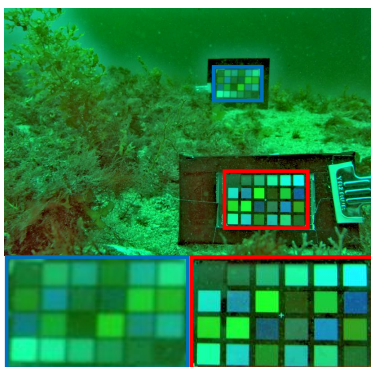
We respectively show the
CIEDE2000 values measured
in “Far” and “Near” regions
in each image.



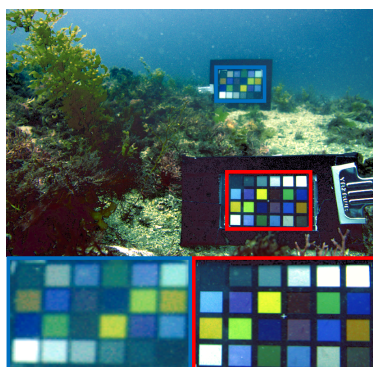
Input underwater image



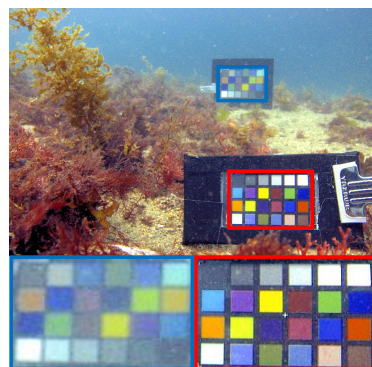
Fused image H



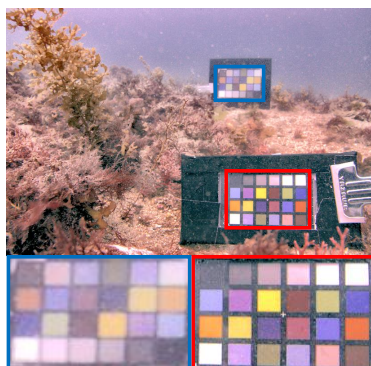
Wen *et al.* [1]
Far : 55.90 Near : 52.95



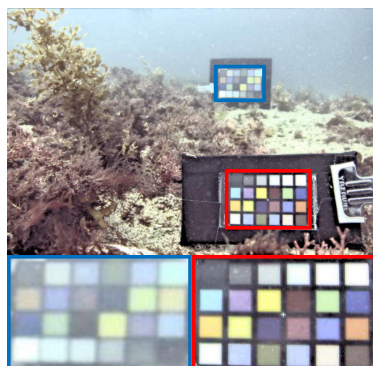
Berman *et al.* [2]
Far : 31.58 Near : 25.50



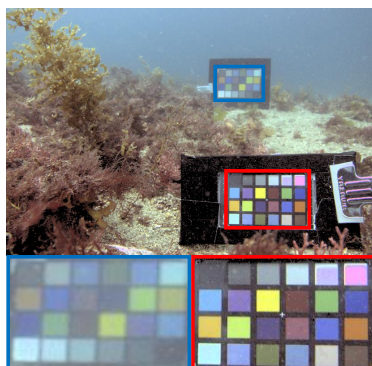
Iqbal *et al.* [3]
Far : 19.84 Near : 19.50



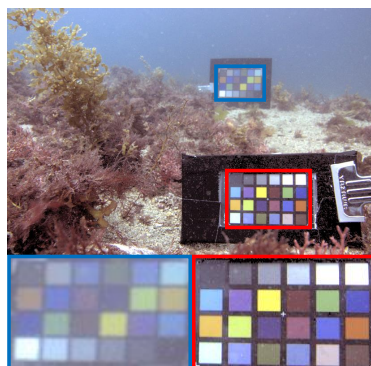
Ancuti *et al.* [4]
Far : 20.27 Near : 20.17



Fu *et al.* [5]
Far : 23.65 Near : 23.01



GrayWorld [6]
Far : 19.29 Near : 14.35



Yang *et al.* [9]
Far : 19.77 Near : 15.80

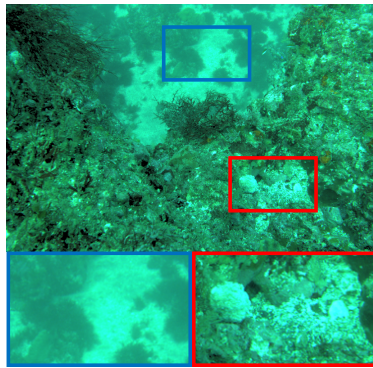


Nomura *et al.* [8]
Far : 16.41 Near : 13.84

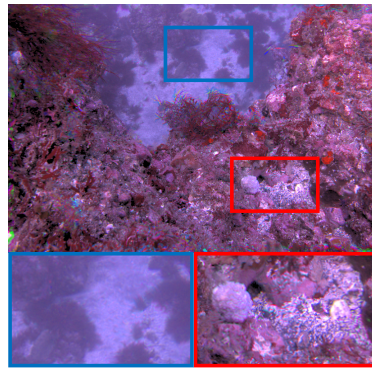


Ours
Far : **14.31** Near : **12.83**

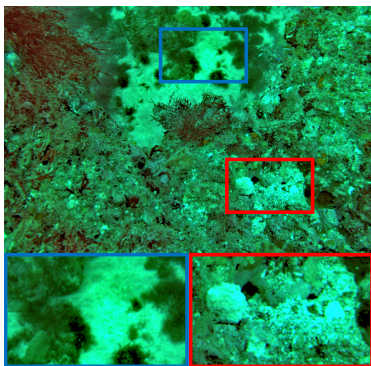
Visual comparisons
in color correction
of underwater images
(scene “S5”)



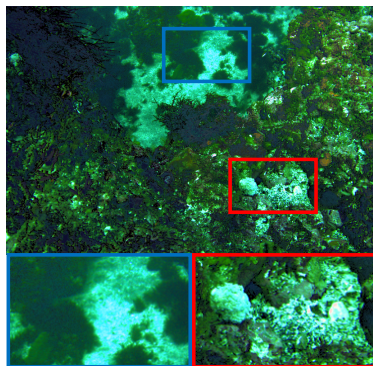
Input underwater image



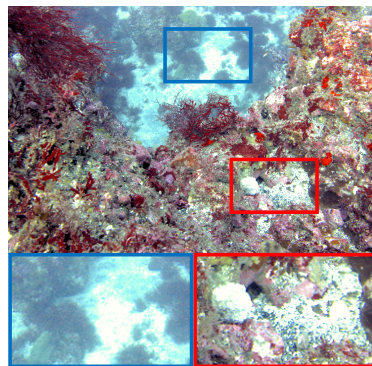
Fused image **H**



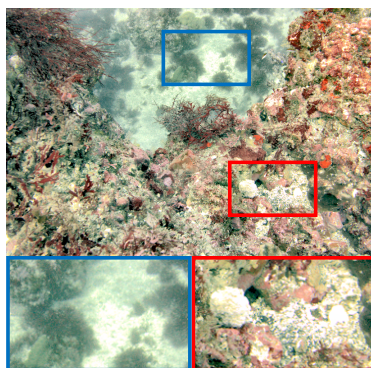
Wen *et al.* [1]



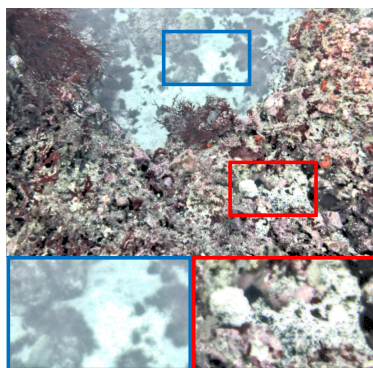
Berman *et al.* [2]



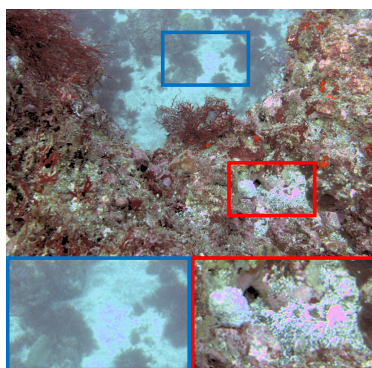
Iqbal *et al.* [3]



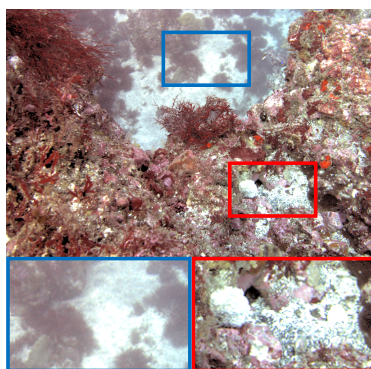
Ancuti *et al.* [4]



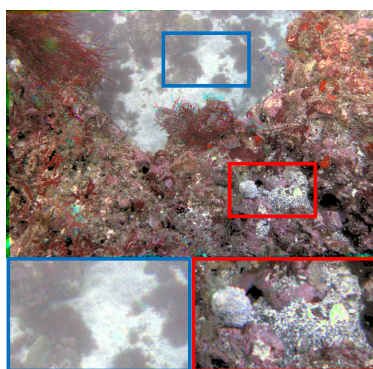
Fu *et al.* [5]



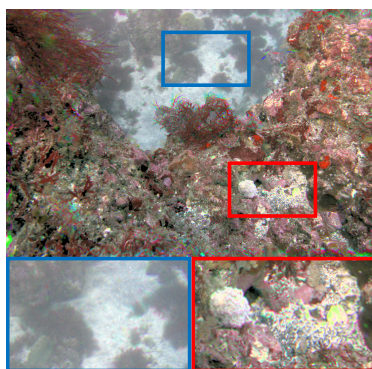
GrayWorld [6]



Yang *et al.* [9]

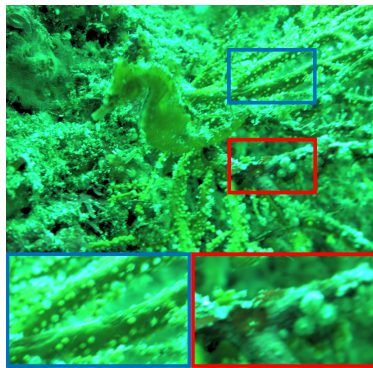


Nomura *et al.* [8]

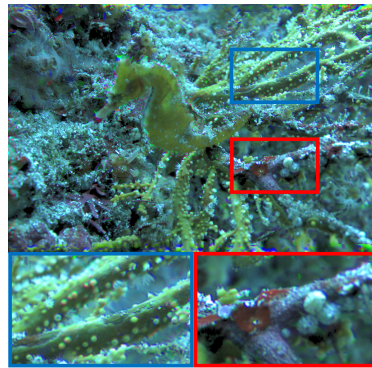


Ours

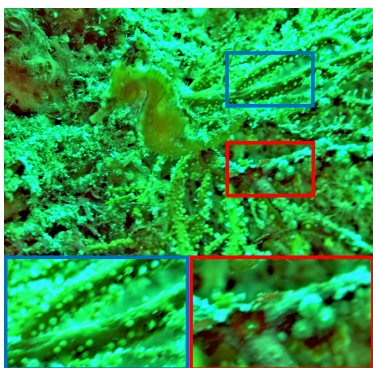
Visual comparisons
in color correction
of underwater images
(scene “S6”)



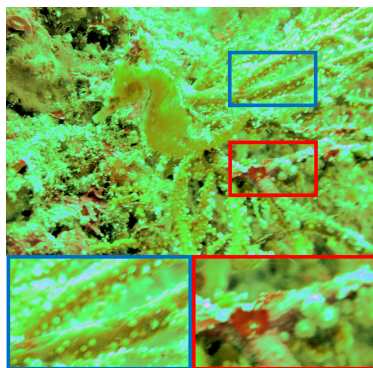
Input underwater image



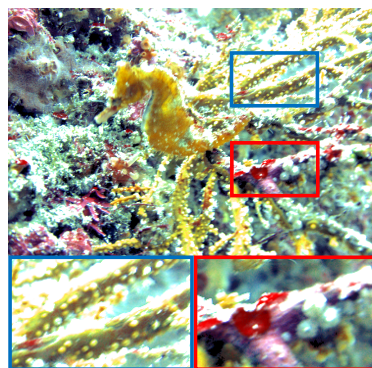
Fused image H



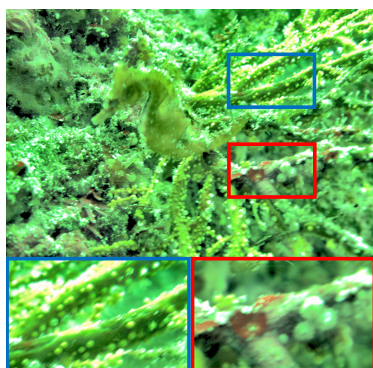
Wen *et al.* [1]



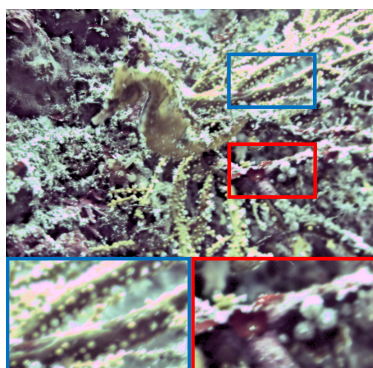
Berman *et al.* [2]



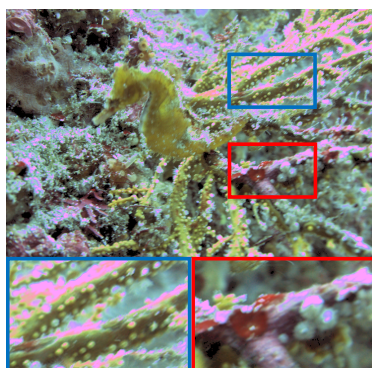
Iqbal *et al.* [3]



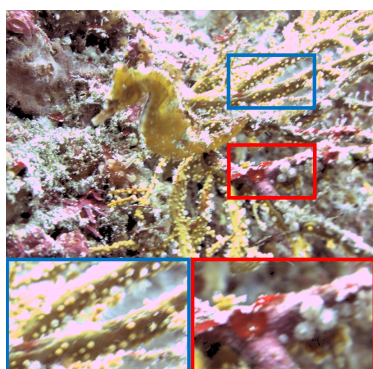
Ancuti *et al.* [4]



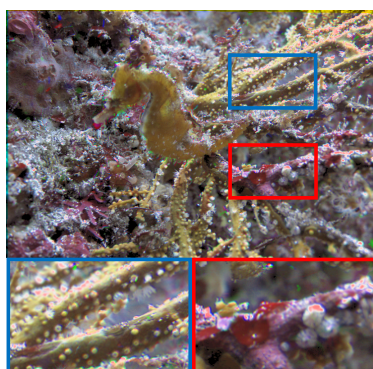
Fu *et al.* [5]



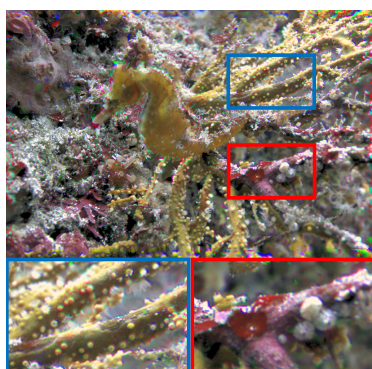
GrayWorld [6]



Yang *et al.* [9]



Nomura *et al.* [8]

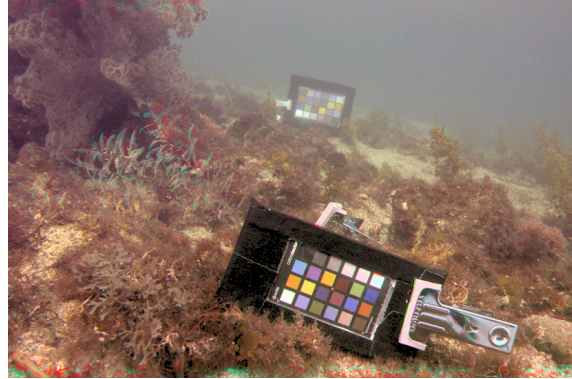


Ours

2. Results with Varying Parameters

Influences of varying th
for scene "S1"

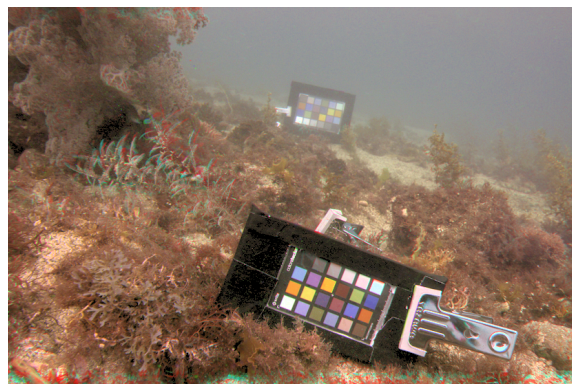
We respectively show the
CIEDE2000 values measured
in "Far" and "Near" regions
in each image.



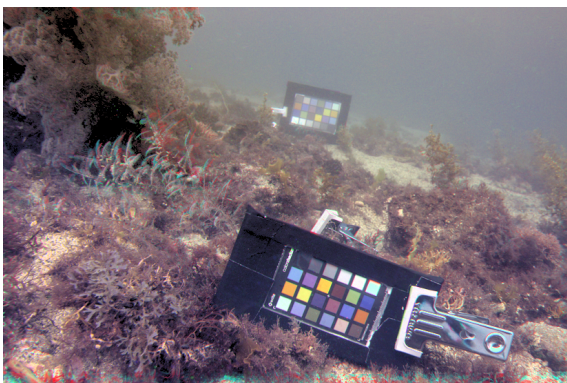
$th = 0.26$
Far : 14.05 Near : 11.74



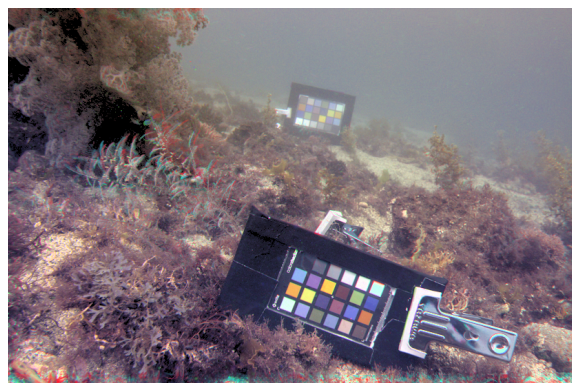
$th = 0.27$
Far : 14.05 Near : 11.67



$th = 0.30$
Far : **13.99** Near : **11.66**



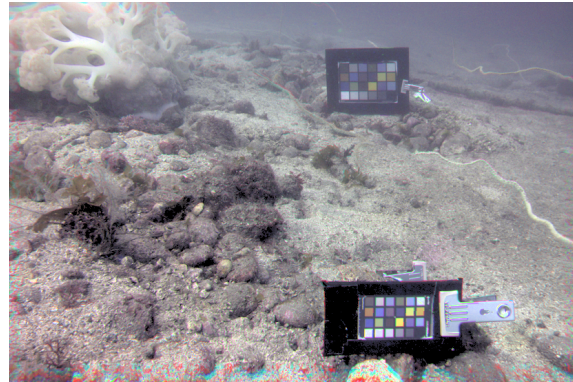
$th = 0.33$
Far : 14.04 Near : 13.00



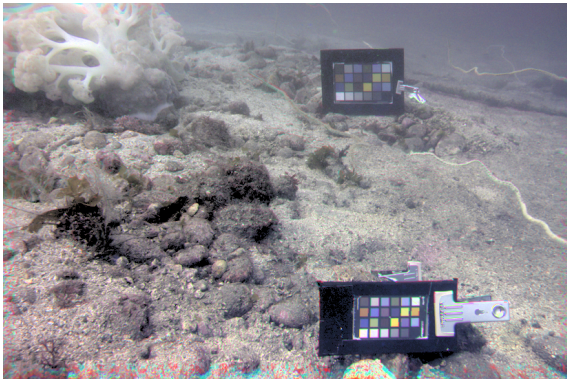
$th = 0.39$
Far : 14.05 Near : 13.01

Influences of varying S for scene "S2"

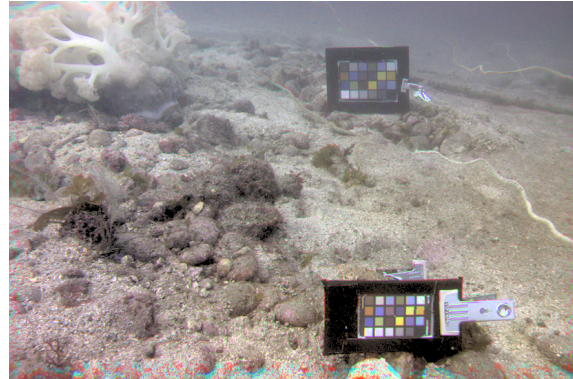
We respectively show the
CIEDE2000 values measured
in "Far" and "Near" regions
in each image.



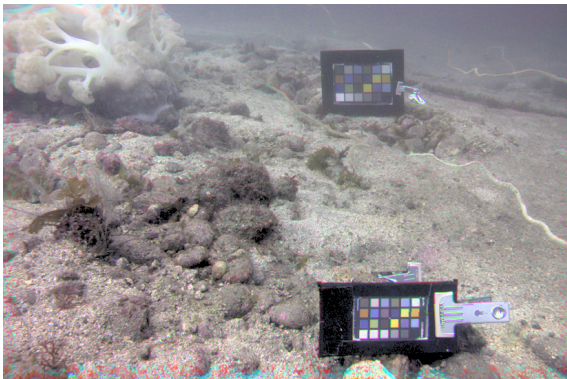
$S = 1$
Far : 29.93 Near : 17.85



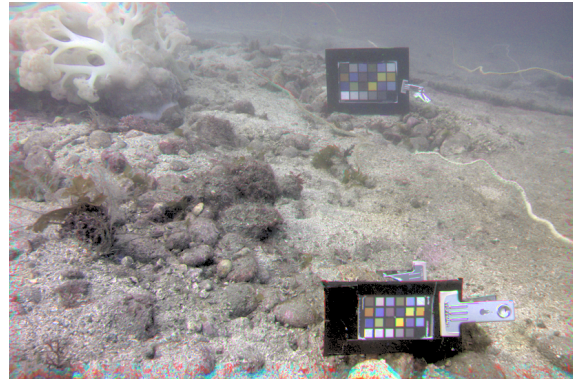
$S = 3$
Far : 30.18 Near : 18.01



$S = 5$
Far : **27.02** Near : **14.99**



$S = 7$
Far : 28.00 Near : 16.58



$S = 9$
Far : 27.98 Near : 15.82

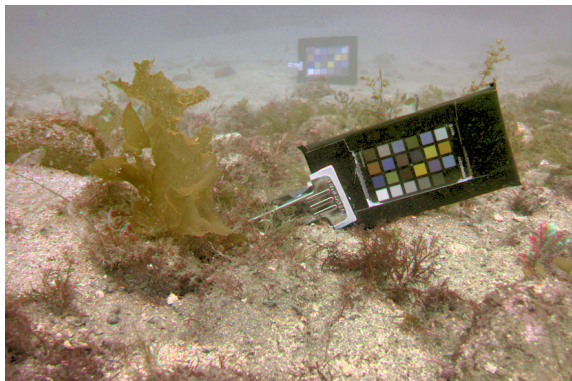
Influences of varying α
for scene "S3"



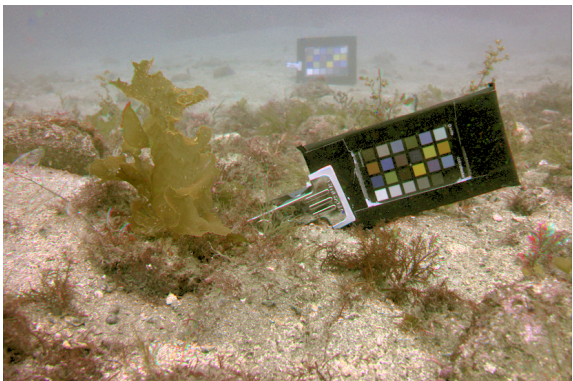
$\alpha = 0.05$



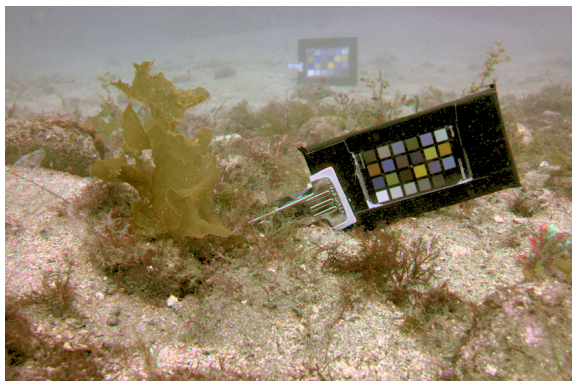
$\alpha = 0.1$



$\alpha = 0.2$



$\alpha = 0.4$



$\alpha = 0.8$

References

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