JPEG Pleno Holography:
Conversion of complex-valued DHs to binary off-axis DHs

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09.05.2021

Overview

Various complex-valued digital holograms (DH) from the JPEG Pleno Holography database were converted into off-axis binary DHs. For that the resolution of the DHs was doubled in one dimension.

E.g. 16K x 16K px
-> 32K x 16K px

- Double pixel count (higher coding complexity)
+ Preservation of Field-of-View (FoV) and visible scene size

This document tabulates the parameters of the data, the generation procedure, and the reconstruction instructions.

Small-scale binary data in the dataset

	Testset	Fourier	Resolution	Pixel pitch (um)	Wavelength (nm)	Type	Scene depth	Reconstruction distance (mm)	Reference wave curvature radius R (mm)
Astronaut	EmergImg-HoloGrail	FALSE	5176x2588	2,2	632,8	OCH	Deep	-160 - -175	Inf
Biplane16k	Interfere-III	FALSE	32768x16384	1	633; 532; 460	CGH	Deep	37.4-49.7	Inf
Biplane16k	b-com	FALSE	32768x16384	1	640; 532; 473	CGH	Deep	37.4-49.7	Inf
Ball	Interfere-IV with WUT	TRUE	2048x32768	3,45	532	CGH	Medium	701-751	700
Chess	Interfere-IV with WUT	TRUE	2048x32768	3,45	532	CGH	Deep	496.4-806.3	700
Earth	Interfere-IV with WUT	TRUE	2048x32768	3,45	532	CGH	Deep	706-752	700
CornellBox3_16K	Interfere-V	FALSE	32768x16384	2	633	CGH	Medium	220-286.15	Inf
CornellBox4_16K	Interfere-V	FALSE	32768x16384	2	633	CGH	Medium	220-286.15	Inf
DeepChess	Interfere-IV with WUT	TRUE	2048x32768	3,45	532	CGH	Deep	396.4-1606.3	998,6
DeepCornellBox_16K	Interfere-V	FALSE	32768x16384	2	633	CGH	Medium	209.0 - 532.0	Inf
DeepDices2k	b-com	FALSE	4096x2048	4,8	640; 532; 473	CGH	Deep	5.07-246	Inf
DeepDices8k4K	b-com	FALSE	15360x4320	4,8	640; 532; 473	CGH	Deep	10.1- 492	Inf
DeepDices16k	b-com	FALSE	32768x16384	0,4	640; 532; 473	CGH	Deep	3.38-45.9	Inf
Dices4k	b-com	FALSE	8192x4096	0,4	640; 532; 473	CGH	Deep	1.64-3.28	Inf
Dices8k	b-com	FALSE	16384x8192	0,4	640; 532; 473	CGH	Deep	3.29-6.55	Inf
Dices16k	b-com	FALSE	32768×16384	0,4	640; 532; 473	CGH	Deep	6.58-13.1	Inf
DiffuseCar16k	b-com	FALSE	32768×16384	0,4	640; 532; 473	CGH	Deep	4.4-10	Inf
Horse	EmergImg-HoloGrail	FALSE	1944x972	4,4	632,8	OCH	Deep	135-150	Inf
Sphere	Interfere-IV with WUT	TRUE	2048x32768	3,45	532,8	OCH	Medium	960	960
Squirrel	Interfere-IV with WUT	TRUE	1792x55808	3,45	632,8	OCH	Deep	465-535	500
Warsaw Mermaid (OnAxis)	WUT	TRUE	2010x39588	3,45	632,8	OCH	Medium	340-355	350
Wolf	Interfere-IV with WUT	FALSE	2048x32768	3,45	532,8	OCH	Deep	740-820	780
Piano16k	b-com	FALSE	32768×16384	0,4	640; 532; 473	CGH	Deep	6.8-12.5	Inf
Ring16k	b-com	FALSE	32768×16384	0,4	640; 532; 473	CGH	Deep	44475	Inf
SpecularCar16k	b-com	FALSE	32768×16384	0,4	640; 532; 473	CGH	Deep	4.4-10	Inf
Lowiczanka Doll (OnAxis)	WUT	TRUE	2016x59394	3,45	637; 532; 457	OCH	Medium	1030-1075	1060

Binarization and reconstruction pipelines

Content preparation (Fresnel DHs)

Binarization pipeline(s)

Original DH

- Given: Complex valued DH in spatial/hologram plane

DH*

- FT
- Vertical symmetric zero-padding to double size in Fourier domain
- Inverse FT
- Vertical FoV/2 off-axis PW reference wave modulation in spatial/hologram plane

Binary DH

1, if real(H)>=0
0, otherwise

Reconstruction of bin. DH

Reconstructed DH*

- Vertical FoV/2 off-axis PW reference wave demodulation
- FT
- Vertical FoV/2 BW limitation (Filtering of conj. image + DC) by deleting half of Fourier domain
- Inverse FT
- Regular back-propagation

Binary DH

FT.. Fourier transform
BW.. Bandwidth
PW.. Plane wave
DC.. Direct current/mean

Content preparation (Fourier DHs)

Binarization pipeline(s)

Org. DH

- Given: Complex valued DH in Fourier domain = hologram plane

DH*

- FT
- Horizontal symmetric zero-padding to double size in spatial domain
- Inverse FT
- Horizontal FoV/2 off-axis PW reference wave modulation in Fourier/hologram plane

Bin. DH

1, if real(H)>=0
0, otherwise

Reconstruction of bin. DH

Bin. DH

Reconstructed DH*

- Horizontal FoV/2 off-axis PW reference wave demodulation
- FT
- Horizontal FoV/2 BW limitation (Filtering of conj. image + DC) by deleting half of Spatial domain
- Inverse FT
- Regular back-propagation

FT.. Fourier transform
BW.. Bandwidth
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Reconstruction (in practice)

Reconstruction can be performed using the Matlab implementation of NRSH 6.0 or later. An example is stated below.

```
dat = load('Astronaut_Hol_v2_binX2.mat’);
if(dat.isX2 == 1), disp(‘Doubled pixelcount’), end
z = -0.172
aperture = size(dat.Hbin) .* [0.5, 1];
xpos = 0; hpos = 0;

% Reconstruction using same clipping thresholds (cmin, cmax) and carrying same L2-energy (dat.refFroNorm) as complex-valued pendants
% If cmin, cmax are given from reconstruction of complex-valued DH
rec = nrsh(dat.Hbin, ‘emergimg’, ‘emergimg/astronaut_000.txt’, z, {aperture}, xpos, ypos, cmin, cmax, ‘’, dat.refFroNorm);

% Otherwise, the following is sufficient:
rec = nrsh(dat.Hbin, ‘emergimg’, ‘emergimg/astronaut_000.txt’, z, {aperture}, xpos, ypos, [], [], ‘’);
```