Peer Review File

Decimeter-depth and polarization addressable color 3D meta-holography

REVIEWER COMMENTS

Reviewer #1 (Remarks to the Author):

The manuscript introduces multifunctional metasurface that can realize two independent full-color 3D holography under different handedness of incident light. It is important to push the limitation of multiplexing metasurface since the one critical bottleneck of the metasurface is its passive nature. The proposed approach for addressing the challenge is novel. Overall, I find this work intriguing and meaningful, and I think it might be published in Nature Communications. However, for its publication in Nature Communications, it needs to undergo a major revision. The detailed comments on this work are below.

1. The current implementation of the hologram only addresses two different depths, so it is unclear whether it truly qualifies as a 3D hologram. Is it possible to encode a more densely varied range of holograms in different z-spaces? Typical 3D meta-holography is described in the following papers.
Doi: 10.1038/ncomms3808
Doi: 10.1002/adma.202208520

2. Currently, the four holograms are placed in two different z-spaces and two different handedness, which seems insufficient to claim high capacity. It would be beneficial to compare with other high capacity papers and include those references in this paper.
Doi: 10.1002/adma.202311785
Doi: 10.1126/science.ade5140
Doi: 10.1021/acsnano.1c10100

3. What are the differences between designing a Fresnel hologram to display at 5 mm and 70 mm, combining the phases, and the method presented in this paper? If there are unique advantages to this method, clearly expressing them would help emphasize the novelty.

4. Why is there significant crosstalk despite the large depth difference of 67 mm between the holograms?

5. The quality of the hologram displayed at a depth of 3 mm appears to be good, but the image quality of the hologram displayed at a depth of 70 mm does not seem to be as good. An analysis of this issue is needed.

6. The authors claim full color holography, but typical full color holography involves displaying independent holograms for each of the RGB channels. If the RGB channels can be displayed on the same plane, it is meaningful, but is this the case in this paper? (i.e., is there no chromatic aberration?) If so, it is necessary to precisely analyze whether the RGB holograms converge on the same plane. Based on the current data, it appears that there is some aberration, but the gap between the RGB holograms at 3 mm depth is not wide, and the holographic images seem to converge near that point. The authors should observe the 70 mm hologram by simultaneously projecting lasers of the three RGB wavelengths, similar to figure 5d. If there is chromatic aberration, it will be more pronounced at 70 mm depth, making it difficult to achieve high-quality white holograms.

7. A detailed explanation is needed on what basis the 96-degree viewing angle was achieved. It is important to clarify whether this is the maximum viewing angle possible with the given period or if the authors actually implemented it. Since metasurfaces typically have a period of around 300-400 nm, if it is the former, it does not enhance the novelty of the paper. However, if the authors conducted actual experiments on the wide viewing angle, it could be significant.

8. The commercialization potential of metasurfaces is very important. Including the manufacturing approaches for metasurface commercialization in the paper would help readers understand how this technology can be practically used.
Doi: 10.1038/s41563-023-01485-5
Doi: 10.1038/s43016-024-00957-4
Doi: 10.1038/s41377-023-01086-6
Doi: 10.1038/s41378-024-00681-w
Doi: 10.1016/j.mattod.2024.01.010
Doi: 10.1002/lpor.202300929

Reviewer #2 (Remarks to the Author):

In order to satisfy the need of large depth 3D holography in the field of optical information storage and medical diagnosis, the manuscript “Decimeter-depth and polarization addressable full color 3D meta-holography” proposes the new method. The authors combine the angular spectrum diffraction theory with the metasurface. The metasurface is utilized to record the complex amplitude information of the object and the whole information for the RCP and LCP incident light is recorded on the metasurface. Therefore, the polarization multiplexing meta-hologram can be realized. In addition, they increase the reconstruction depth based on reducing aliasing, the experiment results show the effectiveness of the proposed method. They also achieve the chromatic aberration-free holography, which is significant to the display and virtual reality.
1. In the first paragraph of the introduction, the author introduce the significance of the holography and the limitations of the holography based on the SLM and DMD, but the introduction of the significance of the large-depth holography is suggested to be added. And I also suggest that several sentences indicating the application fields of the large-depth holography be added to the introduction to demonstrate the value of the research.
2. The Figure 1 indicates the concept of the proposed 3D meta-holography, but there is a mistake in the figure. The positions of “LCP” and “RCP” need to be reversed, because the LCP light means that when observing light along the direction of the observer, the polarization direction of the light is counterclockwise and the RCP light means that when observing light along the direction of the observer, the polarization direction of the light is clockwise.
3. In the paragraph 2 of the page 4(paragraph 2 of the chapter “Structure of the metasurface”), the authors introduce the pixel spacing of the proposed method of 3D holography, but when the previous method is mentioned, “in previous work on polarization multiplexing holograms,” the related references need to be added to the manuscript to illustrate the advantage of your choice of pixel spacing.
4. In the Eq. (1), the A0(fx, fy; 0) is used to represent the spatial spectrum of the object, but according to the Figure 2, there are two objects and the distance between them is d. Therefore, I

would like to ask whether it is appropriate to use “0” to represent the axial coordinate.
5. In the paragraph 1 of the page 6, the “A0(fx, fy; 0) and A(fx, fy; 0)” should be corrected to “A0(fx, fy; 0) and A(fx, fy; z)”, because the “A(fx, fy; z)” represents the spatial spectrum of the holographic plane, and the axial coordinate is z.
6. The paragraph 3 of the page 12 indicates the advantage of the proposed algorithm, but the paragraph only introduces the depths of the two objects, lacking the introduction of the diffraction distance of the reconstruction. And the Figure 5(a) also does not contain the related information. Therefore, the information should be added.
7. When introducing the color meta-holography(paragraph 4 of the page 12), the manuscript does not provide the wavelength information, so the wavelengths are suggested to added in the Figure 6 to illustrate the performance of the aberration-free holography.
8. When the polarization holography is introduced in the introduction, some related references should be included, for example: (i) Nano Letters 17 (1), 445–452 (2017), (ii) Nano Letters 15(5), 3122-3127 (2015), (iii) Nano Letters 14 (1), 225-230 (2014).

The co-authors and I would like to express our gratitude to the reviewers for their careful reading and valuable comments about our manuscript "***Decimeter-depth and polarization addressable color 3D meta-holography***". Based on these comments and suggestions, we have made careful modifications to the original manuscript. We have fully addressed the issues raised by reviewers in the revised manuscript. The manuscript has been significantly improved, and we believe it meets the stringent requirements of Nature Communications.

As detailed below, we have revised our manuscript in response to the reviewers' comments. The original referee comments are shown in black color, whereas for ease of communication, our answers are provided in blue. Our revisions have also been marked in the main text and supplementary information files in blue.

Reviewer#1

The manuscript introduces multifunctional metasurface that can realize two independent full-color 3D holography under different handedness of incident light. It is important to push the limitation of multiplexing metasurface since the one critical bottleneck of the metasurface is its passive nature. The proposed approach for addressing the challenge is novel. Overall, I find this work intriguing and meaningful, and I think it might be published in Nature Communications. However, for its publication in Nature Communications, it needs to undergo a major revision. The detailed comments on this work are below.

Response: We sincerely thank the reviewer for the constructive and valuable feedback, which helps us further strengthen our manuscript.

1. The current implementation of the hologram only addresses two different depths, so it is unclear whether it truly qualifies as a 3D hologram. Is it possible to encode a more densely varied range of holograms in different z-spaces? Typical 3D meta-holography is described in the following papers.

Doi: 10.1038/ncomms3808

Doi: 10.1002/adma.202208520

Response: We thank the reviewer for the valuable suggestions, which are very helpful to us. Indeed, by using the proposed meta-hologram algorithm, more dense holograms with different ranges can be encoded in different z-spaces. In the original supplementary material, the reconstruction results of complex objects in four different depths were verified by simulation. To verify the advantages of the proposed method in 3D reconstruction more intuitively, nine objects located in different depths are simulated, and the polarization states are set accordingly. As shown in Fig. A (Fig. 6 in the revised manuscript), when LCP light is the incident light, the nine numbers "123456789" are reconstructed at nine different depths respectively. When RCP light is the incident light, the nine letters "ABCDEFGHI" are reconstructed at nine different depths respectively. The simulation results verify the feasibility of the proposed method in coding more dense holograms. The above-mentioned two relevant papers are about typical 3D meta-holography, and we have added them to the references. The new results and discussions have been added in the supplementary in the revised manuscript according to the reviewer's suggestions. (Please see Ref. [33], Ref. [35], Fig. 6, the paragraphs above Fig. 6)

Figure A. 3D meta-holographic reconstruction results in different z-spaces. **a** Reconstructed images at nine different depths under LCP irradiation. **b** Reconstructed images at nine different depths under RCP irradiation.

2. Currently, the four holograms are placed in two different z-spaces and two different handedness, which seems insufficient to claim high capacity. It would be beneficial to

compare with other high capacity papers and include those references in this paper.

Doi: 10.1002/adma.202311785

Doi: 10.1126/science.ade5140

Doi: 10.1021/acsnano.1c10100

Response: Thanks for the reviewer's valuable suggestions. 3D meta-holography with large depth and polarization function can increase the spatial information capacity in a new dimension, which has great application potential in the fields such as storage and encryption. In the original manuscript, we set two holograms to different polarization states, and each hologram contains letters located in two different depths for 3D reconstruction. In fact, for each polarization hologram, the depth plane it contains can be adjusted, and we can encode denser holograms in different z-spaces. The proposed method can realize multi-level reconstruction in a large depth range of 0.95 dm. As shown in Fig. 6 in the revised manuscript, nine objects with different depths are simulated and reproduced, and the results verify the feasibility of the proposed method.

In addition, we are very grateful to the reviewer for recommending the papers, and we also pay attention to these papers on high-capacity holography. The first reference (10.1002/adma.202311785) realizes dynamic hyperspectral holography with high information capacity by integrating the inverse-designed metasurface with oblique helicoidal cholesteric liquid crystal. This inverse-designed method can encode ten independent holographic images with different wavelengths by single-phase mapping. The second reference (10.1126/science.ade5140) skillfully introduces engineered noise into the precise solution of Jones matrix elements, breaking the fundamental limitation of polarization multiplexing capacity of metasurfaces constrained by Jones matrix dimensions. The results show eleven independent holographic images reconstructed with different polarizations. The third reference (10.1021/acsnano.1c10100) proposes a SiNx-based optical encryption platform through dual-band holograms, in which the dual-band hologram operates as a vectoral hologram using multiple individual polarization channels in the UV range and as an independent hologram in the visible range.

The above three references significantly expand the information capacity by using the tunable or polarization multiplexing metasufaces, showing high development potential. Different from the above references, a 3D meta-holography based on angular spectrum diffraction theory is developed in our proposed method to break through the depth limitation. Combined with the proposed meta-hologram algorithm, denser holograms with different ranges can be encoded in different z-spaces, and the depth is extended to decimeter level. The proposed algorithm is unique, which realizes large depth reconstruction without sacrificing information in other dimensions such as polarization or wavelength. The used metasurface structure is amorphous silicon based on geometric phase control. Our proposed method extends the angular spectrum diffraction theory to meta-holography, and uses the metasurface structure with independent polarization control to generate polarization-multiplexed 3D meta-hologram, thus realizing large-depth meta-holographic reconstruction in different polarization states. The diffraction idea and generation method of meta-hologram proposed in the manuscript are different from the above references, and the structure of the fabricated metasurface is also different. We are very grateful for the valuable suggestions. We also plan to combine the proposed method with the interesting metasurface structure in above references in our future experiment. These discussions have been added in the revised manuscript according to the reviewer's suggestions, Fig. 6 and the paragraphs above Fig. 6. The suggested references have been added to the revised manuscript as [36]-[38].

3. What are the differences between designing a Fresnel hologram to display at 5 mm and 70 mm, combining the phases, and the method presented in this paper? If there are unique advantages to this method, clearly expressing them would help emphasize the novelty.

Response: We thank the reviewer for the thoughtful suggestions. The difference between the proposed method and Fresnel method is as follows: Firstly, for the conventional Fresnel method, when the complex amplitude information is directly converted into pure phase information, conversion errors may occur. The proposed method compensates the conversion errors by error diffusion algorithm, instead of directly extracting the phase from the complex amplitude information of the 3D object. This approach optimizes the problem of uneven distribution of internal light field in meta-holographic 3D reconstruction. To compare the results better, we locally enlarge the results of the reconstructed images, as shown in the blue boxed areas in Fig. B (Fig. 5a in the revised manuscript), which shows significantly improved quality. Secondly, the under-sampling operation of meta-hologram in the discrete sampling process using the conventional Fresnel method will loss information, which will lead to spectrum aliasing and seriously affect the reconstructed light field of large-depth meta-holography. In the proposed method, we analyze the mechanism of spectrum aliasing and realize meta-holographic 3D reconstruction with ultra-large depth by constraining the frequency domain of the transfer function. As shown in the green box area in Fig. B, with the increase of reconstruction depth, the meta-holographic reconstruction image using the Fresnel method rapidly produces stray light in the central region of the letter “U”, which seriously affects the meta-holographic reconstruction quality at large depth. In contrast, the corresponding region of the meta-holographic images using the proposed method is almost unaffected by the reconstruction distance. The above unique advantages have been updated in the revised manuscript in Fig. 5 and the discussion has been added to the paragraph above Fig. 5, as suggested.

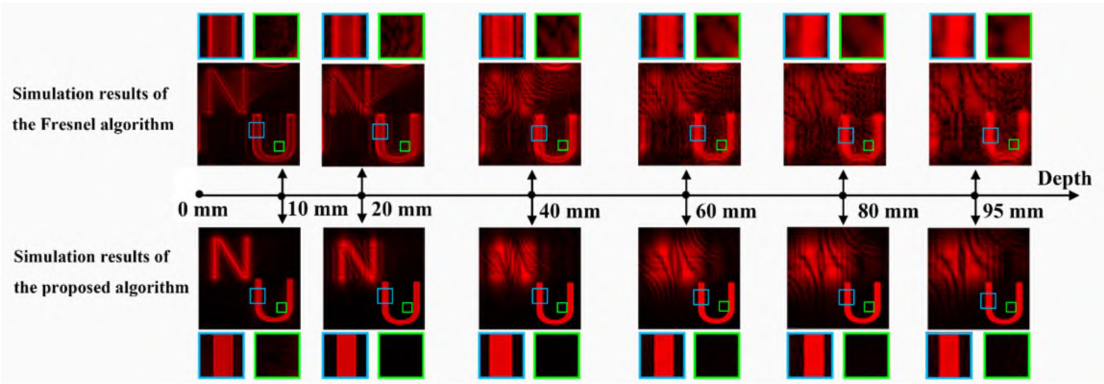

Figure B Large depth simulation results of the meta-hologram.

4. Why is there significant crosstalk despite the large depth difference of 67 mm between the holograms?

Response: We thank the reviewer for the valuable and professional suggestion. The crosstalk in the experiment is mainly due to the 3D algorithm itself. The hologram generated by our proposed method contains all the information of the 3D object at each point, which is different from the calculation method of the 2D multi-object holograms. Although the 3D blurred image at the defocus plane is reflected in the form of crosstalk, it is also a part of the 3D object. Tomographic algorithm including Fresnel algorithm and angular spectrum algorithm is a plane-to-plane diffraction propagation calculation method. In holographic reconstruction, the light field along the z-axis near the target reconstruction depth can be regarded as the target reconstruction field with added additional phase factor. Therefore, the out-of-focus blurred light field of the object can still be captured in a long distance, which leads to the problem of crosstalk. It can also be seen from the simulation results that with the increase of the depth of the letter “U”, the letter “N” will become more and more blurred, but its blurred diffraction image still exists, thus contributing to the crosstalk.

Currently, the most direct way to solve the crosstalk problem is to superimpose an additional diffraction phase during the meta-hologram generation, and once it is correctly focused at the target depth, the holographic diffraction filed is allowed to diffract quickly later. However, this algorithm may need to make a trade-off between high quality and large depth reconstruction. In future, we will further study this approach to find a solution to eliminate crosstalk and achieve natural and realistic in-focus and out-of-focus effects without damaging the quality of holographic reconstruction images. The above discussion has been added in Supplementary material S3.

5. The quality of the hologram displayed at a depth of 3 mm appears to be good, but the image quality of the hologram displayed at a depth of 70 mm does not seem to be as good. An analysis of this issue is needed.

Response: We appreciate the reviewer's thoughtful inquiries. The reasons for the differences in the image quality are analyzed as follows: in optical experiments, in order to observe and capture the reconstructed images conveniently, it is necessary to amplify the reconstructed light field through a microscope objective (see the description in the experimental section for the detailed model). When the reconstructed image is obtained at a depth of 3 mm, the metasurface is located near the working distance of the microscope objective. In this case, most of the energy of the holographic diffraction light field modulated by the metasurface can be efficiently received by the microscope objective, resulting in the quality of the holographic image displayed at a depth of 3 mm being close to the simulation result. However, when the reconstructed image is obtained at a depth of 70 mm, the metasurface is positioned 70 mm away from the working distance of the microscope objective. In this case, only a small part of holographic diffraction light field modulated by the metasurface can be efficiently received by the microscope objective, thus significantly affecting the imaging quality. Therefore, the quality of the holographic image displayed at a depth of 70 mm is not as good as the ones at 3 mm. However, this is only the difference introduced during the optical reconstruction, it is not the intrinsic limitation of the approach. The simulation results presented in the manuscript demonstrate the high-quality reconstruction capability of the proposed method at a large-depth range, as shown in Fig. 5a and Fig. 6. We have added these discussions in the revised manuscript according to the reviewer's suggestions. (Please see the paragraph above Fig. 4)

6. The authors claim full color holography, but typical full color holography involves displaying independent holograms for each of the RGB channels. If the RGB channels can be displayed on the same plane, it is meaningful, but is this the case in this paper? (i.e., is there no chromatic aberration?) If so, it is necessary to precisely analyze whether the RGB holograms converge on the same plane. Based on the current data, it appears that there is some aberration, but the gap between the RGB holograms at 3 mm depth is not wide, and the holographic images seem to converge near that point. The authors should observe the 70 mm hologram by simultaneously projecting lasers of the three RGB wavelengths, similar to figure 5d. If there is chromatic aberration, it will be more pronounced at 70 mm depth, making it difficult to achieve high-quality white holograms.

Response: We are very grateful for the reviewer's valuable suggestions. The meta-hologram based on the angular spectrum diffraction can handle positional chromatic aberration and magnification chromatic aberration in holographic reconstruction. However, there is a challenge for it to handle axial chromatic aberration. When the meta-hologram is irradiated with mismatched wavelengths laser, the axial displacement is directly proportional to the reconstruction distance and also depends on the wavelengths. When the meta-hologram is illuminated by RGB composite light sources, the gap between the RGB holographic images with a depth of 3 mm is negligible, and white light holographic reconstruction result can be obtained at this position. However, the gap between RGB holographic images with a depth of 70 mm becomes significant, which makes it challenging to achieve high-quality white light holographic reconstruction. Therefore, the proposed algorithm can only realize white holographic reconstruction at a close range at the moment.

The introduction of RGB color reconstruction results in the manuscript aims to prove that the designed metasurface shows good diffraction efficiency in all three RGB wavelength bands without magnification color difference and position color difference. In the supplementary materials of the revised manuscript, we have also added the color difference verification results of 70 mm depth, as shown in Fig. C (Fig. S4 in the supplementary material). In our future work, we have planned to code three independent holograms to compensate the chromatic aberration in advance. But this is beyond the scope of the current work. We have clarified the color difference, changed 'full color' to 'color' in the revised manuscript, and supplemented these discussions according to the suggestions. (Please see the paragraph below Fig. 5 and Supplementary material S4)

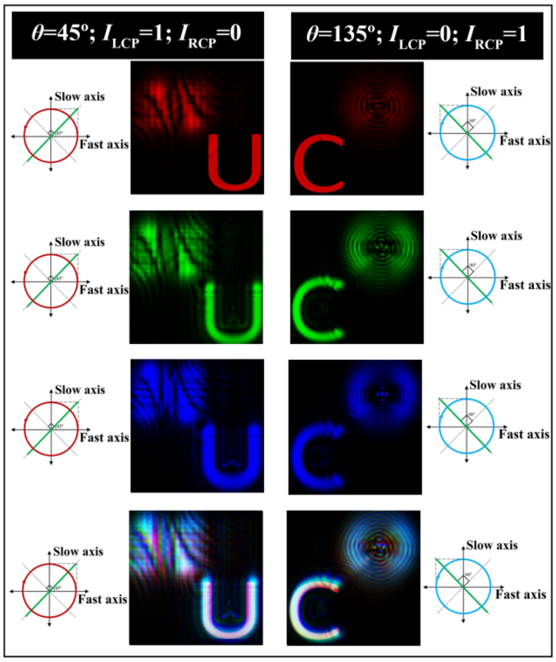

Figure C Simulation results of the meta-hologram at 70 mm depth.

7. A detailed explanation is needed on what basis the 96-degree viewing angle was achieved. It is important to clarify whether this is the maximum viewing angle possible with the given period or if the authors actually implemented it. Since metasurfaces typically have a period of around 300-400 nm, if it is the former, it does not enhance the novelty of the paper. However, if the authors conducted actual experiments on the wide viewing angle, it could be significant.

Response: Thanks for the reviewer's valuable suggestions. As suggested, we refer to the existing references (such as 10.1038/nnano.2015.2]) and use the following equation to calculate the viewing angle, as shown in Eq. (A1):

, (A1)

where θ represents the viewing angle, λ represents the wavelength of the incident light, and p represents the pixel spacing. This viewing angle is a theoretical value calculated based on the pixel spacing of the metasurface. In the preparation of this size of metasurface structure, the process has been explored for many years, and finally the metasurface with the pixel spacing of 300 nm in our method is processed. The large viewing angle is one of the advantages of our metasurface and is not the main argument of the current paper. According the reviewer's suggestions, we have deleted the emphasis on the advantages of viewing angle.

8. The commercialization potential of metasurfaces is very important. Including the manufacturing approaches for metasurface commercialization in the paper would help readers understand how this technology can be practically used.

Doi: 10.1038/s41563-023-01485-5

Doi: 10.1038/s43016-024-00957-4

Doi: 10.1038/s41377-023-01086-6

Doi: 10.1038/s41378-024-00681-w

Doi: 10.1016/j.mattod.2024.01.010

Doi: 10.1002/lpor.202300929

Response: Thanks for the reviewer's valuable suggestion. We agree the commercialization potential of metasurface is critical. We have further reviewed the commercial manufacturing approaches of metasurface, and the suggested relevant references have been added in the revised manuscript according to the suggestions. (Please see Refs. [20]-[25])

Reviewer#2

In order to satisfy the need of large depth 3D holography in the field of optical information storage and medical diagnosis, the manuscript "Decimeter-depth and polarization addressable full color 3D meta-holography" proposes the new method. The authors combine the angular spectrum diffraction theory with the metasurface. The metasurface is utilized to record the complex amplitude information of the object and the whole information for the RCP and LCP incident light is recorded on the metasurface. Therefore, the polarization multiplexing meta-hologram can be realized. In addition, they increase the reconstruction depth based on reducing aliasing, the experiment results show the effectiveness of the proposed method. They also achieve the chromatic aberration-free holography, which is significant to the display and virtual reality.

Response: We sincerely thank the reviewer for the constructive and valuable feedback, which helps us further strengthen our manuscript.

1. In the first paragraph of the introduction, the author introduce the significance of the holography and the limitations of the holography based on the SLM and DMD, but the introduction of the significance of the large-depth holography is suggested to

be added. And I also suggest that several sentences indicating the application fields of the large-depth holography be added to the introduction to demonstrate the value of the research.

Response: We thank the reviewer for the valuable suggestions. Large-depth holography can greatly improve the depth information of 3D reconstructed images. For example, when large-depth holography is applied to the display field, it can bring viewers a better sense of immersion and experience, and this shocking effect is expected to be further applied in virtual and augmented reality and other fields. Additionally, in the field of industrial inspection, the large-depth holography enables detailed information of 3D objects to be reconstructed in a large depth range, which is critical for the calibration of component details. These discussions have been added in the introduction according to the suggestions. (Please see the first paragraph of Section 1)

2. The Figure 1 indicates the concept of the proposed 3D meta-holography, but there is a mistake in the figure. The positions of "LCP" and "RCP" need to be reversed, because the LCP light means that when observing light along the direction of the observer, the polarization direction of the light is counterclockwise and the RCP light means that when observing light along the direction of the observer, the polarization direction of the light is clockwise.

Response: We thank the reviewer for the attention to details. As suggested, Fig. 1 has been corrected according to the suggestions. (Please see Fig. 1)

3. In the paragraph 2 of the page 4(paragraph 2 of the chapter "Structure of the metasurface"), the authors introduce the pixel spacing of the proposed method of 3D holography, but when the previous method is mentioned, "in previous work on polarization multiplexing holograms," the related references need to be added to the manuscript to illustrate the advantage of your choice of pixel spacing.

Response: We thank the reviewer for the valuable suggestions. The related references have been added in the revised manuscript. (Please see Refs. [42]-[43])

4. In the Eq. (1), the A0(fx, fy; 0) is used to represent the spatial spectrum of the object, but according to the Figure 2, there are two objects and the distance between them is d. Therefore, I would like to ask whether it is appropriate to use "0" to represent the axial coordinate.

Response: We thank the reviewer for the question. We agree the use of "0" to represent the axial coordinate may be confusing. We have revised the relevant contents in the original manuscript to make it more standardized and easier to understand according to the suggestions. The modification involves changing $A_0(f_x, f_y; 0)$ to $A_0(f_x, f_y; d_0)$, $T_0(f_x, f_y; 0)$ to $T_0(f_x, f_y; d_0)$, $T_1(f_x, f_y; 0)$ to $T_1(f_x, f_y; d_0)$ and $T_2(f_x, f_y; 0)$ to $T_2(f_x, f_y; d_0)$. (Please see Eqs. (1)-(6) and the paragraphs between them)

5. In the paragraph 1 of the page 6, the "A0(fx, fy; 0) and A(fx, fy; 0)" should be corrected to "A0(fx, fy; 0) and A(fx, fy; z)", because the "A(fx, fy; z)" represents the spatial spectrum of the holographic plane, and the axial coordinate is z.

Response: We thank the reviewer for the attention to details. As suggested, the manuscript has been revised according to the suggestions. (Please see the first paragraph of Page 6)

6. The paragraph 3 of the page 12 indicates the advantage of the proposed algorithm, but the paragraph only introduces the depths of the two objects, lacking the introduction of the diffraction distance of the reconstruction. And the Figure 5(a) also does not contain the related information. Therefore, the information should be added.

Response: Thanks for the valuable suggestions. In the experiment, the diffraction distance and reconstruction depth of the reconstructed image are the same. We have added this description in the revised manuscript according to the suggestions. (Please see the paragraph below Fig. 3)

7. When introducing the color meta-holography(paragraph 4 of the page 12), the manuscript does not provide the wavelength information, so the wavelengths are suggested to added in the Figure 6 to illustrate the performance of the aberration-free holography.

Response: Thanks for the valuable suggestions. The wavelengths have been added in the revised manuscript according to the suggestions. (Please see Fig. 5)

8. When the polarization holography is introduced in the introduction, some related references should be included, for example: (i) Nano Letters 17 (1), 445–452 (2017), (ii) Nano Letters 15(5), 3122-3127 (2015), (iii) Nano Letters 14 (1), 225-230 (2014).

Response: Thanks for the valuable suggestions. We have further reviewed the polarization holography and the suggested relevant references have been added in the revised manuscript according to the suggestions. (Please see Refs. [39]-[41])

To conclude, we sincerely thank the referees for their constructive comments and feedback, which helped us to further improve the quality and clarity of our manuscript.

We look forward to hearing back from you regarding our revised submission.

Sincerely yours,

Wei Lu, Bao-Hua Jia and Qiong-Hua Wang

REVIEWERS' COMMENTS

Reviewer #1 (Remarks to the Author):

The authors revised the manuscript reflecting all the queries and comments. The concerns are all cleared for me. I appreciate the efforts of the authors. Now I fully support its publication in Nature Communications.

Reviewer #2 (Remarks to the Author):

The revised manuscript “Decimeter-depth and polarization addressable color 3D meta-holography” has been revised to address my comments and has provided detailed answers to our questions. I recommend it for publication.