

Research data for

All-optical pattern recognition and image processing on a metamaterial beam splitter

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This research data description should be read and understood in the context of the corresponding manuscript. The figure numbers correspond to the figure numbers of the manuscript.

Image file: Fig1d-Metamaterial_SEM_image.tif

Description: Scanning electron microscope image showing part of the planar metamaterial. Grey corresponds to gold and black corresponds to apertures.
A cropped section of this image is shown in the manuscript.

Excel file: Fig1d-Metamaterial_Spectra.xlsx

Description: Reflection R, transmission T and absorption A spectra of the fabricated metasurface for illumination of its front and for illumination of its back.

Image files: Fig2....tif (17 files)

Description: Tif image files captured by the CCD camera for all cases corresponding to figure 2 of the manuscript. In all cases, the horizontal axis corresponds to the x-axis and the vertical axis corresponds to the y-axis. Each image corresponds to 164µm x 164µm on the metasurface sample plane.

The images show the planar metamaterial illuminated by beam A only (Fig2-TargetImage.tif), beam B only (Fig2-TestImage_x_Match.tif), and both beams A and B (Fig2-Similarities_x_Match.tif, Fig2-Differences_x_Match.tif), where “x_Match” in the filenames specifies the number of test image dots that match the target image (x = 0, 2, 4, 6, 8). Different relative phases of beams A and B correspond to constructive or destructive interference of matching dots of target and test images in the detected output beam.

In the manuscript, the background noise (Fig2-darkscan.tif) has been subtracted from the plotted images and the pixel count has been translated to the equivalent µm-scale on the sample plane (512 x 512 pixels, each being 16µm x 16µm in size on the CCD, demagnified 50x by the imaging optics) and is centered around and limited to the imposed profiles. Therefore, the areas shown in the manuscript span 20 µm x 20 µm on the metamaterial.

Excel file: Fig2b-PatternNormPower.xlsx

Description: The integrated total power per .tif image (Fig2-Similarities_x_Match.tif and Fig2-Differences_x_Match.tif) after background subtraction (Fig2-Darkscan.tif) is acquired by summing all pixels within the 20µm x 20µm region of interest. The power is normalized over 4x the integrated total power of the target image (Fig2-TargetImage.tif).

Image files: Fig3a....tif (14 files)

Description: Tif image files captured by the CCD camera for all cases corresponding to figure 3 of the manuscript. In all cases, the horizontal axis corresponds to the x-axis and the vertical axis corresponds to the y-axis. Each image corresponds to $164\mu\text{m} \times 164\mu\text{m}$ on the metasurface sample plane.

The images show the planar metamaterial illuminated by beam A only (Fig3a-ReferenceImage.tif), beam B only (Fig3a-TestImage_xxxx.tif), and both beams A and B (Fig3a-StableIceCover_xxxx.tif, Fig3a-ChangedIceCover_xxxx.tif), where years xxxx in filenames specify the year during which the test image was recorded. The test images are compared to the reference image recorded in 1982. Different relative phases of beams A and B correspond to constructive or destructive interference of matching transparent areas (ice cover) of reference and test images in the detected output beam.

In the manuscript, the background noise (Fig3a-Darkscan.tif) has been subtracted from the plotted images and the pixel count has been translated to the equivalent μm -scale on the sample plane (512×512 pixels, each being $16\mu\text{m} \times 16\mu\text{m}$ in size on the CCD, demagnified 50x by the imaging optics) and is centered around and limited to the imposed profiles. Therefore, the areas shown in the manuscript span $30\mu\text{m} \times 30\mu\text{m}$ on the metamaterial.

Excel file: Fig3b-ArcticNormPower.xlsx

Description: The integrated total power per .tif image (Fig3a-StableIceCover_xxxx.tif and Fig3a-ChangedIceCover_xxxx.tif) after background subtraction (Fig3a-Darkscan.tif) is acquired by summing all pixels within the $30\mu\text{m} \times 30\mu\text{m}$ region of interest. The power is normalized over 4x the integrated total power of the reference image (Fig3a-ReferenceImage.tif).