Claims

What is claimed is:

1. A structured illumination imaging system, comprising:

a light emitter to emit light;

a two-dimensional diffraction grating to diffract light emitted by the light emitter to project a first plurality of fringes oriented in a first direction on a sample plane and to project a second plurality of fringes oriented in a second direction, perpendicular to the first direction, on the sample plane; and

a spatial filter wheel to pass through diffracted light received from the two-dimensional diffraction grating in a respective one of the first or second directions and block light in a respective one of the first or second directions, the spatial filter wheel comprising a first plurality of apertures to pass through light diffracted by the two-dimensional diffraction grating in the first direction and a second plurality of apertures orthogonal to the first plurality of apertures to pass through light diffracted by the two-dimensional diffraction grating in the second direction.

2. The structured illumination imaging system of claim 1, further comprising: a beam blocking element to block 0th order light transmitted by the two-dimensional diffraction grating.

3. The structured illumination imaging system of claim 2, wherein the beam blocking element comprises a diffractive optical element patterned to reflect light normal to the element and pass through light at other angles.

4. The structured illumination imaging system of claim 1, wherein the spatial filter wheel is to reflect diffraction orders of light received from the two-dimensional diffraction grating that are not passed through.

5. The structured illumination imaging system of claim 1, wherein the two-dimensional diffraction grating is a transmissive diffraction grating.

6. The structured illumination imaging system of claim 5, further comprising: a solid optic, wherein the transmissive diffraction grating is disposed over or formed on a face of the solid optic that receives light from the light emitter.

7. The structured illumination imaging system of claim 6, wherein dispersion angles of the transmissive diffraction grating are arranged such that 0th order light is blocked on a far side of the solid optic.

8. The structured illumination imaging system of claim 7, wherein the solid optic comprises angled faces to diffract and output first orders of light diffracted by the two-dimensional transmissive diffraction grating.

9. The structured illumination imaging system of claim 8, wherein the angled faces comprise a focusing lens.

10. The structured illumination imaging system of claim 8, further comprising: a projection lens to receive light output by the solid optic.

11. The structured illumination imaging system of claim 1, wherein the two-dimensional diffraction grating is a two-dimensional reflective diffraction grating.

12. The structured illumination imaging system of claim 11, further comprising: a solid optic, wherein the two-dimensional reflective diffraction grating is formed on or disposed over a face of the solid optic opposite an aperture of the solid optic that receives light from the light emitter.

13. The structured illumination imaging system of claim 12, wherein the solid optic further comprises reflective internal faces to reflect and output first orders of light diffracted by the two-dimensional reflective diffraction grating through outlet faces of the solid optic.

14. The structured illumination imaging system of claim 13, wherein the outlet faces comprise a diffractive focusing lens.

15. The structured illumination imaging system of claim 13, further comprising: a projection lens to receive light output by the solid optic.

16. The structured illumination imaging system of claim 1, further comprising: one or more optical elements to phase shift the first plurality of fringes and the second plurality of fringes, wherein the one or more optical elements to phase shift the first plurality of fringes and the second plurality of fringes comprise a parallel plate optic tilted in two perpendicular directions.

17. A method for using a structured illumination imaging system, comprising:

turning on a light emitter of a structured illumination imaging system, the structured illumination imaging system comprising a two-dimensional diffraction grating;

receiving light emitted by the light emitter at the two-dimensional diffraction grating to output first diffracted light oriented in a first direction and second diffracted light oriented in a second direction perpendicular to the first direction;

passing the first diffracted light through a first plurality of apertures of a spatial filter wheel and blocking the second diffracted light at the spatial filter wheel;

projecting the first diffracted light passed through the first plurality of holes as a first plurality of fringes on a sample plane; and

capturing a first plurality of phase images of light emitted by the sample, wherein during capture of the first plurality of images, the first plurality of fringes are phase shifted on the sample plane.

18. The method of claim 17, further comprising:

rotating the spatial filter wheel such that it passes the second diffracted light through a second plurality of apertures of the spatial filter wheel and blocks the first diffracted light at the spatial filter wheel;

projecting the second diffracted light that passes through the second plurality of holes as a second plurality of fringes, orthogonal to the first plurality of fringes, on the sample plane; and

capturing a second plurality of phase images of light emitted by the sample, wherein during capture of the second plurality of images, the second plurality of fringes are phase shifted on the sample plane.

19. The method of claim 17, wherein the two-dimensional diffraction grating is a two-dimensional transmissive diffraction grating formed on a face of a solid optic, wherein the method further comprises:

blocking 0th order light output by the transmissive diffraction grating at a side of the solid optic opposite the transmissive diffraction grating; and

diffracting and outputting, from angled faces of the solid optic, first orders of light diffracted by the two-dimensional transmissive diffraction grating.

20. The method of claim 17, wherein the two-dimensional diffraction grating is a two-dimensional reflective diffraction grating formed on a face of a solid optic opposite an aperture of the solid optic that receives light from the light emitter, wherein the method further comprises:

reflecting, at faces of the solid optic, first orders of light diffracted by the two-dimensional reflective diffraction grating.