Claims

1. A method, comprising:
   capturing, at a structured illumination system, a first image of a sample at a first time, a first sample position, or a first sample temperature;
   estimating, at a computing device, using at least the captured first image, a first structured illumination parameter at the first time, the first sample position, or the first sample temperature;
   capturing, at the structured illumination system, a second image of the sample at a second time, a second sample position, or a second sample temperature;
   estimating, at the computing device, using at least the captured second image, a second structured illumination parameter at the second time, the second sample position, or the second sample temperature; and
   predicting, at the computing device, using at least the first structured illumination parameter or the second structured illumination parameter, a third structured illumination parameter at a third time, a third sample position, or a third sample temperature, the third structured illumination parameter corresponding to a third image captured at the third time, the third sample position, or the third sample temperature, wherein each of the first, second, and third structured illumination parameters comprises a phase, frequency, orientation, or modulation order.

2. The method of claim 1, wherein the first image is captured at the first time, wherein the second image is captured at the second time, wherein the second time is after the first time, wherein the third image is captured at the third time, wherein the third time is between the first time and the second time, and wherein predicting the third structured illumination parameter comprises: predicting, using at least an interpolation method, the third structured illumination parameter at the third time.

3. The method of claim 2, wherein the interpolation method comprises:
   determining, at the computing device, a rate of change from the first structured illumination parameter at the first time to the second structured illumination at the second time; and
   predicting, at the computing device, using at least the determined rate of change, the third structured illumination parameter at the third time.

4. The method of claim 1, further comprising: constructing, at the computing device, using at least the third image and the third structured illumination parameter, a high resolution image.

5. The method of claim 1, wherein the first image is captured at the first time, wherein the second image is captured at the second time, wherein the second time is after the first time, wherein the third image is captured at a third time, wherein the third time is after or before both the first time and the second time, wherein predicting the third structured illumination parameter comprises: predicting, using at least an extrapolation method, the third structured illumination parameter at the third time.

6. The method of claim 5, further comprising: adjusting, using at least the third structured illumination parameter, a hardware component of the structured illumination system to compensate for changes in a structured illumination parameter prior to capturing the third image at the third time.

7. The method of claim 6, wherein adjusting the hardware component comprises: adjusting one or more of: a rotating mirror to adjust a phase or orientation of a structured illumination pattern, a translation stage carrying a diffraction grating to adjust a phase or orientation of a structured illumination pattern, and a sample translation stage to adjust a phase or orientation of a structured illumination pattern.

8. The method of claim 1, further comprising:

storing in a memory of the structured illumination system: the first structured illumination parameter, the second structured illumination parameter, and the third structured illumination parameter; and

reducing, using one or more of the stored first structured illumination, stored second structured illumination parameter, stored third structured illumination parameter, and a stored value based on the known physical characteristics of the structured illumination system, a search space for a fourth structured illumination parameter for a fourth image.

9. The method of claim 1, wherein predicting the third structured illumination parameter corresponding to the third image comprises: applying a least-squares fit to at least the first structured illumination parameter and the second structured illumination parameter.

10. The method of claim 1, wherein:

the first image of the sample is captured at the first sample temperature;

the first structured illumination parameter is estimated at the first sample temperature;

the second image of the sample is captured at the second sample temperature;

the second structured illumination parameter is estimated at the second sample temperature; and

the third structured illumination parameter is predicted at the third sample temperature.

11. The method of claim 1, further comprising:

dividing the first image of the sample into a plurality of image subsections;

estimating, at the computing device, using at least a first image subsection of the plurality of image subsections, a fourth structured illumination parameter;

estimating, at the computing device, using at least a second image subsection of the plurality of image subsections, a fifth structured illumination parameter;

predicting, at the computing device, using at least the fourth structured illumination parameter or the fifth structured illumination parameter, a sixth structured illumination parameter corresponding to a third image subsection of the plurality of image subsections.

12. The method of claim 1, further comprising:

dividing the first image of the sample into a plurality of image subsections;

estimating, at the computing device, using at least a first image subsection of the plurality of image subsections, a fourth structured illumination parameter;

using the estimated fourth structured illumination parameter as a predicted structured illumination parameter of a second image subsection of the plurality of image subsections.

13. A non-transitory computer-readable medium having executable instructions stored thereon that, when executed by a processor, cause the processor to perform operations of:

capturing, at a structured illumination system, a first image of a sample;

estimating, using at least the captured first image, a first structured illumination parameter;

capturing, at the structured illumination system, a second image of the sample;

estimating, using at least the captured second image, a second structured illumination parameter; and

predicting, using at least the first structured illumination parameter or the second structured illumination parameter, a third structured illumination parameter corresponding to a third image, wherein each of the first, second, and third structured illumination parameters comprises a phase, frequency, orientation, or modulation order.

14. The non-transitory computer-readable medium of claim 13, wherein the first image is captured at a first sample position, wherein the second image is captured at a second sample position, wherein the third image is captured at a third sample position between the first sample position and the second sample position, and wherein predicting the third structured illumination parameter comprises: predicting, using at least an interpolation method, the third structured illumination parameter at the third sample position.

15. The non-transitory computer-readable medium of claim 14, wherein the interpolation method comprises:

determining a rate of change from the first structured illumination parameter at the first sample position to the second structured illumination parameter at the second sample position; and

predicting, using at least the determined rate of change, the third structured illumination parameter at the third sample position.

16. The non-transitory computer-readable medium of claim 13, wherein the instructions when executed by the processor, cause the processor to further perform an operation of: constructing, using at least the third image and the third structured illumination parameter, a high resolution image.

17. The non-transitory computer-readable medium of claim 13, wherein the first image is captured at a first sample position, wherein the second image is captured at a second

sample position, wherein the third image is captured at a third sample position, wherein the third sample position is after or before the first sample position and the second sample position, wherein predicting the third structured illumination parameter, comprises: predicting, using at least an extrapolation method, the third structured illumination parameter at the third sample position.

18. The non-transitory computer-readable medium of claim 17, wherein the instructions when executed by the processor, cause the processor to further perform an operation of: adjusting, using at least the third structured illumination parameter, a hardware component of the structured illumination system to compensate for changes in a structured illumination parameter prior to capturing an image at the third sample position.

19. The non-transitory computer-readable medium of claim 18, wherein the adjusted hardware component comprises: a rotating mirror to adjust a phase or orientation of a structured illumination pattern, a translation stage carrying a diffraction grating to adjust a phase or orientation of a structured illumination pattern, or a sample translation stage to adjust a phase or orientation of a structured illumination pattern.

20. The non-transitory computer-readable medium of claim 13, wherein the instructions when executed by the processor, cause the processor to further perform operations of:

storing in a memory of the structured illumination system: the first structured illumination parameter, the second structured illumination parameter, and the third structured illumination parameter; and

reducing, using one or more of the stored first structured illumination, stored second structured illumination parameter, stored third structured illumination parameter, and a stored value based on the known physical characteristics of the structured illumination system, a search space for a fourth structured illumination parameter for a fourth image.

21. A structured illumination imaging system, comprising:

a light emitter to emit light;

a beam splitter to split light emitted by the light emitter to project a structured illumination pattern on a plane of a sample;

a processor; and

a non-transitory computer-readable medium having executable instructions stored thereon that, when executed by the processor, cause the processor to perform operations of:

capturing a first image of a sample;

estimating, using at least the captured first image, a first structured illumination parameter;

capturing a second image of the sample;

estimating, using at least the captured second image, a second structured illumination parameter; and

predicting, using at least the first structured illumination parameter or the second structured illumination parameter, a third structured illumination parameter

corresponding to a third image, wherein each of the first, second, and third structured illumination parameters comprises a phase, frequency, orientation, or modulation order.

22. A method, comprising:

capturing, at a structured illumination system, a first plurality of images of a sample;

estimating, at a computing device, using at least the captured first plurality of images, a first structured illumination parameter;

capturing, at the structured illumination system, a second plurality of images of the sample;

estimating, at the computing device, using at least the captured second plurality of images, a second structured illumination parameter; and

predicting, at the computing device, using at least the first structured illumination parameter or the second structured illumination parameter, a third structured illumination parameter corresponding to one or more images, wherein each of the first, second, and third structured illumination parameters comprises a phase, frequency, orientation, or modulation order.