CLAIMS

1. A method for phase-restoring translational shifting of a multidimensional optical coherence tomography (OCT) image, comprising:

obtaining, from an image source, a spectral signal corresponding to the multidimensional OCT image; and

at one or more processors:

computing a first shifted, complex-valued image by converting the spectral signal to a shifted spectral signal and transforming the shifted spectral signal along a first axis;

computing a spatial frequency component of the multidimensional OCT image by transforming the first shifted, complex-valued image along at least one further axis perpendicular to the first axis; and

producing a phase-restored image by converting the spatial frequency component of the multidimensional OCT image to a shifted spatial frequency spectrum and applying an inverse transform in each of the at least one further axis.

2. The method of claim 1, wherein the multidimensional OCT image is a cropped complex-valued OCT image and obtaining the spectral signal comprises zero-padding the cropped complex-valued OCT image to produce a full range complex-valued OCT image, and transforming the full range complex-valued OCT image to generate the spectral signal, the spectral signal being a complex-valued spectral signal.

3. The method of claim 2, wherein transforming the full range complex-valued OCT image to generate the complex-valued spectral signal comprises applying an inverse Fourier transform to the full range complex-valued OCT image along the axial direction.

4. The method of claim 1, wherein the multidimensional OCT image is a multidimensional complex-valued OCT image and obtaining the spectral signal comprises receiving, from the image source, a real-valued spectral

signal and, at the one or more processors, conducting a Hilbert transform on the real-valued spectral signal.

5. The method of any one of claims 1 to 4, wherein converting the spectral signal to a shifted spectral signal comprises performing pixel-wise multiplication of the spectral signal by an exponential term.

6. The method of claim 5, wherein the first axis is the z axis, and the exponential term is based on a discrete spectral component and a shift of the multidimensional OCT image along the z axis.

7. The method of claim 6, wherein the exponential term is expressed as:

$$\exp(2ik_n\Delta z)$$

where k_n is the discrete spectral component, Δz is a shift of the multidimensional OCT image along the z axis and *i* is an imaginary unit.

8. The method of any one of claims 1 to 4, wherein converting the spatial frequency component of the multidimensional OCT image to a shifted spatial frequency spectrum comprises performing point-wise multiplication of the spatial frequency component of the multidimensional OCT image by an exponential term.

9. The method of claim 8, wherein the exponential term is based on a spatial frequency of the multidimensional OCT image along each further axis and a shift of the multidimensional OCT image along each further axis.

10. The method of claim 9, wherein the multidimensional OCT image is a 2-dimensional image and the exponential term is expressed as:

$$\exp(-iu\Delta x)$$

where Δx is a shift of the multidimensional OCT image along a said further axis, being an x axis, *u* is the spatial frequency of the multidimensional OCT image along the said further axis and *i* is an imaginary unit.

11. The method of claim 9, wherein the multidimensional OCT image is a 3-dimensional image and the exponential term is expressed as:

$$\exp(-iu\Delta x) \cdot \exp(-iv\Delta y)$$

where Δx and Δy are shifts of the multidimensional OCT image along an x axis and a y axis, respectively, the y axis being perpendicular to the x axis, *u* and *v* are the spatial frequencies of the multidimensional OCT image along the x axis and y axis, respectively, and *i* is an imaginary unit.

12. The method of any one of claims 1 to 11, wherein transforming the shifted spectral signal with respect to the first axis comprises applying a 1-dimensional Fourier Transform in a *k* direction to obtain the first shifted, complex-valued image while removing components of the first shifted, complex-valued image having a negative frequency.

13. The method of any one of claims 1 to 10 and 12, wherein the multidimensional OCT image is a 2-dimensional image and:

transforming the first shifted, complex valued image along at least one further axis comprises applying a 1-dimensional Fourier Transform in one said further axis; and

applying an inverse transform in each further axis comprises applying a 1-dimensional inverse Fourier Transform in the one further axis.

14. The method of any one of claims 1 to 9, 11 and 12, wherein the multidimensional OCT image is a 3-dimensional image and:

transforming the first shifted, complex valued image along at least one further axis comprises applying a 2-dimensional Fourier Transform in an x axis and a y axis; and

applying an inverse transform in each further axis comprises applying a 2-dimensional inverse Fourier Transform in the x axis and y axis.

15. A method for imaging movement or deformation in Fourier-domain optical coherence tomography (OCT) comprising:

performing OCT to obtain a multidimensional OCT image; and

performing the method of any one of claims 1 to 14 on the multidimensional OCT image.

16. An image restoration system for phase-restoring translational shifting of a multidimensional optical coherence tomography (OCT) image, comprising:

memory; and

at least one processor, the memory storing instructions that, when executed by the at least one processor, cause the at least one processor to:

obtain, from an image source, a spectral signal corresponding to the multidimensional OCT image;

compute a first shifted, complex-valued image by converting the spectral signal to a shifted spectral signal and transforming the shifted spectral signal along a first axis;

compute a spatial frequency component of the multidimensional OCT image by transforming the first shifted, complex-valued image along at least one further axis perpendicular to the first axis; and

produce a phase-restored image by converting the spatial frequency component of the multidimensional OCT image to a shifted spatial frequency spectrum and applying an inverse transform in each of the at least one further axis.

17. The image restoration system of claim 16, being configured to perform the method of any one of claims 2 to 15.

18. A non-transitory computer-readable storage medium having stored thereon instructions that, when executed by one or more processors of a computer system, cause the computer system to perform the method of any one of claims 1 to 15.