Claims

1. A method of imaging comprising:

receiving a first signal from one or more array elements of a first type in a mixed transducer array;

receiving a second signal from one or more array elements of a second type in the mixed transducer array, wherein at least one of the first type and the second type is an optical sensor;

generating a first image from the first signal and a second image from the second signal; and

combining the first image and the second image to generate a compound image.

2. The method of claim 1, wherein the first type and the second type are optical resonators with different characteristics.

3. The method of claim 1, wherein the second type is a broad bandwidth optical sensor, and wherein the method further comprises receiving a third signal from one or more array elements of a third type, wherein the third type is an ultra-sensitive optical sensor.

4. The method of claim 1, wherein combining the first and second images comprises determining a weighted average of the first image and the second image.

5. The method of claim 4, further comprising determining one or more compounding coefficients for the first and second images and combining the first and second images based on the one or more compounding coefficients.

6. The method of claim 5, wherein determining one or more compounding coefficients for the first and second images comprises:

transforming the first and second images to first and second transform domain images using at least one transformation operator;

determining one or more transform domain compounding coefficients for the first and second transform domain images; and

inverse transforming the one or more transform domain compounding coefficients to determine the one or more compounding coefficients for the first and second images.

7. The method of claim 6, wherein determining one or more transform domain compounding coefficients for the first and second transform domain images comprises applying one or more coefficient compounding rules to the first and second transform domain images.

8. The method of claim 5, wherein determining one or more compounding coefficients for the first and second images comprises:

determining a first image quality factor map for the first image and a second image quality factor map for the second image; and

determining a first compounding coefficient for the first image based on the first image quality factor map, and a second compounding coefficient for the second image based on the second image quality factor map.

9. The method of claim 5, wherein determining one or more compounding coefficients for the first and second images comprises determining a local entropy of each pixel in the first image and in the second image, and determining one or more compounding coefficients based on the determined local entropies.

10. The method of claim 5, wherein determining one or more compounding coefficients for the first and second images comprises applying a linear filter to each of the first and second images.

11. The method of claim 5, wherein determining one or more compounding coefficients for the first and second images comprises determining one or more compounding coefficients as a function of imaging depth.

12. The method of claim 4, wherein determining a weighted average of the first image and the second image comprises applying a saturation mask that reduces weight of at least a portion of the first image and/or second image that has exceeded a predetermined saturation threshold.

13. The method of claim 1, wherein at least one of the first image and the second image is a harmonic image.

14. The method of claim 13, wherein the harmonic image is a sub-harmonic image or a super-harmonic image.

15. An apparatus for imaging a target comprising:
a mixed transducer array comprising:
one or more array elements of a first type configured to receive a first signal;
one or more array elements of a second type configured to receive a second signal, wherein at least one of the first type and the second type is an optical sensor; and
one or more processors configured to:
generate a first image from the first signal and a second image from the second signal; and
combine the first image and the second image to generate a compound image.

16. The apparatus of claim 15, wherein the first type and the second type are optical resonators with different characteristics.

17. The apparatus of claim 15, wherein the first type is a non-optical transducer and the second type is an optical sensor.

18. The apparatus of claim 17, wherein the non-optical transducer is a piezoelectric transducer, a single crystal material transducer, a piezoelectric micromachined ultrasound transducer (PMUT), or a capacitive micromachined ultrasonic transducer (CMUT).

19. The apparatus of claim 17, wherein the second type is a broad bandwidth optical sensor, and wherein the mixed transducer array further comprises one or more array elements of a third type configured to receive a third signal, wherein the third type is an ultra-sensitive optical sensor.

20. The apparatus of claim 19, wherein the one or more processors are configured to filter the first signal, the second signal, and/or the third signal using one or more filters.

21. The apparatus of claim 20, wherein the one or more filters comprise a harmonic band-pass filter.