CLAIMS

1. An apparatus comprising:

one or more optical fibers;

one or more optical waveguides; and

a plurality of resonator nodes arranged in an array of sensing locations, each resonator node comprising an optical coupling between an optical waveguide and an optical fiber having a set of resonant frequencies at a respective sensing location,

wherein each resonator node is configured to communicate a set of signals corresponding to at least one shift in the set of resonant frequencies induced by ultrasound echoes in the optical fiber at the respective sensing location.

2. The apparatus of claim 1, wherein the one or more optical fibers comprise a plurality of optical fibers having the same or substantially similar cross-sectional geometry and material.

3. The apparatus of claim 1, wherein the one or more optical fibers are configured to:

receive a plurality of ultrasound echoes; and

experience the at least one shift in the set of resonant frequencies in response to the plurality of ultrasound echoes,

wherein the one or more optical waveguides are configured to propagate a set of signals corresponding to the at least one shift in the set of resonant frequencies to an optical detector.

4. The apparatus of claim 1, wherein the one or more optical waveguides comprise a tapered optical fiber or an integrated photonic waveguide.

5. The apparatus of claim 1, wherein the one or more optical fibers are in a polymer structure.

6. The apparatus of claim 1, wherein the one or more optical fibers and the one or more optical waveguides are in a polymer structure.

7. The apparatus of claim 1, wherein the one or more optical fibers are perpendicular to the one or more optical waveguides.

8. The apparatus of claim 1, wherein at one or more of the plurality of resonator nodes, the optical waveguide and the optical fiber are in physical contact.

9. The apparatus of claim 1, wherein at one or more of the plurality of resonator nodes, the optical waveguide and the optical fiber are offset by a separation gap.

~~10. The apparatus of claim 1, wherein each of the one or more optical waveguides are coupled to a light source such that the one or more optical waveguides propagate light from the light source.~~

~~11~~10. The apparatus of claim 9, wherein the one or more optical waveguides comprise a plurality of optical fibers arranged in parallel, and wherein the plurality of optical fibers are spaced apart by a distance at least about 5 times the wavelength of the light.

~~12~~11. The apparatus of claim 9, wherein the one or more optical fibers comprise a plurality of optical fibers arranged in parallel, and wherein the plurality of optical fibers are spaced apart by a distance less than about 3 times the wavelength of the light.

~~13~~12. A method of ultrasound sensing comprising:

receiving at one or more optical waveguides, via a plurality of resonator nodes, a first set of signals corresponding to a first set of whispering gallery modes propagating along the circumference of one or more optical fibers;

receiving at the one or more optical waveguides, via the plurality of resonator nodes, a second set of signals corresponding to a second set of whispering gallery modes propagating along the circumference of the one or more optical fibers, the second set of whispering gallery modes propagating in response to the one or more optical fibers receiving a plurality of ultrasound echoes; and

detecting a set of differences between the first set of signals and the second set of signals.

~~14~~13. The method of claim ~~13~~12, wherein the one or more optical fibers comprise a plurality of optical fibers having the same or substantially similar cross-sectional geometry and material.

~~15~~14. The method of claim ~~13~~12, further comprising

calculating a magnitude of each ultrasound echo at each resonator node based at least in part on the set of differences between the first set of signals and the second set of signals; and

associating the magnitude of each ultrasound echo to a sensing location of each resonator node.

~~16~~15. The method of claim ~~13~~12, the one or more optical waveguides configured to propagate at least one of the first set of signals and the second set of signals to an optical detector.

~~17~~16. The method of claim ~~13~~12, further comprising:

transmitting a plurality of ultrasound signals to a target; and

receiving the plurality of ultrasound echoes from the target corresponding to the plurality of ultrasound signals at the one or more optical fibers, the one or more optical fibers configured to perform a synthetic aperture (SA) operation or a compressed sensing (CS) operation.

~~18~~17. The method of claim ~~13~~12, wherein the one or more optical waveguides comprise one or more tapered optical fibers or one or more integrated photonic waveguides.

~~19~~18. The method of claim ~~13~~12, wherein the one or more optical fibers are in a polymer structure.

~~20~~19. The method of claim ~~19~~18, wherein the one or more optical fibers and the one or more optical waveguides are in a polymer structure.

~~21~~20. The method of claim ~~13~~12, wherein each optical fiber is perpendicular to each optical waveguide.

~~22. The method of claim 13, wherein the one or more optical waveguides are coupled to a light source, and the light source propagates light in the one or more optical waveguides.~~

~~23~~21. The method of claim ~~13~~12, wherein at one or more of the plurality of resonator nodes, an optical waveguide and an optical fiber are in physical contact.

~~24~~22. The method of claim ~~13~~12, wherein at one or more of the plurality of resonator nodes, an optical waveguide and an optical fiber are offset by a separation gap.

~~25~~23. The method of claim ~~13~~12, wherein the one or more optical waveguides are aligned to the one or more optical fibers to excite the first set of whispering gallery modes or the second set of whispering gallery modes in the one or more optical fibers.

~~26~~24. An apparatus comprising:

one or more optical fibers, the circumference of each optical fiber configured to propagate a set of whispering gallery modes, and

one or more optical waveguides optically coupled to the one or more optical fibers at a plurality of resonator nodes such that the one or more optical fibers communicate to the one or more optical waveguides a set of signals corresponding to the set of whispering gallery modes,

wherein the one or more optical waveguides are configured to propagate the set of signals to at least one optical detector.

~~27~~25. The apparatus of claim ~~26~~24, wherein the one or more optical fibers are configured to:

receive a plurality of ultrasound echoes;

propagate a second set of whispering gallery modes in response to the plurality of ultrasound echoes; and

communicate to the one or more optical waveguides a second set of signals corresponding to the second set of whispering gallery modes,

wherein the one or more optical waveguides are configured to propagate the second set of signals to the at least one optical detector.

~~28~~26. The apparatus of claim ~~27~~25, wherein the set of whispering gallery modes is a first set of whispering gallery modes, and wherein one or more optical fibers are configured to communicate, through the plurality of resonator nodes, to the one or more optical waveguides a set of signals

corresponding to a difference between the first set of whispering galley modes and the second set of whispering gallery modes.

~~29~~27. The apparatus of claim ~~28~~26, wherein the difference between the first set of whispering gallery modes and the second set of whispering modes is at least one of: at least one shift in a resonant frequency of the optical fiber and an attenuation of a resonance of the one or more optical fibers.

~~30~~28. The apparatus of claim ~~26~~24, wherein the one or more optical fibers comprise a plurality of optical fibers having the same or substantially similar cross-sectional geometry and material.

~~31~~29. The apparatus of claim ~~26~~24, wherein the one or more optical waveguides comprise one or more tapered optical fibers or one or more integrated photonic waveguides.

~~32~~30. The apparatus of claim ~~26~~24, wherein the one or more optical fibers are in a polymer structure.

~~33~~31. The apparatus of claim ~~32~~30, wherein the one or more optical fibers and the one or more optical waveguides are in a polymer structure.

~~34~~32. The apparatus of claim ~~32~~30, wherein the one or more optical fibers are perpendicular to the one or more optical waveguides.

~~35~~33. The apparatus of claim ~~32~~30, wherein each of the one or more optical waveguides are coupled to a light source such that the one or more optical waveguides propagate light from the light source.