

CLAIMS

1. A structural health monitoring method comprising:
directly forming an acoustic transducer on a surface of a structure to be monitored;
generating, by the acoustic transducer, an acoustic wave to apply stress loading to a region of interest on the structure; and
detecting a presence of a defect in the region of interest, wherein detecting comprises a non-contact optical imaging of the region of interest with and without the stress loading and an analysis of imaging data from the non-contact optical imaging.
2. The method as claimed in claim 1, wherein directly forming the acoustic transducer comprises:
directly forming a piezoelectric layer on the surface of the structure;
patterning a plurality of electrodes on the piezoelectric layer; and
selecting a periodicity of the electrodes based on a wavelength of the acoustic wave.
3. The method as claimed in claim 2, further comprising forming the plurality of electrodes as concentric curves, and selecting a center of the concentric curves to coincide with the region of interest.
4. The method as claimed in any one of the preceding claims, wherein the transducer comprises a phased-array transducer comprising a plurality of elements, and wherein generating the acoustic wave comprises controlling a time delay between the elements to tune a penetration depth of the acoustic wave in the region of interest.
5. The method as claimed in claim 4, wherein generating the acoustic wave further comprises activating selected elements of the plurality of elements.
6. The method as claimed in any one of the preceding claims, further comprising directly forming a plurality of acoustic transducers on the surface of the structure and simultaneously generating a plurality of acoustic waves corresponding to the acoustic transducers to detect the presence of one or more defects.

7. The method as claimed in any one of claims 2 to 6, wherein directly forming the piezoelectric layer on the surface of the structure comprises depositing a piezoelectric ceramic layer on the surface of the structure by a thermal spray process.
8. The method as claimed in any one of claims 2 to 6, wherein directly forming the piezoelectric layer on the surface of the structure comprises depositing a piezoelectric polymer layer on the surface of the structure by an aerosol spray process.
9. The method as claimed in any one of the preceding claims, wherein the non-contact optical imaging of the structure comprises shearography imaging.
10. The method as claimed in any one of claims 1 to 8, wherein the non-contact optical imaging of the structure comprises holographic imaging.
11. The method as claimed in any one of claims 1 to 8, wherein the non-contact optical imaging of the structure comprises optical metrology.
12. A structural health monitoring system comprising:
 - an acoustic transducer formed directly on a surface of a structure to be monitored;
 - a non-contact optical imaging device configured to image a region of interest on the structure; and
 - a processor communicatively coupled to the acoustic transducer and the non-contact optical imaging device,wherein the acoustic transducer is configured to generate an acoustic wave to apply stress loading to the region of interest, and wherein the processor is configured to receive imaging data of the region of interest from the non-contact optical imaging device with and without the stress loading and to analyse the imaging data to detect a presence of a defect in the region of interest.
13. The system as claimed in claim 12, wherein the acoustic transducer comprises a piezoelectric layer and a plurality of electrodes patterned on the piezoelectric layer, and wherein a periodicity of the electrodes is selected based on a wavelength of the acoustic wave.

14. The system as claimed in claim 13, wherein the plurality of electrodes comprise concentric curves, and wherein a center of the concentric curves is selected to coincide with the region of interest.
15. The system as claimed in any one of claims 12 to 14, wherein the transducer comprises a phased-array transducer comprising a plurality of elements, and wherein the processor is further configured to control a time delay between the elements to tune a penetration depth of the acoustic wave in the region of interest.
16. The system as claimed in claim 15, wherein the processor is further configured to activate selected elements of the plurality of elements to generate the acoustic wave.
17. The system as claimed in any one of claims 12 to 16, comprising a plurality of acoustic transducers directly formed on the surface of the structure and communicatively coupled to the processor, wherein the plurality of acoustic transducers are configured to simultaneously generate a plurality of acoustic waves to detect the presence of one or more defects.
18. The system as claimed in any one of claims 12 to 17, wherein the piezoelectric layer comprises a piezoelectric ceramic layer.
19. The system as claimed in any one of claims 12 to 17, wherein the piezoelectric layer comprises a piezoelectric polymer layer.
20. The system as claimed in any one of claims 12 to 19, wherein the non-contact optical imaging device comprises a shearography imaging device.
21. The system as claimed in any one of claims 12 to 19, wherein the non-contact optical imaging device comprises a holographic imaging device.
22. The system as claimed in any one of claims 12 to 19, wherein the non-contact optical imaging device comprises an optical metrology device.