

CLAIMS

What is claimed is:

1. A system for automatically monitoring an anatomical structure of a subject, comprising:
 - at least one ultrasound patch attached to said subject, wherein said patch comprises one or more ultrasound sensors, communication system, and an electric board for ultrasound transmission and/or reception, wherein the ultrasound patch generates at least one ultrasound image in one or more modes selected from the group consisting of M-mode, 2D, 3D and Doppler ultrasound;
 - a server for processing the at least one ultrasound image using one or more analytical tools to generate at least one processed ultrasound image, wherein the one or more analytical tools comprise radon transformation, higher-order spectra techniques, and/or active contour models;
 - a storage medium configured to store instructions defining a deep learning CNN,
 - wherein the server executes the deep learning CNN to obtain an automatic classification result selected from two or more classes indicating the functional state of the anatomical structure; and
 - an output to communicate the classification result to a user.
2. The system of claim 1, wherein the two or more classes comprises a normal class and abnormal class.
3. The system of claim 1, wherein the at least one ultrasound patch comprises a flexible piezoelectric material.
4. The system of claim 1, wherein the ultrasound patch is flexible and conforms to the surface of the subject.
5. The system of claim 1, wherein the ultrasound image is an M-mode and 2D

image.

6. The system of claim 1, wherein the ultrasound image is a 2D and Doppler image.
7. The system of claim 1, wherein the one or more analytical tools comprise radon transformation.
8. The system of claim 1, wherein the one or more analytical tools comprise higher-order spectra techniques to generate a bispectrum plot and/or a cumulant plot.
9. The system of claim 1, wherein the one or more analytical tools comprises radon transformation, HOS techniques, and active contour models.
10. The system of claim 1, wherein the at least one ultrasound image comprises an M-mode image, wherein the one or more analytical tools comprise radon transformation, HOS techniques and active contour model.
11. The system of claim 1, wherein the at least one ultrasound image comprises an M-mode image, wherein the one or more analytical tools comprise radon transformation and HOS techniques.
12. The system of claim 1, wherein the at least one ultrasound image comprises an M-mode image, wherein the one or more analytical tools comprise active contour model.
13. The system of claim 1, wherein the anatomical structure is a heart or blood vessel of a subject.
14. The system of claim 13, wherein the blood vessel is the brachial artery.

15. The system of claim 1, wherein the at least one ultrasound patch is connected to the server through a wireless connection.
16. A computer implemented method for automatically monitoring an anatomical structure of a subject, comprising:
- obtaining at least one ultrasound image from at least one ultrasound patch;
 - transmitting the at least one ultrasound image into a server;
 - processing the at least one ultrasound image using one or more analytical tools to generate at least one processed ultrasound image;
 - inputting the at least one processed ultrasound image into a deep learning CNN to obtain an automatic classification result selected from two or more classes indicating the functional state of the anatomical structure; and
 - displaying the classification result to a user.
17. The method of claim 16, wherein the two or more classes comprises a normal class and abnormal class.
18. The method of claim 16, wherein the classification result is indicative of the subject's likelihood of having a condition or disease.
19. The method of claim 16, wherein the classification result identifies at least one of damaged tissue, blockages to blood flow, narrowing of vessels, tumors, congenital vascular malformations, reduced blood flow, absent blood flow or increased blood flow.
20. The method of claim 18, wherein the condition or disease is at least one of cardiovascular disease, cancer, infection or soft tissue damage.
21. The method of claim 16, wherein the at least one ultrasound image is transmitted to the server through a wireless connection.

22. A method of identifying an ailment or determining a prognosis of a subject with an ailment, the method comprising the steps of:
obtaining at least one ultrasound image of an anatomical structure in the subject from at least one ultrasound patch attached to the subject;
transmitting the at least one ultrasound image into a server;
processing the at least one ultrasound image using one or more analytical tools to generate at least one processed ultrasound image;
inputting the at least one processed ultrasound image into a deep learning CNN to obtain an automatic classification result selected from two or more classes indicating the functional state of the anatomical structure, and
displaying the classification result to a user, wherein the classification result is indicative of the subject's risk of having an ailment or the prognosis of the subject with an ailment.
23. The method of claim 22, wherein the classification result identifies at least one of damaged tissue, blockages to blood flow, narrowing of vessels, tumors, congenital vascular malformations, reduced blood flow, absent blood flow or increased blood flow.
24. The method of claim 22, wherein the ailment is at least one of cardiovascular disease, cancer, infection or soft tissue damage.
25. The method of claim 22, wherein the one or more analytical tools comprises radon transformation.
26. The method of claim 22, wherein the one or more analytical tools comprises active contour model.
27. The method of claim 22, wherein the at least one ultrasound image is transmitted to the server through a wireless connection.