CLAIMS

I claim:

1. A method of performing active auscultation comprising:

directing, by a processor, a broadband acoustic signal into user's body toward a ~~target of interest~~user's lung, wherein the broadband acoustic signal is a pulse that comprises a plurality of frequencies;

receiving, by the processor, an acoustic signal from the user's body, the received acoustic signal corresponding to the broadband acoustic signal; ~~and~~

determining, by the processor, a characteristic of the received acoustic signal, wherein the characteristic is at least one of an intensity and a frequency of the received acoustic signal; and

determining, by the processor, a volume of trapped air present in the user's lung using the determined characteristic, the trapped air being air that is trapped within discrete pockets of lung tissue of the user's lung following the user's exhalation of air from the lung.

2. The method of claim 1, wherein the broadband acoustic signal is a first broadband acoustic signal and the received acoustic signal is a first received acoustic signal, the method further comprising:

receiving, by the processor, a second acoustic signal from the user's body, the received acoustic signal corresponding to a second broadband acoustic signal projected into the user's body;

determining, by the processor, a characteristic of the second received acoustic signal, wherein the characteristic of the second received acoustic signal is at least one of an intensity and a frequency of the second received acoustic signal;

comparing, by the processor, a characteristic of the first and second received acoustic signals; and

providing, by the processor, an indication of the comparing~~son~~ of the characteristic of the first and second received acoustic signals to an operator.

3. The method ~~any~~ of claim~~s~~ 1 or 2, further comprising:

comparing, by the processor, the characteristic of the received acoustic signal to a predetermined value.

4. The method of claim 1, further~~ing~~ comprising:

adjusting, by the processor, at least one of a duration of the broadband acoustic signal, an intensity of the broadband acoustic signal, and frequencies included in the

broadband acoustic signal responsively to the determined characteristics of the broadband acoustic signal.

5. The method of claim 1, wherein the broadband acoustic signal comprises a plurality of frequencies between 2,000 Hz and 30,000 Hz.

6. The method of claim 1, wherein a duration of the pulse is within the range of 0.1 seconds and 2 seconds.

7. The method of claim 1, wherein the target is at least one of a heart and a lung of the user.

8. The method of claim 1, wherein the target is the user's lung, the method further comprising:

determining a volume of air trapped in the user's lung responsively to the determined characteristic.

97. A method comprising:

receiving, by a processor, a detected acoustic signal from a receiver, the detected acoustic signal corresponding to an acoustic signal directed toward a target lung within the a body of a user in a pulse and responsively emanating from the user, the acoustic signal comprising a plurality of frequencies; and

analyzing, by the processor, the received detected acoustic signal to determine a resonant frequency for the targetlung; and

determining, by the processor, a volume of trapped air present in the lung following the user's exhalation of air from the lung using the resonant frequency, the volume of trapped air being air that is trapped within discrete pockets of lung tissue following the user's exhalation of air from the lung.

10. The method of claim 9, wherein the target is the user's lung, the method further comprising:

determining, by the processor, a volume of trapped air present in the user's lung responsively to the resonant frequency.

118. The method any of claims 9 or 10 7, further comprising:

comparing, by the processor, the resonant frequency of the target lung to a predetermined value.

129. The method of claim 97, wherein the acoustic signal directed toward a lung within the body of the user is a broadband acoustic signal stimuli, the method further ing comprising:

adjusting, by the processor, at least one of a duration, an intensity of the broadband acoustic signal stimuli, and frequencies included in the broadband acoustic signal stimuli responsively to the determined resonant frequency of the targetlung.

1310. The method of claim 97, wherein the acoustic signal directed toward a lung with the body of the user is athe broadband acoustic signal stimuli that has a frequency is between 2,000 Hz and 30,000 Hz.

1411. A method for performing active auscultation comprising:

providing, by a processor in communication with an emitter, signal stimuli to the emitter so that the emitter produces acoustic energy of a plurality of frequencies, the acoustic energy being directed towards an organ of a user;

receiving, by the processor, via a receiver in communication with the processor, an acoustic energy response that corresponds to the acoustic energy of the plurality of frequencies directed towards to the organ;

analyzing, by the processor, the received acoustic energy response to determine a resonant frequency for the organ; and

determining, by the processor, a volume of trapped air in the organ based on the resonant frequency for the organ, the trapped air being air that is trapped within discrete pockets of organ tissue.

1512. The method of claim 1411, wherein the plurality of frequencies directed towards the organ includes a set of discrete frequencies.

1613. The method of claim 1512, wherein the signal stimuli cause the emitter to produce acoustic energy that cycles through the set of discrete frequencies over a predetermined period of time.

1714. The method of claim 1411, wherein the signal stimuli cause the emitter to produce acoustic energy that includes a series of pseudo-randomly selected frequencies.

1815. The method of claim 1411, wherein signal stimuli cause the emitter to produce a burst of acoustic energy that includes the plurality of frequencies.

19. The method any of claims 14-18, further comprising:

determining, by the processor, a volume of air trapped in the organ based on the resonant frequency for the organ.

2016. The method of any one of claims 1411-1815, further comprising:
receiving, by the processor, information pertaining to the user; and
correlating, by the processor, the received information with the resonant frequency of the organ.

2117. The method of claim 2016, wherein the received information pertains to one or more of a physiological characteristic of a user, a diagnosis of a user, a size of the organ, a shape of the organ, a type of fluid in the organ, a type of gas in the organ, a location of the emitter, a location of the receiver, a level of ambient noise, and an orientation of a user.

2218. The method of claim 1411, wherein the signal stimuli cause the emitter to produce a broadband signal with one or more of a predetermined frequency response and a predetermined frequency bin.

23. A system, comprising:

a processor configured to:

provide signal stimuli to an emitter in communication with the processor such that the emitter produces acoustic energy of a plurality of frequencies, the acoustic energy being directed towards an organ of a user's body;

receive, via a receiver in communication with the processor, an acoustic energy response that corresponds to the acoustic energy of the plurality of frequencies directed towards to the organ;

generate, a comparison between the acoustic energy response and a predetermined threshold; and

determine, based on the comparison, one or more resonant frequencies for the organ.

24. A method of performing active auscultation comprising:

providing, by a processor in communication with an emitter, a first signal stimuli to the emitter such that the emitter produces acoustic energy of a first plurality of frequencies that is directed towards an organ;

receiving, by the processor, via a receiver in communication with the processor, a first acoustic energy response that corresponds to the acoustic energy of the first plurality of frequencies directed towards the organ;

providing, by the processor, a second signal stimuli to the emitter such that the emitter produces acoustic energy of a second plurality of frequencies that is directed towards the organ;

receiving, by the processor, via the receiver, a second acoustic energy response that corresponds to the acoustic energy of the second plurality of frequencies directed towards the organ;

generating, by the processor, a comparison between the first acoustic energy response and the second acoustic energy response; and

determining, by the processor, based on the generated comparison, one or more characteristics of the organ.

25. The method of claim 24, wherein the one or more characteristics of the organ includes one or more of sound frequency over time and sound intensity over time.

26. A wearable auscultation sensor comprising:

an emitter configured to project an acoustic signal into a user's body;

a receiver configured to receive an acoustic signal emanating from the user's body; and

a noise cancelling device configured reduce ambient noise in the received acoustic signal.

27. The wearable auscultation sensor of claim 26, wherein the noise cancelling device comprises noise-cancelling circuitry specifically designed to cancel unwanted ambient noise.

28. The wearable auscultation sensor of claim 26, wherein the noise cancelling device adds a signal that is 180 degrees out of phase with targeted ambient noise to filter the ambient noise from the received signal.