

CLAIMS

What is claimed is:

1. A method for continuously, non-invasively, an directly measuring blood pressure, the method comprising:
 - providing a calibrated measurement device having a blood-flow control balloon and a sensor array;
 - placing the sensor array in a non-invasive manner over a surface patch of skin connected to an artery by adjoining soft tissues;
 - inflating the blood-flow control balloon with a controlled amount of pressure;
 - in response to the inflating of the blood-flow control balloon, detecting, via the sensor array, changes in artery size and shape during a heartbeat cycle, the changes corresponding to spatio-temporal signals from the artery or in the adjoining soft tissues; and
 - measuring and processing, via a controller, the spatio-temporal signals to determine blood-pressure parameters.
2. The method of claim 1, wherein the detecting, via the sensor array, of the changes in the artery size and shape includes determining at least one of a deformation of the skin surface patch or forces within and on the skin surface patch.
3. The method of claim 2, further comprising measuring at least one of the deformation or the forces with an array of tactile sensors included in the sensor array.
4. The method of claim 2, further comprising measuring at least one of the deformation or the forces with an optical system.
5. The method of claim 2 further comprising measuring at least one of the deformation or the forces with a retrographic sensor included in the sensor array.
6. The method of claim 2, further comprising determining the changes in the artery size and shape based on a change in skin-surface height, the sensor array being in direct contact with the skin surface.

7. The method of claim 6, further comprising comparing, via the controller, the skin-surface height at two or more locations and times to infer systolic and diastolic blood pressure.
8. The method of claim 1, further comprising determining the changes in the artery size and shape based on an ultrasound of the artery.
9. The method of claim 1, further comprising placing the blood-flow control balloon in direct contact with the surface patch of skin.
10. The method of claim 1, further comprising:
 - providing the calibrated measurement device with a strap, a strap control balloon and a strap force sensor;
 - placing the strap over a limb containing the artery such that the strap control balloon and the strap force sensor are in contact with different regions of the surface patch of skin;
 - and
 - fine tuning the calibrated measurement device by inflating the strap control balloon to change the force applied between the surface patch of skin and the strap.
11. A calibrated measurement device for continuously, non-invasively, and directly measuring blood pressure, the calibrated measurement device comprising:
 - a strap;
 - a blood-flow control balloon coupled to an internal surface of the strap, the blood-flow control balloon having an inflated state in which a controlled amount of pressure isolates a spatio-temporal signal from an artery without compromising venous and lymphatic circulation or flow in other arteries of a limb containing the artery; and
 - a sensor array mounted on an internal surface of the blood-flow control balloon to non-invasively monitor blood pressure, the sensor array detecting changes in the artery size and shape during a heartbeat cycle and when the blood-flow control balloon is in the inflated state, the changes corresponding to spatio-temporal signals from the artery.
12. The calibrated measurement device of claim 11, wherein the strap is removably attached.

13. The calibrated measurement device of claim 11, further comprising a rigid support mounted to the strap, the blood-flow control balloon being mounted on the rigid support.
14. The calibrated measurement device of claim 11, further comprising a strap control balloon coupled to the internal surface of the strap in a different area than the blood-flow control balloon, the strap control balloon having an inflated state in which a force applied between a skin surface of the limb and the strap is fine tuned.
15. The calibrated measurement device of claim 12, further comprising a strap force sensor coupled to the internal surface of the strap in a different area than the blood-flow control balloon and the strap control balloon, the strap force sensor detecting the force applied between a skin surface of the limb and the strap when at least one of the blood-flow control balloon and the strap control balloon is in the respective inflated state.
16. The calibrated measurement device of claim 11, wherein the sensor array includes an array of tactile sensors.
17. The calibrated measurement device of claim 11, wherein the sensor array includes one or more resistive, piezoelectric, or capacitive elements.
18. A method for continuously, non-invasively, and directly measuring blood pressure in an artery, the method comprising:
 - providing a calibrated measurement device having strap for mounting on a limb, the strap having mounted on its internal surface a blood-flow control balloon, a strap control balloon, and a strap force sensor, the blood-flow control balloon having mounted on its internal surface a sensor array;
 - placing the strap over a limb such that the sensor array is in contact with a skin surface over an artery in a non-invasive manner;
 - inflating the blood-flow control balloon with a controlled amount of pressure without compromising venous and lymphatic circulation or flow in other arteries of the limb containing the artery;
 - in response to inflating the blood-flow control balloon, detecting, via the sensor array, changes in the artery size and shape during a heartbeat cycle, the changes corresponding to spatio-temporal signals from the artery;

inflating the strap control balloon with a controlled amount of pressure to apply a tension force between the strap and the skin surface of the limb;

based on detection by the sensor array and the strap force sensor, fine-tuning pressure applied by at least one of the blood-flow control balloon or the strap control balloon to enhance detection of the spatio-temporal signal; and

measuring and processing, via a controller, the spatio-temporal signal to determine blood-pressure parameters.

19. The method of claim 18, wherein the detecting of the changes in the artery size and shape includes measuring at least one of a deformation of the skin surface or forces within and on the skin surface.

20. The method of claim 18, further comprising determining the changes in the artery size and shape and changes in soft tissues adjoining the artery based on ultrasound.