CLAIMS

What is claimed is:

1. A method for continuously, non-invasively, and directly measuring blood pressure, the method comprising:

providing a calibrated measurement device having a frame with a first side and a second side, a balloon mounted to the second side, an optical system between the first side and the balloon, ~~blood-flow control balloon~~ and a sensor array having a sensor surface;

placing the sensor array in a non-invasive manner over a ~~surface patch of~~ skin surface 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 signals, via the optical system and the sensor array, caused by 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 signals are visible deformations in the sensor surface, and wherein the visible deformations in the sensor surface are caused by deformations in the skin surface, the deformations being caused by the changes in artery size and shape during a heartbeat cycle ~~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, wherein the sensor array further comprises capacitance-based tactile sensors, and wherein the signals are tactile deformations in the sensor surface, the tactile deformations in the sensor surface being caused by deformations in the skin surface, the deformations being caused by the changes in artery size and shape during a heartbeat cycle~~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, wherein the optical system further includes a camera capable of detecting the signals~~further comprising measuring at least one of the deformation or the forces with an optical system~~.

5. The method of claim 1, wherein the calibrated measurement device further includes a rigid support adjacent to the balloon and between the optical system and the sensor array; and wherein the rigid support is transparent and the balloon is transparent~~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 1, wherein the sensor surface further includes a reflective layer in contact with the skin surface and responsive to deformations in the skin surface~~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 2,

wherein inflating the balloon further includes a gradual increase and a gradual decrease of a pressure in the balloon;

wherein detecting signals further includes detecting at least one signal at a low value of pressure during the gradual increase of pressure until the at least one signal is attenuated;

wherein measuring further includes measuring a mean pressure in the balloon; and

wherein processing further includes mapping markers of the at least one signal to estimate systolic blood pressure, mean arterial pressure, and diastolic blood pressure~~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~~sensor surface in direct contact with the skin surface ~~patch of skin~~.

10. The method of claim ~~1~~9, further comprising:

coating the skin surface with a pigment prior to placing the sensor surface in direct contact with the skin surface~~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 frame;

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 a~~n internal~~ surface of the ~~blood flow control~~ balloon to directly contact a skin surface and non-invasively monitor blood pressure, the sensor array including a camera mounted to the frame and spaced from the balloon for detecting ~~changes~~ deformations in the skin surface caused by changes in artery size and shape during a heartbeat cycle; the deformations in the skin surface corresponding to blood pressure~~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 transparent rigid support mounted to the strap, the ~~blood flow control~~ balloon being mounted on the transparent rigid support; the transparent rigid support being positioned between the camera and the balloon.

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~~the 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~~the 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 further includes an array of capacitance-based tactile sensors.

17. The calibrated measurement device of claim 11, wherein the sensor array further 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.