We claim as our invention:

1. An apparatus for applying variable pressure to enhance blood flow in a vertebrate organism's limb comprising:

(a) means for detecting cardiovascular activity of the organism, and achieving the optimized photoplethysmograph (PPG) waveform, based on the inputs from the electrocardiograph (EKG) and PPG;

(b) means for adjusting five variables pertaining to inflation of a series of inflatable cells, the inflatable cells located along the length of the said limb to optimize the PPG signal, namely delay time, maximum cuff pressure, duration of cell inflation, velocity at which each successive cell inflation begins, beginning proximally and proceeding distally, and sequential air cell compression pressure gradient going distally down the limb;

(c) means for compressing at least one limb of the organism progressively from a proximal region to a distal region of the limb;

(d) means for triggering the compressing means in timed relation with the detected cardiovascular activity.

Wherein said apparatus is characterized in that

Reading of the inputs from EKG and PPG by the computer implemented system of said means for detecting cardiovascular activity, followed by adjusting the said five variables for cell inflation to optimize the PPG signal or alternatively the default setting applicable therein or the manual override by the user;

and

the sequential gradient compression generated cardiovascular activity synchronized waveform, delivered in sequence along the long axis of the limb, with each heartbeat via the series of inflatable cells to mimic and enhance natural arterial flow.

2. The apparatus of Claim 1 where in the means for detecting the cardiovascular activity comprises at least one photoplethysmograph (PPG) signal as well as an electrocardiographic apparatus connected to one or more electrodes placed on the skin of the organism.

3. The apparatus of Claim 2 wherein the PPG apparatus identifies the cardiovascular activity and transmits a signal into an algorithm or default settings that adjust air cell inflations to produce the required optimized blood flow.

4. The apparatus of Claim 1 where in the means for compressing at least one vertebrate organism's limb comprises one or more pneumatic devices adapted to substantially surround at least one transverse region of the limb preferably by way of simultaneously mounting multiple cuffs at multiple positions, thereby compressing the surrounded region(s) in response to an increase in pneumatic pressure applied to the device; wherein said means for compression of said apparatus is characterized in compressing at least one organism's limb or applying negative pressure therein, optionally in combination with compression or separately.

5. The apparatus of Claim 4 wherein the means for compressing at least one vertebrate organism's limb comprises a plurality of pneumatic devices, adapted to apply progressive compression to the limb; wherein said means of compression is provisioned to actuate compression, once the five variables for cell inflation are adjusted to optimize the blood flow.

6. The apparatus of Claim 4 wherein the means for compressing at least one vertebrate organism's limb comprises a multi-compartment pneumatic device having fluid conduits between adjacent compartments.

7. The apparatus of Claim 6 wherein the fluid conduits are sized to provide progressive changes in pneumatic pressure within each more distal compartment when such pressure is changed to the adjacent proximal compartment.

8. The apparatus of Claim 6 wherein each fluid conduit comprises a valve.

9. The apparatus of Claim 8 wherein each valve changes state in response to a threshold pressure in the adjacent proximal compartment.

10. The apparatus of Claim 9 wherein the threshold pressure is electrically controllable.

11. The apparatus of Claim 5 wherein a separately controlled source of pneumatic pressure is provided to each pneumatic device.

12. The apparatus of Claim 4 wherein the means for compressing the limb comprises a plurality of hollow soft walled cells that are applied circumferentially around the limb, longitudinally adjacent to each other, along the long axis of the limb, and connected via a fluid conduit to a regulated source of compressed fluid, as well as having connectivity via a fluid conduit to a means to exhaust cell fluid contents in a regulated manner.

13. The apparatus of Claim 3 wherein the means for compressing at least one vertebrate organism's limb is operable to compress the limb in a time interval less than the interval between successive largest detected signals.

14. The apparatus of Claim 13 wherein the time interval is from zero to the average interval between largest detected signals measured in a preceding predetermined time epoch.

15. The apparatus of Claim 1 further comprising means for controlling one or more of the amount of compression, rate of increase of pressure and rate of decrease of pressure applied to the limb.

16. The apparatus of Claim 5 further comprising means for exerting negative pressure at a wound site on the organism's limb.

17. The apparatus of Claim 16 wherein the negative pressure is varied in timed relation to a received signal that is a detected signal indicative of cardiovascular activity.

18. The apparatus of Claim 17 wherein the negative pressure is varied in timed relation to inflation of the immediately proximal limb pneumatic compartment.

19. The apparatus of Claim 17 wherein negative pressure in the most distal limb pneumatic compartment is activated to enter that compartment when positive pressure is changed in the immediately adjacent proximal compartment.

20. The apparatus of Claim 5 further comprising means for exerting negative pressure in successive pneumatic compartments located sequentially along the long axis of the limb, but providing negative pressure from a limb's distal part to its proximal part.

21. A method for determining the effect of treatment of a vertebrate organism, using an apparatus of claim 1, comprising (a) means for detecting cardiovascular activity of the organism; (b) means for compressing at least one limb of the organism progressively from a proximal region to a distal region of the limb; (c) means for triggering the compressing means in timed relation with a detected cardiovascular activity, the method comprising the steps of (a') directing light of one or more predetermined wavelengths at a predetermined skin location on the organism and detecting the reflected or transmitted light therefrom; (b') determining a pulse wave representative of the blood flow by analyzing the detected light; (c') measuring the size of the pulse wave before treatment and again after treatment; and (d') providing an indication of the relative sizes of the pre- and post-treatment pulse waves;

Wherein said method is characterized in that

Reading of the inputs from EKG and PPG by the computer implemented system of said means for detecting cardiovascular activity, followed by adjusting the said five variables, the five variables for cell inflation are adjusted to optimize the PPG signal, namely delay time, maximum cuff pressure, duration of cell inflation, velocity at which each successive cell inflation begins, beginning proximally and proceeding distally, and sequential air cell compression pressure gradient going distally down the limb, for cell inflation to optimize the PPG signal or alternatively the default setting applicable therein or the manual override by the user;

and

the sequential gradient arterial pulse wave synchronized waveform, delivered in sequence along the long axis of the limb, with each heartbeat via a series of inflatable cells located along the length of the said limb to mimic and enhance natural arterial flow.

22. A method of applying variable pressure on a vertebrate organism using the apparatus of Claim 1 wherein the following treatment parameters may be independently varied:

(a) delay in time from largest detected signal at which time the most proximal compartment inflation begins;

(b) maximal pressure in one or more compartments;

(c) duration of compartment inflation;

(d) time after inflation of most proximal compartment when the next compartment inflation begins;

(e) pressure of each successive compartment, relative to its most immediate neighboring proximal compartment; and

(f) duration of treatment.

23. The method of claim 22, comprising the steps of (a) detecting cardiovascular activity of the organism; (b) compressing at least one limb of the organism progressively from a proximal region to a distal region of the limb by; (c) triggering the compressing means in timed relation with a detected cardiovascular activity.

24. The method of Claim 23 wherein said variable pressure is applied on a vertebrate organism, in one or more of the following conditions: peripheral arterial obstructive disease; microangiopathy; vasculitis; vasovasorum disease; complex regional pain syndrome; frostbite; erythromelalgia; trauma induced limb wound; chronic limb wound; diabetic neuropathic wounds; trench foot; Raynaud's disease; peripheral neuropathy; and peripheral arterial diseases in which traditional or standard treatments are contraindicated or not advised.

25. A method of claim 23, comprising the steps of (a) detecting cardiovascular activity of the organism; (b) applying sub-atmospheric pressure to at least one wound site of the organism in timed relation with a detected cardiovascular activity.