

CLAIMS

What is claimed is:

1. A peripheral intravenous (IV) waveform analysis (PIVA) system, comprising:
 - a peripheral IV device configured to acquire, from a vein of a living subject, peripheral venous signals; and
 - an processing device communicatively connected to the peripheral IV device, configured to:
 - receive the peripheral venous signals from the peripheral IV device;
 - perform a spectral analysis on the peripheral venous signal to obtain a peripheral venous pressure frequency spectrum; and
 - perform a statistical analysis on amplitudes of peaks of the peripheral venous pressure frequency spectrum to determine an intravascular volume status of the living subject in real time.
2. The PIVA system of claim 1, wherein:
 - the intravascular volume status of the living subject indicates hypovolemia when amplitude decreases greater than a first threshold are detected from the peaks of the peripheral venous pressure frequency spectrum; and
 - the intravascular volume status of the living subject indicates hypervolemia when amplitude increases greater than a second threshold are detected from the peaks of the peripheral venous pressure frequency spectrum.
3. The PIVA system of claim 1, wherein the processing device is communicatively connected to the peripheral IV device through a wireless connection.
4. The PIVA system of claim 1, wherein the processing device is a computing device.
5. The PIVA system of claim 1, wherein the spectral analysis is a spectral fast Fourier transform (FFT) analysis, wherein the statistical analysis comprises:
 - obtaining a plurality of baseline peaks $\{B_{N-1}\}$ on a baseline peripheral venous pressure frequency spectrum, wherein N is a positive integer, and the plurality of baseline peaks $\{B_{N-1}\}$ respectively corresponds to a plurality of frequencies $\{F_0, F_1,$

$\dots, F_N\}$, such that B_{N-1} is a function of F_{N-1} satisfying $B_{N-1} = B_{N-1}(F_{N-1})$, wherein F_N is greater than F_{N-1} ;

obtaining a plurality of peaks $\{P_{N-1}\}$ on the peripheral venous pressure frequency spectrum, wherein the plurality of peaks $\{P_{N-1}\}$ correspond to the plurality of frequencies $\{F_0, F_1, \dots, F_N\}$, such that P_{N-1} is a function of F_{N-1} satisfying $P_{N-1} = P_{N-1}(F_{N-1})$; and

determining the intravascular volume status of the living subject in real time by comparing the amplitudes of the peaks $\{P_{N-1}\}$ to that of the baseline peaks $\{B_{N-1}\}$ respectively.

6. The PIVA system of claim 5, wherein the baseline peripheral venous pressure frequency spectrum is obtained by:

acquiring, by the peripheral IV monitoring device, the peripheral venous signals from the vein of the living subject at an earlier time period; and

processing the peripheral venous signals acquired at the earlier time period by the spectral FFT analysis to obtain the baseline peripheral venous pressure frequency spectrum.

7. The PIVA system of claim 5, wherein:

the plurality of peaks $\{P_{N-1}\}$ comprises a first peak P_0 corresponding to a first frequency F_0 and a second peak P_1 corresponding to a second frequency F_1 ;

the first peak P_0 corresponding to the first frequency F_0 is associated with a respiratory rate of the living subject; and

the second peak P_1 corresponding to the second frequency F_1 is associated with a heart rate of the living subject.