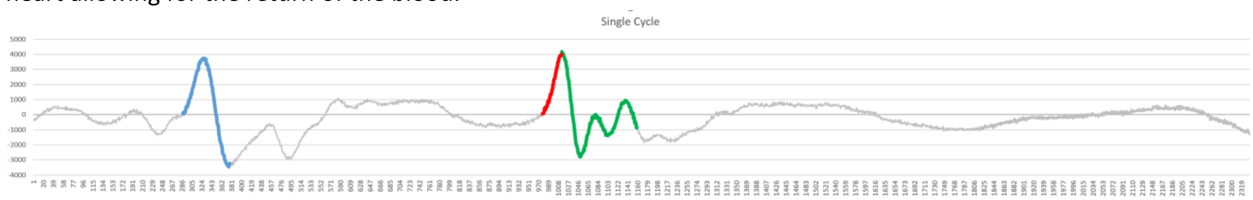
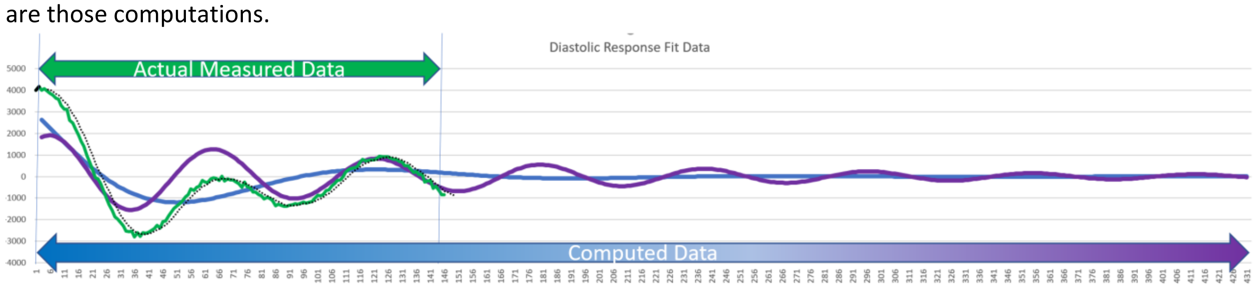
Diastolic Dysfunction – The aging of the heart

One of the more interesting aspects of the human heart is its aging process, which has been called Diastolic Dysfunction. The heart will beat approximately 3 billion times over the average life span and its efficiency will slowly ebb as the muscle tissues get stiffer. This aging affects the intake of returning blood to the heart during the Diastolic interval of the heart, commonly looked at as the second pulse of the normal two pulse heart-beat. Fortunately, in the pending patent 62928212 a discovery was made about the starting intervals of the Diastolic period (red and green data below) as compared to the beginning (blue data) of the Systolic interval, a measure mechanical stiffness was made possible. While the blue data shows the Systolic force, its response is that of the body response, where the green of the red and green intervals are the response of the heart to the function of the heart allowing for the return of the blood.



The interval highlighted in red is the force of the heart associated with the return of blood to the heart. The green highlighted data is the interval of force of the heart responding to that return. In the mechanical world if you have force data measured in Lbs./Force (red) and frequency of resonance (green) to that force you can compute mechanical impedance factors. From small structures such as bells and those as large as buildings have structural characteristics that are associated with compliance. Things will either get stiffer or more pliable in their aging properties. One of the classic demonstrations of stiffness (compliance) is the cracking of the Liberty Bell.

In the case of the human heart, if one takes the response data and computes the, amplitude, frequency and damping over time; one can compute factors that are associated with that structure's characteristics. Shown here are those computations.



Algorithmic processes performed on the very brief interval of Diastolic Response (green data) reveal two frequencies (blue and purple). The blue data indicates that the overall structure of the heart is moving extremely slowly back to its original position within the body as it is impacted with the force allowing the return of blood. Shown above, it would take two cycles of the heart to return to its ambient position over time if it was not subject to additional forces (the beating of the heart). If it so happened that, that diastolic interval was the very last beat of the heart, it would return to its quiescent position at that frequency of those two cycles. Additionally, the purple data trace shows the structural resonance of the heart itself. Note that it takes 9 intervals to come to a "ringing stop"; it is that frequency (cycles over time) that give us the figures of merit for that particular structure. The reducing amplitudes over time and the frequency provide the ability to determine damping.

Fortunately, our sampled data did not stop. This particular subject's heart DID keep beating, but if you look closely at the upper data graph you can see evidence that the structures resonance did indeed keep moving in the next interval which is the Early Diastole interval. But it is obfuscated by that interval's activity.

If one was to continue to measure the subject at frequent intervals over their life (yearly physicals); the frequencies, amplitudes and damping figures would indeed change over time. The trends of those changes and when compared to other subject's characteristics a lot can be learned about the structure, and provide figures of merit for the aging of the structure, which is the human heart.