Figure 3 A Typical First Kernel (Impulse response) for Control subject

Novel Method for Assessing Autonomic Function in Astronauts before and after space flight

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Abstract

The experimental procedure of lowering and raising a leg while the subject in supine position is considered to stimulate and entrain the autonomic nervous system of ten Astronauts before and after space flight . The assessment of autonomic function for each group is achieved using an algorithm based on Volterra kernel estimation. By applying this algorithm and considering the process of lowering and raising a leg as stimulus input and the Heart Rate Variability signal (HRV) as output for system identification, a mathematical model is expressed as integral equations. The integral equations are considered and fixed for Astronauts before and after space flight for two weeks so that the identification method reduced to the determination of the values within the integral called kernels, resulting in an integral equations whose input-output behavior is nearly identical to that of the system in both two conditions. The model for each group contains the linear part (first order kernel) and quadratic part (second order kernel). A difference equation model was employed to represent the system . The results show significant difference in first order kernel(impulse response) and second order kernel (mesh diagram) for each condition. Using first order kernel and second order kernel, it is possible to assess autonomic function qualitatively and quantitatively in both conditions and how effectively space flight affects the autonomic function of Astronauts

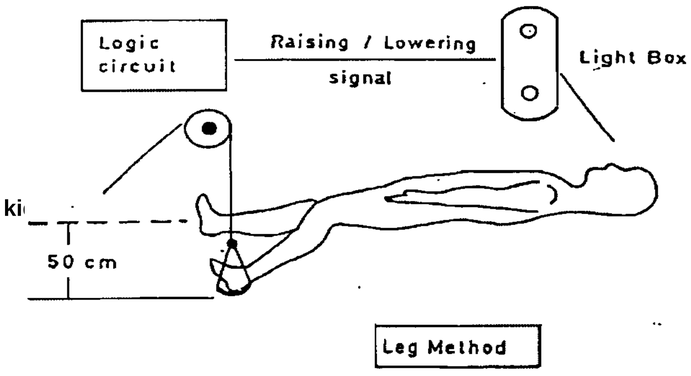


FIGURE 1 The leg method experiment.

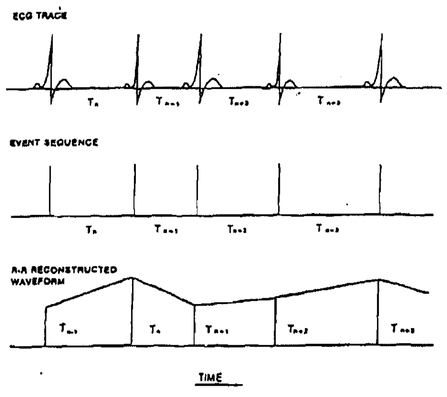
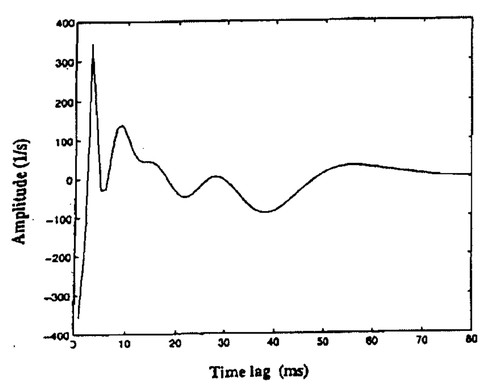


FIGURE 2 The generation of heart rate variability signal derived from Electro Cardio Gram (ECG).



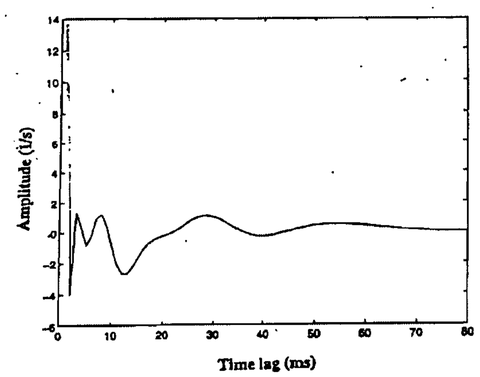
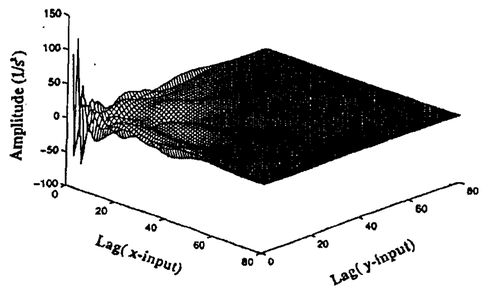


Figure 3 and Figure 4 A Typical First Kernel (Impulse response) for Astronaut before space flight and After Space Flight respectively



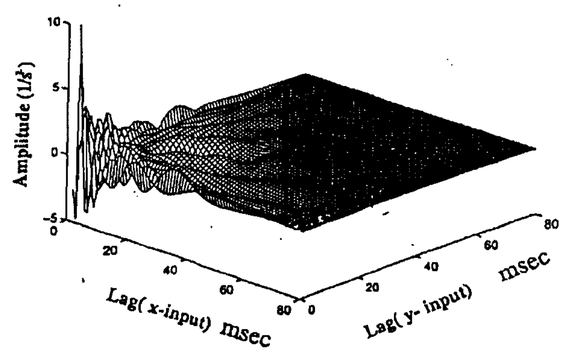


Figure 5 and Figure 6 A Typical second kernel (mesh diagram) for Astronaut before space flight and Astronaut after space flight respctively