

A Mathematical Model For Artificial Generating Of HRV Based On Integral Pulse Frequency Modulation With Chaotic Threshold

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Developing a mathematical model for the artificial generation of heart rate variability (HRV) signal has been widely investigated by many researchers. HRV signal is a useful tool for the evaluation of cardiovascular system and autonomy nerves. In this paper we present a developed Integral Pulse Frequency Modulation (IPFM) model for generating such artificial HRV signals. The heart rate (HR), which is the inverse of the RR-interval, directly affects the blood pressure. The autonomic nerve system (ANS) is responsible for short-term regulation of the blood pressure. The ANS uses two subsystems, the sympathetic and parasympathetic systems. The HR may be increased by sympathetic activity or decreased by parasympathetic activity. The balance between the effects of the sympathetic and parasympathetic systems is referred to as the sympathovagal balance and is believed to be reflected in the beat-to-beat changes of the cardiac cycle. We can use spectral analysis of HRV to investigate the effects of sympathetic and parasympathetic activities on HR. We see three main bands of VLF, LF and HF. In this research we have tried to artificially produce normal HRV and for several diseases related to autonomic control of HR with a pre-defined power spectrum density. We use Chaotic threshold rather than fix or random threshold for the IPFM block. In our model, power spectrum of HRV is very close to real HRV signals, and we could achieve more conformity between a mathematical model and real conditions by applying of Chaotic series based on various Chaotic maps on threshold level of IPFM model. We show comparison of these different chaotic maps in the output signals. The results were closely correlated with the real data which confirm the effectiveness of the proposed model. This Model can be used in new generation of artificial HRV signal in pacemakers.