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KARDIA: A Matlab software for the analysis of cardiac interbeat intervals

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ABSTRACT

This article presents KARDIA, a Matlab (MathWorks Inc., MA) software developed for the analysis of cardiac interbeat interval (IBI) data. Available functions are called through a graphical user interface and permit the study of phasic cardiac responses (PCRs) and the estimation of time and frequency domain heart rate variability (HRV) parameters. Scaling exponents of heartbeat fluctuations are calculated with the detrended fluctuation analysis (DFA) algorithm. Grand average and individual subject results can be exported to spreadsheets for further statistical analysis. KARDIA is distributed free of charge under the terms of GNU public license so that other users can modify the code and adjust the program's performance according to their own scientific requirements.

1. Introduction

Time intervals between successive heartbeats are obtained from electrocardiographical (ECG) recordings and provide a way to measure heart rate patterns, either in resting states (heart rate variability; HRV) or as response to external stimuli (phasic cardiac responses; PCRs). Many commercial data acquisition programs provide algorithms to subtract interbeat intervals (IBIs) from ECG recordings and to calculate some of the most common HRV parameters. The problem of PCR analysis, however, is not addressed by these programs and most researchers depend on custom software to calculate heart rate changes in response to experimental stimuli. In addition, HRV analysis is a field that has gained considerable interest in recent years and a significant number of new metrics deriving from statistical physics have been proposed as complementary to traditional time and frequency domain measures [1]. At the same time, older algorithms are continuously being refined, and advanced methods are being tested in order to further improve the assessment of autonomic function in health and disease [2].

As an alternative to commercial software, several free HRV analysis programs are also available to cardiovascular researchers. Two of the most sophisticated and user-friendly are Ecglab [3] and POLYAN [4]. Ecglab is a Matlab toolbox that performs not only HRV analysis, but also R-wave peak detection from raw ECG recordings. HRV analysis functions

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