HRVAS: Heart Rate Variability Analysis Software

This document is in "beta" mode. Thus it is a work in progress. If the information that you need isn't listed or isn't clearly stated, please contact the author.

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Contents

Description

HRVAS is a MATLAB application for performing HRV analysis. A single GUI is used to choose analysis options and to display results. HRVAS includes time-domain, frequency-domain, Poincare, non-linear, and time-frequency HRV analysis. HRVAS also features batch processing and export tools.

Installation

Below there are instructions for the two installation types available for HRVAS. Type A describes how to install HRVAS for use without MATLAB. Type B describes how to install/setup HRVAS if you have already have MATLAB. If you don't know what MATLAB is…then Type A is for you.

A. Standalone Application

Software Dependencies: Software needed to run HRVAS

MATLAB v2008 or higher - Older versions probably work as long as it's not too old. If you don't have MATLAB, please contact the author about a stand-alone version.

How to Install

1. Install the MATLAB Compiler Runtime (MCR). Download and run MCRInstaller.exe. MCR is needed to allow HRVAS to run outside of the MATLAB environment.

2. Unzip the HRVAS_v1.0.1.zip package. Run HRVAS.exe to open the user interface.

B. MATLAB Source Code

Software Dependencies: Software needed to run HRVAS

1. MATLAB v2008 or higher - Older versions probably work as long as it's not too old. If you don't have MATLAB, please contact the author about a stand-alone version.

MATLAB Toolbox Dependencies: Toolboxes needed to run certain aspects of HRVAS

1. MATLAB Signal Processing Toolbox (needed frequency analysis)
2. MATLAB Wavelet Toolbox (*OPTIONAL*, needed IF using wavelet filtering)

File Dependencies: other files needed to run ECG Viewer

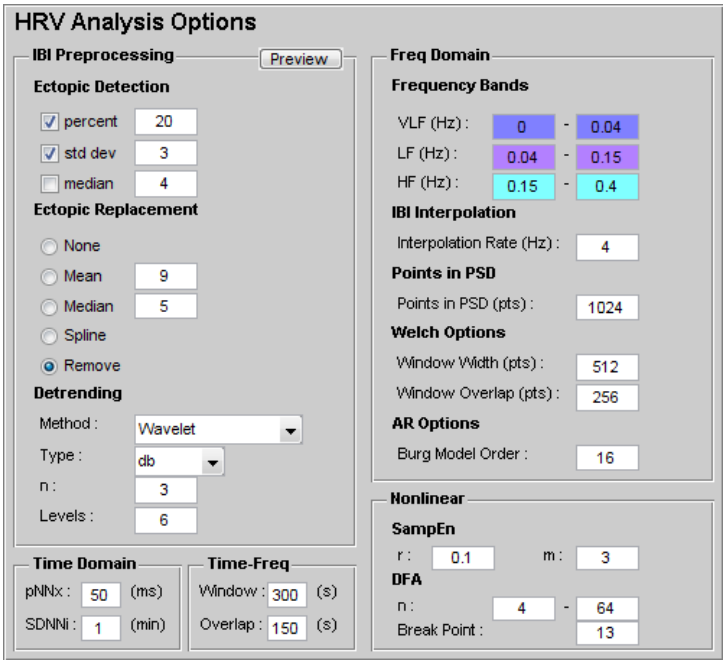
1. HRVAS.m - primary GUI for HRVAS
2. timeFreqHRV.m – time-frequency HRV function
3. poincareHRV.m – Poincare HRV function
4. timeDomainHRV.m – time-domain HRV function
5. freqDomainHRV.m – freq-domain HRV function
6. nonlinearHRV.m – nonlinear HRV function
7. locateOutliers.m - locates IBI outliers or ectopic beats
8. batchHRV.m – batch processing function
9. exportHRV.m – function to export HRV
10. ellipsedraw.m – draws ellipse for Poincare plots (by another author)
11. lomb2.m – computes Lomb-Scargle PSD
12. preProcessIBI.m – function to preprocess IBI
13. replaceOutliers.m – function that replaces IBI outliers
14. slidingWindow.m – function to get increments for sliding window
15. wavelet.m – wavelet functions (by another author)

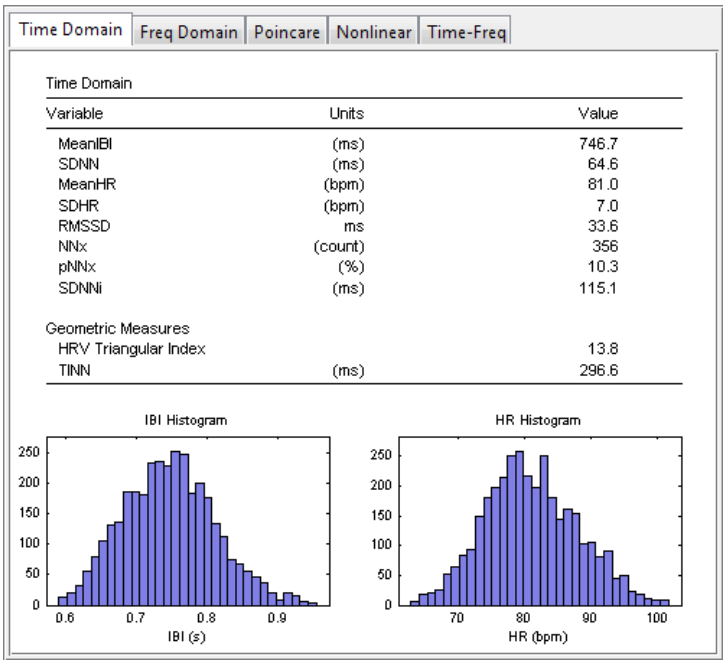
How to Install

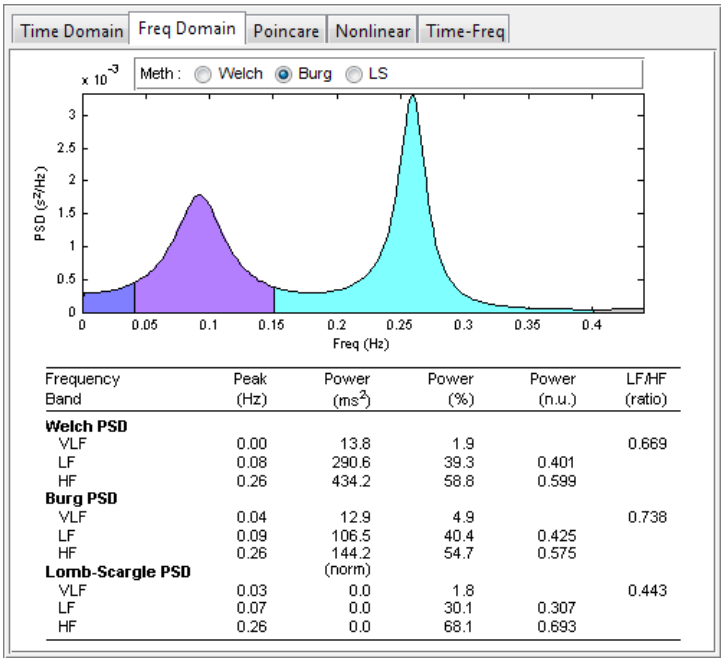
1. Unzip the HRVAS_v1.0.0.zip package. Run the main.m file within MATLAB to open the user interface.

Quick Start Guide

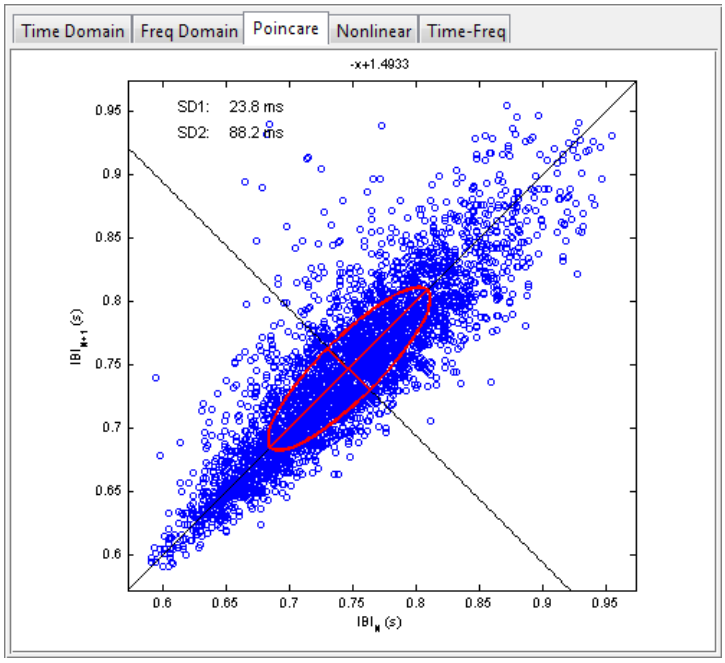
1. Select an IBI data file.
2. Adjust analysis options
3. Preview IBI or Run Analysis
    1. Click “Preview” to see a preview of the preprocessed IBI signal.
    2. Click “Run” to generate HRV results.
4. Select a tab to see results for that analysis method.
5. Export HRV results … if needed.

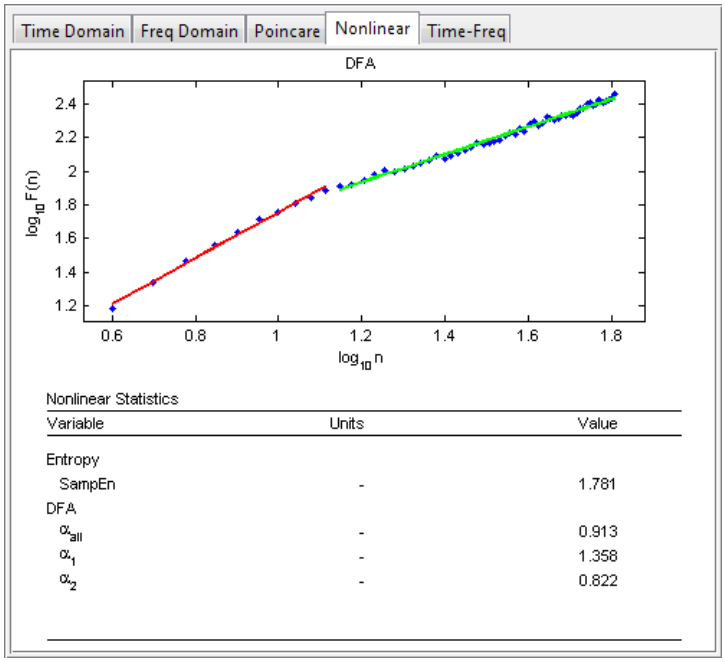

HRV Analysis Options
IBI Preprocessing
Preview
Ectopic Detection
percent
20
std dev
3
median
4
Ectopic Replacement
None
Mean
9
Median
5
Spline
Remove
Detrending
Method :
Wavelet
Type :
db
n :
3
Levels :
6
Time Domain
pNNx :
50
(ms)
SDNNi :
1
(min)
Time-Freq
Window :
300
(s)
Overlap :
150
(s)
Freq Domain
Frequency Bands
VLF (Hz) :
0
0.04
LF (Hz) :
0.04
0.15
HF (Hz) :
0.15
0.4
IBI Interpolation
Interpolation Rate (Hz) :
4
Points in PSD
Points in PSD (pts) :
1024
Welch Options
Window Width (pts) :
512
Window Overlap (pts) :
256
AR Options
Burg Model Order :
16
Nonlinear
SampEn
r :
0.1
m :
3
DFA
n :
4
64
Break Point :
13


Time Domain
Freq Domain
Poincare
Nonlinear
Time-Freq
Time Domain
Variable
Units
Value
MeanIBI
(ms)
746.7
SDNN
(ms)
64.6
MeanHR
(bpm)
81.0
SDHR
(bpm)
7.0
RMSSD
ms
33.6
NNx
(count)
356
pNNx
(%)
10.3
SDNNi
(ms)
115.1
Geometric Measures
HRV Triangular Index
13.8
TINN
(ms)
296.6
IBI Histogram
250
200
150
100
50
0
0.6
0.7
0.8
0.9
IBI (s)
HR Histogram
250
200
150
100
50
0
70
80
90
100
HR (bpm)



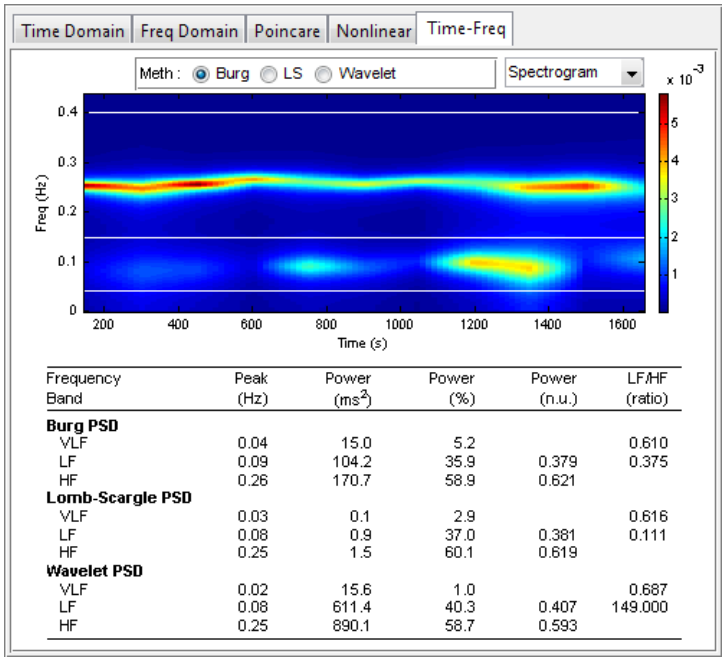
Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)	LF/HF (ratio)
Welch PSD					
VLF	0.00	13.8	1.9		0.669
LF	0.08	290.6	39.3	0.401	
HF	0.26	434.2	58.8	0.599	
Burg PSD					
VLF	0.04	12.9	4.9		0.738
LF	0.09	106.5	40.4	0.425	
HF	0.26	144.2	54.7	0.575	
Lomb-Scargle PSD		(norm)			
VLF	0.03	0.0	1.8		0.443
LF	0.07	0.0	30.1	0.307	
HF	0.26	0.0	68.1	0.693	





Nonlinear Statistics

Variable	Units	Value
Entropy		
SampEn	-	1.781
DFA		
α_{all}	-	0.913
α_1	-	1.358
α_2	-	0.822



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)	LF/HF (ratio)
Burg PSD					
VLF	0.04	15.0	5.2		0.610
LF	0.09	104.2	35.9	0.379	0.375
HF	0.26	170.7	58.9	0.621	
Lomb-Scargle PSD					
VLF	0.03	0.1	2.9		0.616
LF	0.08	0.9	37.0	0.381	0.111
HF	0.25	1.5	60.1	0.619	
Wavelet PSD					
VLF	0.02	15.6	1.0		0.687
LF	0.08	611.4	40.3	0.407	149.000
HF	0.25	890.1	58.7	0.593	

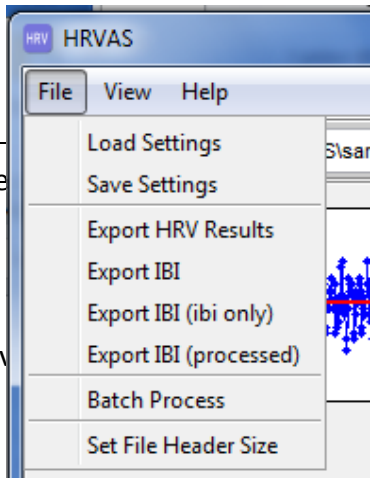
Misc. Information

Input Data

HRVAS can read inter-beat interval files (.ibi) and text files (.txt), both of which are ASCII files. The expected data format must have one or two columns. If one column is used, this

column must represent IBI/RR values in units of seconds. If two columns are used, the first column represents time in units of seconds. The second column represents IBI/RR values in units of seconds

Exporting Results



1. Export HRV Results – exports HRV results to a MS Excel file
2. Exporting IBI
    a. Export IBI – exports currently loaded IBI
    b. Export IBI (ibi only) – exports IBI values only. Time v
    c. Export IBI (processed) – exports preprocessed IBI.

Batch Processing

File>Batch Processing

1. Choose directory.
2. Select files. Uncheck the checkbox labeled “Include all files” to select individual files for batch processing.
3. Run Batch.

HRV Analysis & Preprocessing

- Include simple/short information about preprocessing options

For detailed information about IBI preprocessing and HRV analysis see the document Ramshur_thesis.docx.