

HRV-Trainer

Manual

Introduction

Every HRV analysis provides you with a huge number of parameters and diagrams, each of which quantifies or visualizes HRV in its own way. Although their common purpose is to express the amount of HRV in some way, each single parameter or diagram provides a distinct perspective on HRV. Unfortunately, it isn't easy to embrace the special characteristics of a parameter or diagram intuitively. Even a description of the properties of a parameter is often of modest value. It is a bit like learning to drive: A good theoretical background is necessary, but practice is pivotal.

For this reason we developed HRV-Trainer. It is a powerful tool to help you examine in a practical way the properties of the most important parameters and diagrams related to HRV analysis, without the need to wait for the right subject with a special HRV pattern to come along. With HRV-Trainer you can easily simulate the most important heart rate traces you will see in your practical work. By shifting the simulation settings you can observe how doing so affects parameters and diagrams. All your simulation settings can be stored in templates. With templates, you can even create real-time animations, providing an illustrative visual impression of how diagrams change according to changing heart rate traces.

Note:

HRV-Trainer calculates the common HRV parameters and diagrams. They are not especially explained here, because information about them can be easily found in the literature. Some parameters and diagrams are derived from HRV-Scanner, a professional HRV system of BioSign GmbH. For a description of these, please refer to the HRV-Scanner manual.

How to create a synthetic heart rate trace

First, define the type of HRV measurement you want to simulate. You can choose between the DBT (Deep breathing Test) and the Short-Term-HRV. The DBT measures the respiratory sinus arrhythmia with a respiratory rate of 6 breathing cycles per minute. This test specifically gathers information about the parasympathetic branch of the autonomic nervous system. The Short-Term-HRV is a test in which the subject is recumbent and quiescent, without any extra stimulation. It gives insights into the activity of both the parasympathetic and the sympathetic system, and the balance between them.

The next steps are to adjust the mean heart rate and, optionally, to apply a respiratory sinus arrhythmia (RSA). The latter creates a sinusoidal oscillation of the heart rate with a modifiable frequency and amplitude.

Analogous to the RSA you can add an additional sinus wave to the heart rate trace in each of the three frequency bands (VLF, LF and HF).

You also can apply a trend to the heart rate trace, i.e. a continuous increase or decline of the heart rate. Finally, you can insert up to six sudden jumps of the heart rate (artifacts), reflecting ectopic beats or motion artifacts, if you want to explore how this could influence the results of the HRV analysis.

When all settings have been made, you press "Create Heart Rate" to apply all the settings to a new heart rate trace. You can also store the settings in templates. A couple of predefined templates facilitate getting started with HRV-Trainer.

How to create animations

It is possible to create short "movies" with HRV-Trainer. These animations display clearly how diagrams and parameters change during the transition of the heart rate trace from one template to another. To create an animation, determine the sequence of the templates in which you are interested. The length of the animation can be adjusted using the "Duration" setting. "Frames/Sec" determines how many single shots of the diagrams will be taken per second.

An example:

You have created two templates. The first template defines a heart rate trace with a weak respiratory sinus arrhythmia (3 bpm). The second template adjusts a heart rate trace with a large respiratory sinus arrhythmia (30 bpm). The settings for animation length and frame rate are 10 s and 25 pictures per second, respectively. If you now create the animation, HRV-Trainer will calculate a sequence of $10 \times 25 = 250$ pictures for each diagram, corresponding to the increasing respiratory sinus arrhythmia from 3 bpm up to 30 bpm in 250 steps.

Making an animation also creates a special diagram that tracks a certain HRV parameter during the animation. You can select the parameter from a list of available parameters. This diagram quantifies precisely how a parameter is influenced when the heart rate trace is changed from one template to another.