beatwell.tech

Product Catalogue

Beatwell

Edition 2025

Our vision is to create a universally accessible wellness monitoring, empowering individuals to better understand and manage their heart health. We believe that cutting-edge technologies can bridge the gap between early detection, prevention, and effective intervention, reducing the global burden of cardiovascular disease.

We envision a future where advanced cardiac monitoring solutions are seamlessly integrated into everyday healthcare systems, empowering clinicians, researchers, and digital health innovators to leverage real-time, high-quality data for more informed decision-making. Through continuous innovation, strategic partnerships, and a deep commitment to scientific excellence, we aim to set we aim to set an improved standard for health data processing.

Our mission is to revolutionize the processing of health data by developing advanced, accessible, and scalable algorithms and technology solutions for our partners—clinics, hospitals, medical device manufacturers, and digital health companies. We are dedicated to seamless integration, ensuring our technologies are interoperable and secure.

By harnessing artificial intelligence, cutting-edge biomedical signal processing, and connected devices, we transform raw cardiovascular data into meaningful, actionable insights. Through innovation and collaboration, cardiovascular disorders are addressed by making health monitoring more accessible, empowering individuals worldwide with greater knowledge and control over their well-being.

Content

Core Technology

Through extensive R&D, Beatwell Technologies has created a pioneering model of hemodynamic signals that acquire blood circulation information through various sensing techniques. This model enables the collection of precise data about both cardiac function and the arterial system from virtually any anatomical location. By applying a novel method of standalone analysis of hemodynamic signals, we derive actionable insights into the condition of the cardiovascular system.

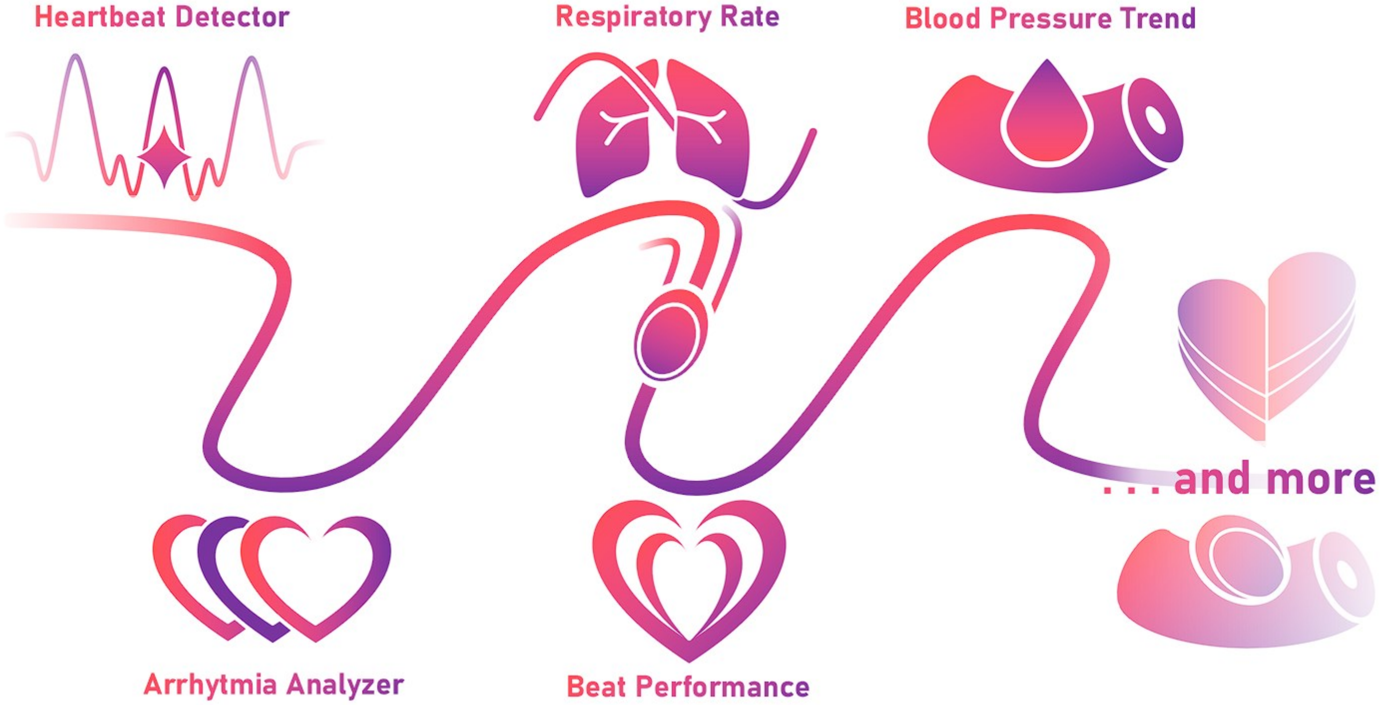
A key advantage of our proprietary algorithms lies in their ability to identify and validate each individual heart beat waveform with high temporal precision. This beat-by-beat segmentation unlocks advanced processing techniques, such as detailed waveform morphology analysis, allowing for deeper physiological understanding that surpasses conventional averaged data models.

The developed algorithm modules are designed to function seamlessly across a wide range of modern technologies*, including photoplethysmography, regardless of the smart device they are integrated into. To ensure long-term consistency and reliability in a field that currently lacks standardization, our algorithms adhere to a robust internal standard**. Today, this structured approach enhances their integration into wellness applications, fitness trackers, and other wearable technologies. By transforming smart devices into intelligent tools for cardiovascular monitoring and preventive care, our technology enables a comprehensive understanding of heart and vascular health — essential for early detection, accurate diagnosis, and personalized medical strategies.

*Each algorithm module specifies the technologies it was tested on and internally validated.
**The internally developed standards are referenced within the associated algorithm module(s).

At Beatwell Technologies, we're continuously evolving to meet the growing demands of the wellness and smart health industries. Our next development milestones focus on expanding our capabilities to include additional information such as beat performance, cuffless blood pressure trend and stress indicators — all designed to offer richer, more personalized wellness insights.

Our roadmap includes strategic collaborations with wearable manufacturers, wellness platforms, and digital health providers to ensure smooth deployment and strong market differentiation. With every step forward, our goal remains the same: to empower our partners with intelligent, plug-and-play technology that adds measurable value to their users.



Individual Heartbeat Detection

Enhance your health and fitness devices with highly accurate individual heartbeat detection. Our hybrid algorithm leverages proven classical techniques combined with **Neural Network** validation to deliver robust, real-time heart rate data. Designed for seamless integration, it ensures superior data quality and reliability across diverse health monitoring applications.

Key Features

- Compatible with various sensing techniques (see Table 1.1).
- Configurable detection modes: express and stabilized (see Table 1.2).
- Individual heart beat detection performance of **minimum 93%** (see Figure 1.1).
- Individual heart beat waveform quality assessment (see Table 1.3).
- Intrinsic noise and artifact immunity.
- Minimum signal sampling frequency of 100 Hz.

Usecases

- Individual heart beat segmentation for custom analysis.
- Cardiac function monitoring in wellbeing devices.
- Raw estimation of the heart rate (HR) and variability (HRV)[1].
- Characterization of the heart cycle activity.

Performance

The algorithm performs on a variety of physiological signals[2] described below:

Table 1.1 Module tested compatibility

Signal Type	Acquisition Location	Acquisition Device
PPG	Index finger	Pulse oximeter, Smart-ring
	Wrist	Smart-watch
	Forehead	Pulse oximeter
	Ear lobe	Pulse oximeter
	Chest site	Smart-patch
ART	Brachial left and right	Invasive arterial line
	Radial left and right	
	Femoral left and right	
ABP	Brachial left and right	Contact oscillometric pressure
	Radial left and right	
	Femoral left and right	
RVS	Front chest	Remote Radar 10/24 GHz

[1] The module is marking the detected and validated cardiac cycles by the systolic peak criteria, thus providing a raw estimation of the heart rate. Improving HR results is taken exclusively by the integrator party due to used system' electrical characteristics that involves compensation methods.
[2] Tested on private waveforms database collection.

Table 1.2 Detection modes

Characteristics	Express mode	Stabilized mode
Minimum buffering length	1 second	3 seconds
Accuracy	Minimum 90%	Minimum 95%
Artifact Immunity	Medium	High
Applicability	Immediate result	Post event analysis

For the express mode it was tested a single pulse condition that was evaluated as valid (V) or invalid (A - artifact) heart beats[3)] (see Figure 1.1A).

For the stabilized modes it was tested on a ten pulses condition with a variation of combination between occurance of valid (V) and invalid (A - artifact) heart beats[3)] (see Figure 1.1B).

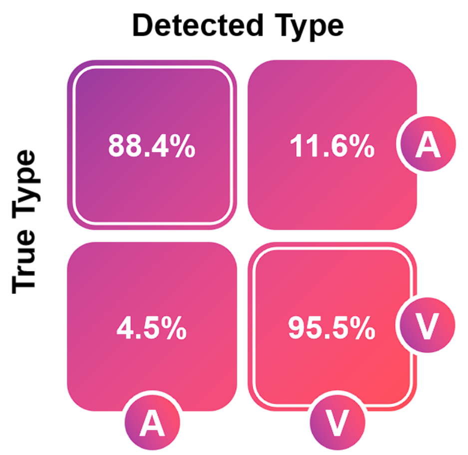


Figure 1.1A Performance of Express Mode

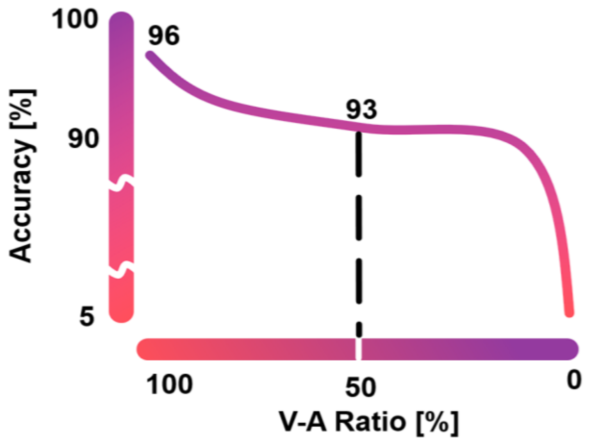


Figure 1.1B Performance of Stabilized Mode

The Beatwell Technology waveform quality assessment standard evaluates the cycles with regard to the confidence level of the extracted cardiovascular information that can be obtained through further analysis. The developed standard defines three major quality classes, as shown in Table 1.3. This feature is applicable only in Stabilized Mode.

Table 1.3 Waveform quality standard

Waveform quality class	Description
High quality (HQ)	The signal has a well-defined shape that enables accurate extraction of heart rate metrics and supports further contour analysis with high confidence.
Medium quality (MQ)	The signal has a moderately defined shape, allowing for heart rate extraction, but contour analysis is prone to errors. Signals in this category typically have low noise levels.
Low quality (LQ)	The signal has a poor shape, which affects the extraction of heart rate metrics, and contour analysis cannot be applied. This class typically includes signals with artifacts and a high level of noise.

[3)] Heartbeats type were evaluated by medical specialists by considering EKG reference.

Arrhythmia Analyzer

Integrate advanced arrhythmia analyzer into health monitoring systems with a **fractal-focused** algorithm capable of identifying subtle heartbeat irregularities often missed by conventional methods. By recognizing and validating these atypical waveforms, the module corrects heart rate and variability metrics using additionaly a proprietary internal standard that quantifies arrhythmic patterns.

Detects prolonged (PRL) or premature (PRM) spurious heartbeats linked to the following conditions, but not limited to:

- Atrial Fibrilation - **AFib**
- Premature Atrial Complexes - **PAC**
- Atrial Flutter - **AFlut**
- Premature Ventricular Complexes - **PVC**
- Left Fascicular Block - **LFB**
- 1st degree A-V Block - **AVB**
- Right Bundle Branch Block **RB3**

Key Features

- Compatible with various sensing techniques (see Table 2.1).
- Arrythmia pattern detection performs on hemodynamic signals without external EKG.
- Fractals detection performance of **minimum 90%** (see Figure 2.1).
- Corrected heart rate and variability results due to fractal detection.
- Configurable thresholds for labeling prolonged or premature cycles.
- Minimum signal sampling freqency of 200 Hz.

Usecases

- Arrhythmia pattern detection in real time for preventive screening.
- Arrhythmia event characterization in diagnosticated disorders.
- Stress assessment via detection of stress-related arrhythmias and ectopic beats.
- Cardiac function monitoring in wearable and wellbeing devices.
- Sensor fusion with EKG related devices.
- Characterization of the heart cycle activity.

Important: The module detects arrythmia patterns within heartbeat activity without attributing to a specific cardiovascular disease (CVD). The diagnostic interpretation is the exclusive responsibility of medical professionals.

Performance

Precondition: The module is expecting a sequance of validated heart beats of at least 3 cycles. An incomplete sequence or an unverified heart beats affects the performance of the fractal detection.

The algorithm performs on a variety of physiological signals described below:

Table 2.1 Module tested compatibility

Signal Type	Acquisition Location	Acquisition Device
PPG	Index finger (any)	Pulse oximeter, smart-ring
	Wrist left and right	Smart-watch
	Forehead	Pulse oximeter
	Ear lobe	Pulse oximeter
ART	Brachial left and right	Invasive arterial line
	Radial left and right	
	Femoral left and right	
ABP	Brachial left and right	Contact oscillometric pressure
	Radial left and right	
	Femoral left and right	

The algorithm performance is evaluated on a hymodynamic signal's delimited frame containing fractal beats (Figure 2.1). Synchronous EKG reference waveform is just for tracking support. The detection performance between artifact shape (A) and true fractal shape (F) is depicted in Figure 2.2.

Important: Fractal detection performance is highly dependent by the following factors:

- Signal processing system by the delivered final waveform quality to be processed.
- Sensor measurement site by the completeness of the recorded hemodynamic information.

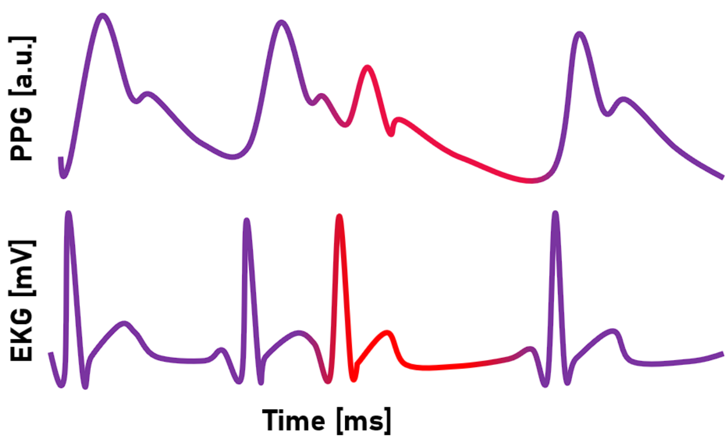


Figure 2.1 Fractal detection test*

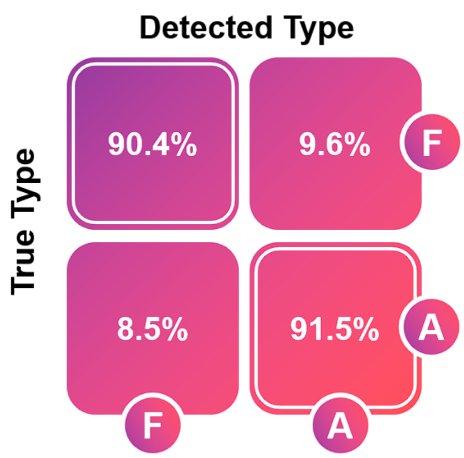


Figure 2.2 Performance of fractal detection

*For illustration purposes only. Actual data is provided for interested parties upon request.

Respiratory Rate Estimation

Add scalable respiratory monitoring capabilities to your device with a sensor-free algorithm that extracts respiratory rate directly from physiological signals. By analyzing waveform dynamics, the module can also identify signs of **Respiratory Sinus Arrhythmia** (RSA), offering deeper insights into autonomic function and overall cardiorespiratory health.

Key Features

- Compatible with invasive, contact and remote acquired signals by any devices, including wearables (see Table 3.1).
- Sensor-free by fully extraction using physiological sensors (see Table 3.1).
- Respiratory Sinus Arrhythmia (RSA) detection capability (see Table 3.2).
- Minimum absolute error of 1 ± 0.5 respiration rate (RR).[1]
- Adaptive sensitivity based on signal quality.[2]

Usecases

- Pulmonary function monitoring in wearable and wellbeing devices.
- Low resource health monitoring settings.
- Sleep monitoring for quality assessment.
- Study of the pulmonary activity.

Performance

The algorithm performs on a variety of physiological signals described below:

Table 1.1 Module tested compatibility

Signal Type	Acquisition Location	Acquisition Device
PPG	Index finger	Pulse oximeter, Smart-ring
	Wrist	Smart-watch
	Forehead	Pulse oximeter
	Ear lobe	Pulse oximeter
	Chest site	Smart-patch
ART	Brachial left and right	Invasive arterial line
	Radial left and right	
	Femoral left and right	
ABP	Brachial left and right	Contact oscillometric pressure
	Radial left and right	
	Femoral left and right	

1) In scenarios where respiratory rate can be detected, the algorithm achieves minimal error in comparison with capnographic reference measurements.

2) The algorithm adjusts its sensitivity based on real-time assessment of the signal quality. In low-quality or physiologically uninformative signals, confidence scores are reduced and respiratory estimations are delivered conservatively.

The Respiratory Sinus Arrhythmia is displayed as a difference between maximum and minimum heart rate (in BPM) during the detected physiological process as shown in Fig 3.1.

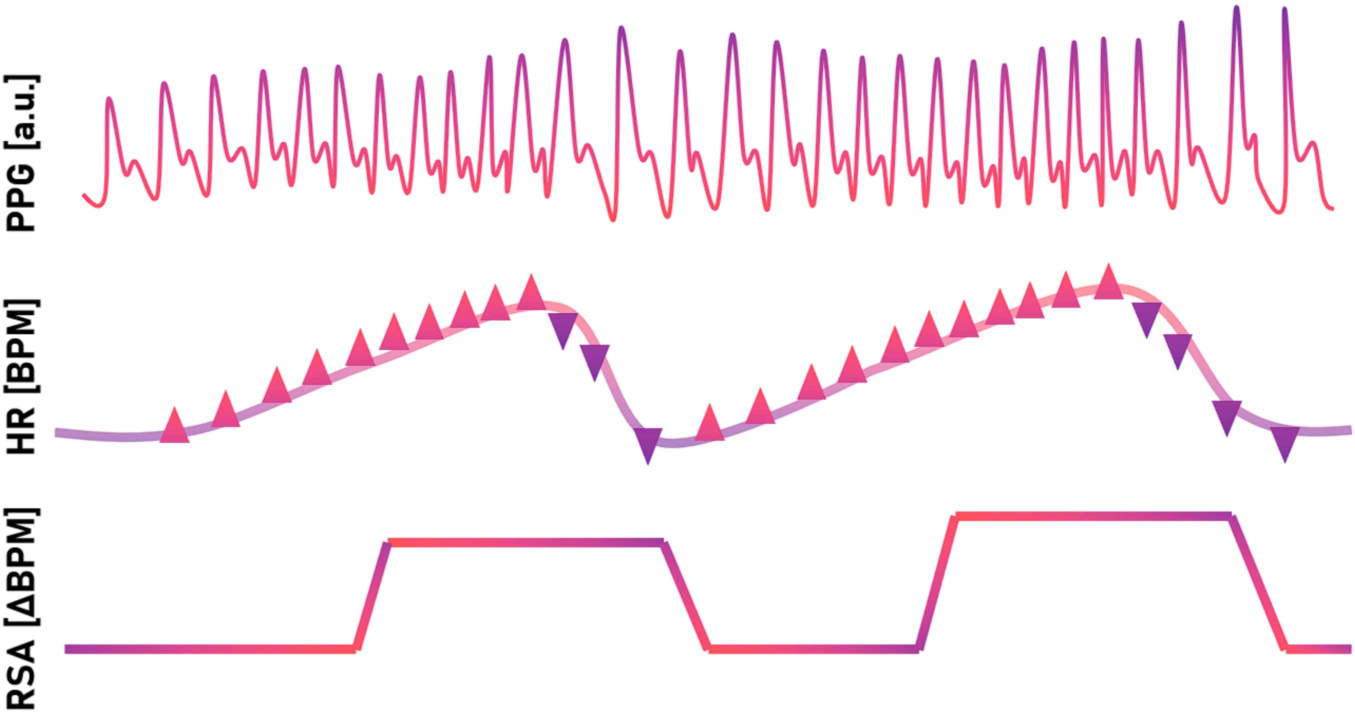


Fig. 3.1 Example of detected RSA represented as HR modulation power*

*For illustration purposes only. Actual data is provided for interested parties upon request.