

Coherence Formula Sheet

PolarH10 RR-derived coherence

Data path

- Input stream: accepted RR intervals from the Heart Rate Measurement characteristic.
- Physical H10: those RR intervals are device-derived from ECG beat timing inside the strap.
- Synthetic transport: the coherence solve still uses RR, while synthetic PMD ECG is emitted separately so the waveform view stays aligned to the same beat schedule.

Fixed spectral model

The app keeps the paper-defined constants fixed:

- peak search band: 0.04–0.26 Hz
- peak integration window: 0.030 Hz centered on the dominant peak
- total-power band: 0.0033–0.4 Hz

These formulas operate on the RR-derived tachogram after the irregular beat-interval stream has been resampled into a continuous time series. In the notation below, f is frequency in hertz, $PSD(f)$ is the power spectral density at that frequency, f_{peak} is the strongest oscillation in the allowed coherence band, P_{peak} is the power concentrated around that oscillation, and P_{total} is the broader band power used as the paper's reference total.

$$f_{peak} = \arg \max_{f \in [0.04, 0.26]} PSD(f)$$

This step finds the dominant rhythm inside the coherence search band instead of across the entire spectrum.

$$P_{peak} = \int_{f_{peak}-0.015}^{f_{peak}+0.015} PSD(f) df$$

This integrates a narrow window around the dominant peak so the metric rewards concentrated narrowband power rather than diffuse nearby energy.

$$P_{total} = \int_{0.0033}^{0.4} PSD(f) df$$

This is the total reference power across the wider HRV band used by the cited method.

$$\text{paper coherence ratio} = \left(\frac{P_{peak}}{P_{total} - P_{peak}} \right)^2$$

This ratio rises when one narrow resonance-like peak dominates the spectrum and falls when power is spread across the rest of the band.

UI-facing normalized score

The app also publishes a bounded score for the headline readout and summary charts:

$$\text{normalized coherence}_{0..1} = \text{clamp}\left(\frac{P_{peak}}{P_{total}}, 0, 1\right)$$

Here the app is simply reporting the fraction of tracked power that sits in the dominant peak window, then clamping that fraction to a display-friendly range.

This normalized score is an application-level presentation choice. It is not the McCraty paper ratio itself.

Runtime choices around the paper formula

The cited source fixes the spectral constants above, but it does not define the operator-side runtime details used by this app. The current implementation uses:

- a rolling RR window
- cubic-spline resampling of the RR tachogram
- a 128-point Hann-windowed spectrum solve
- a smoothed headline 0..1 display value
- a separate confidence score based on RR count and window coverage

Those runtime choices describe how the app gets from incoming RR intervals to $PSD(f)$ and to a stable operator readout. They affect warmup, smoothness, and confidence behavior, but not the core paper ratio formula shown above.

Alignment status

The implementation is aligned to the cited reference at the formula level for the peak search band, peak-window width, total-band limits, and paper coherence ratio. The display normalization, smoothing, and confidence telemetry are explicit application-level additions.

References

- McCraty, Atkinson, Tomasino, and Bradley, *The Coherent Heart* (2006).
- <https://mesmerprism.github.io/PolarH10/reference/coherence-workflow.html>
- <https://mesmerprism.github.io/PolarH10/reference/references.html>