

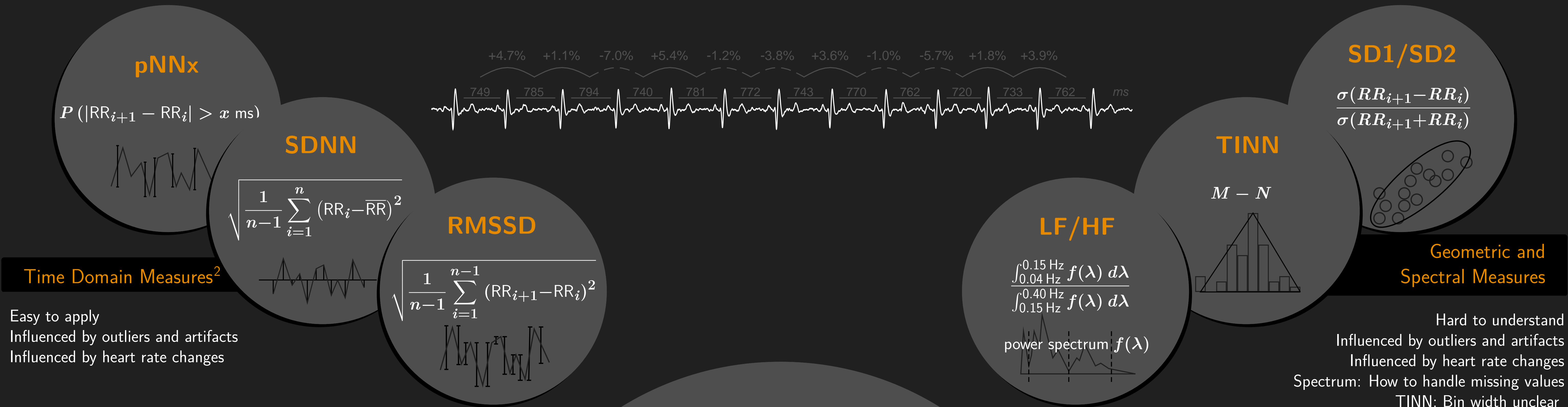
A robust, simple and reliable measure of Heart Rate Variability using relative RR intervals

Marcus Vollmer

Department of Mathematics and Computer Science
University of Greifswald, Germany

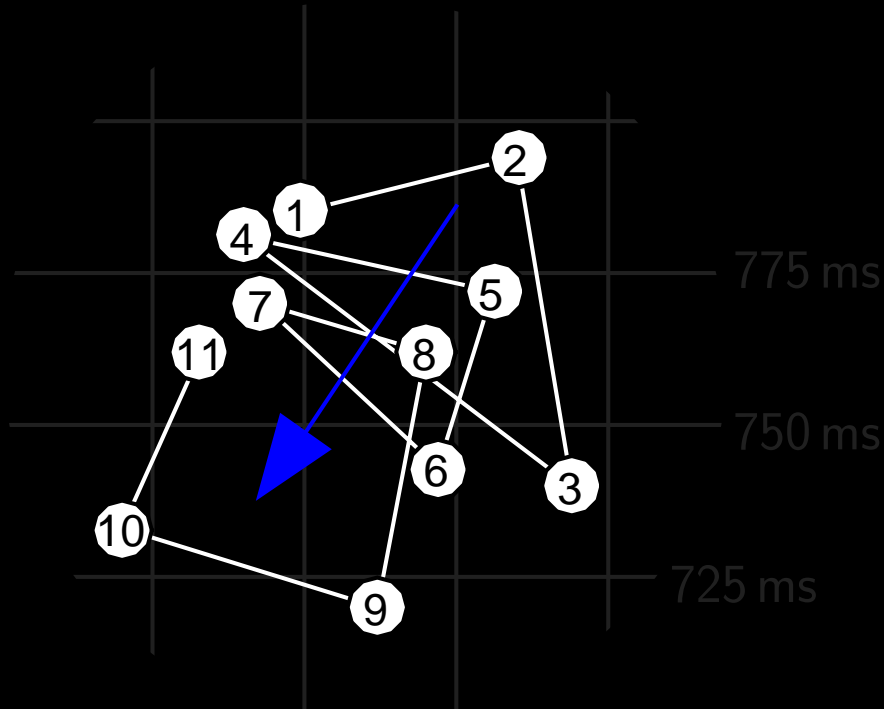
Heart Rate Variability

Heart Rate Variability (HRV) characterizes the variation of the heart rate when analyzing successive cardiac cycles over a fixed measuring period. HRV is a measurand of the neurovegetative activity and autonomic function of the heart and describes the ability of the heart to change time intervals from one heart beat to the next, continually and without overloading, and to flexibly adjust to different overloads.¹



Absolute RR intervals are influenced by heart rate changes. A good measure should be adjusted to the temporary heart rate.

Complex dynamics of heart beat intervals disguised in the Poincaré map.

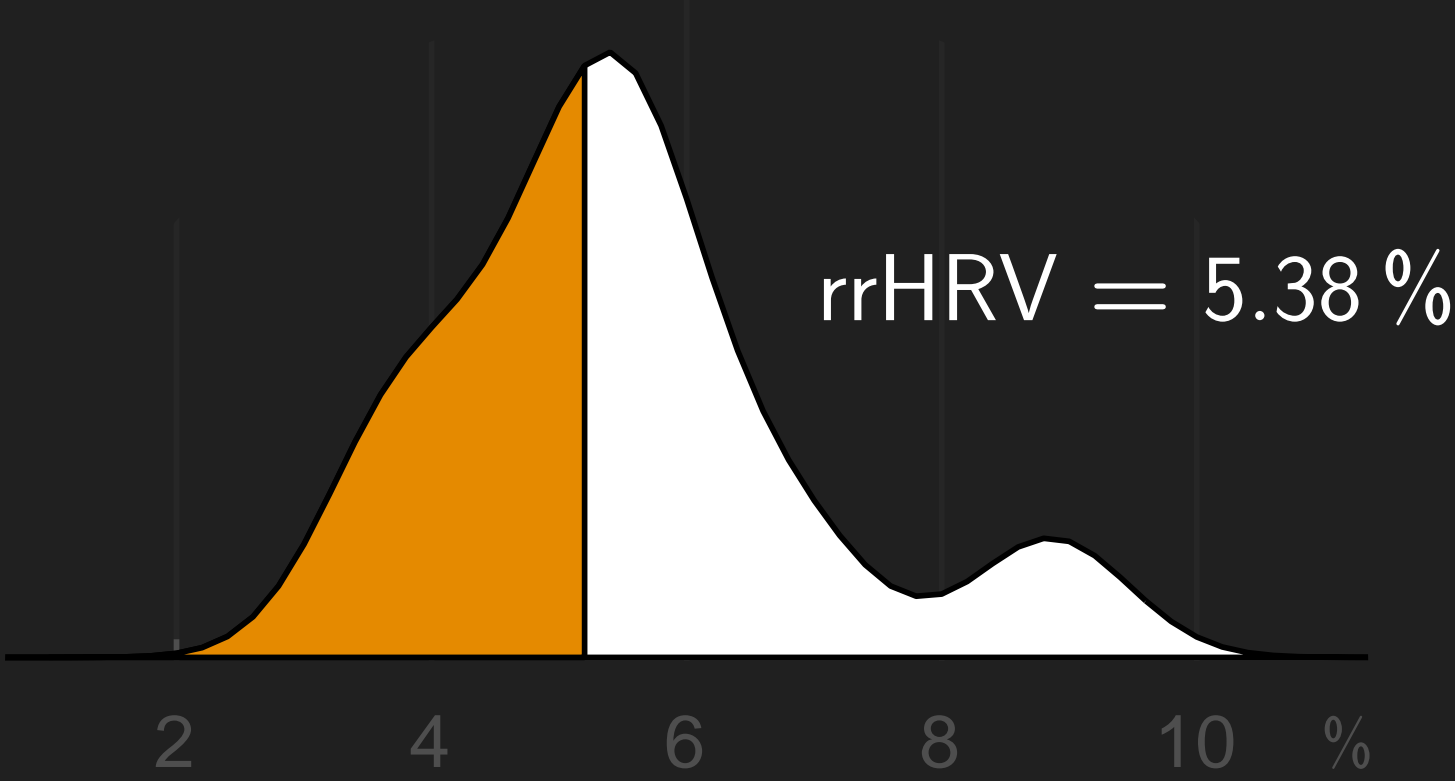
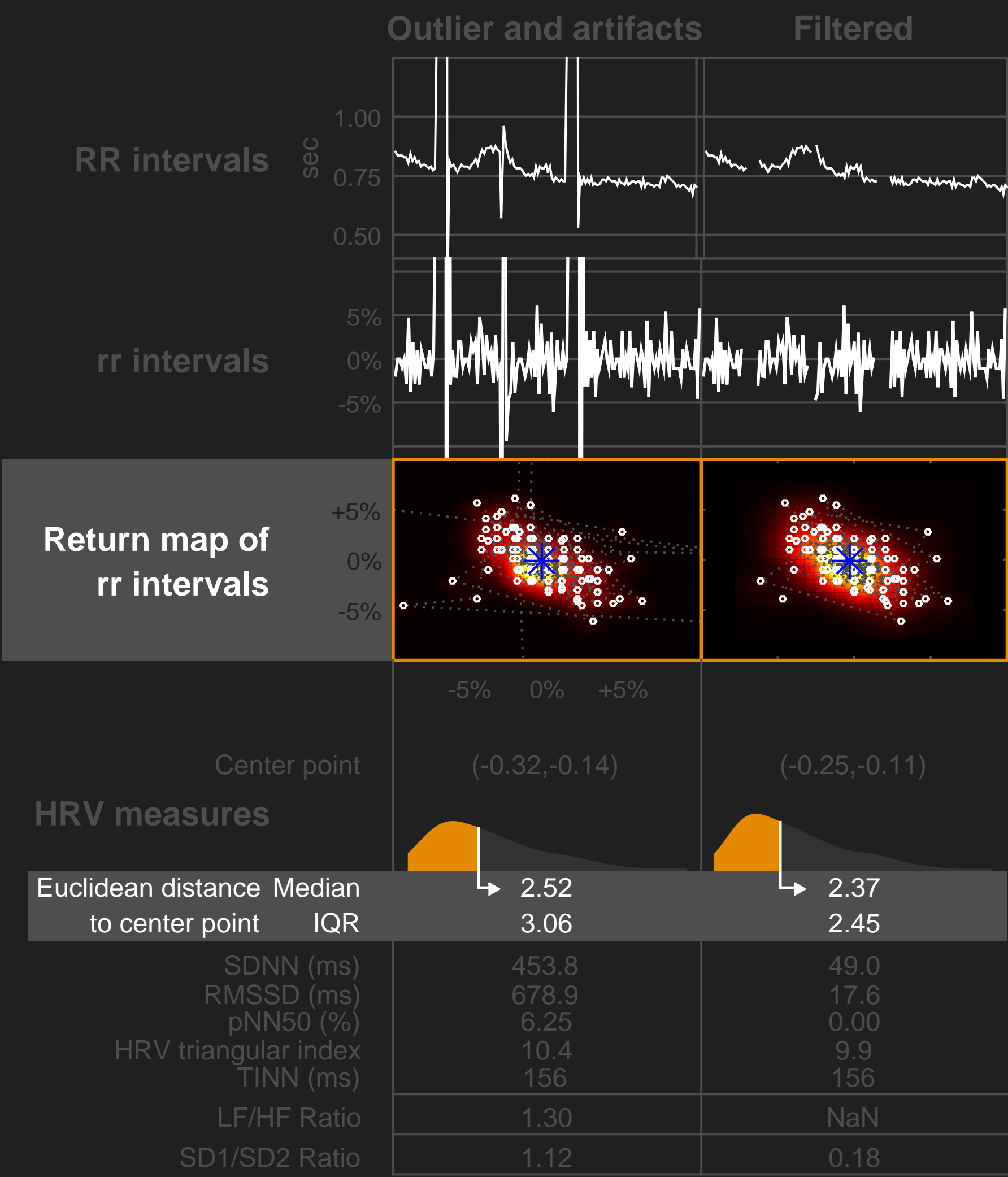


d_i is the **euclidean distance** between (rr_i, rr_{i+1}) and center point c , which is the average of relative RR intervals for which $|rr_i| < 20\%$.

The interquartile range (IQR) of (d_i) provides information about the **annular intensity**.

Center point c provides information about **increasing** ($c > 0$) or **decreasing heart rates** ($c < 0$).

Outliers and Artifacts excerpt of nsr2db/nsr037³

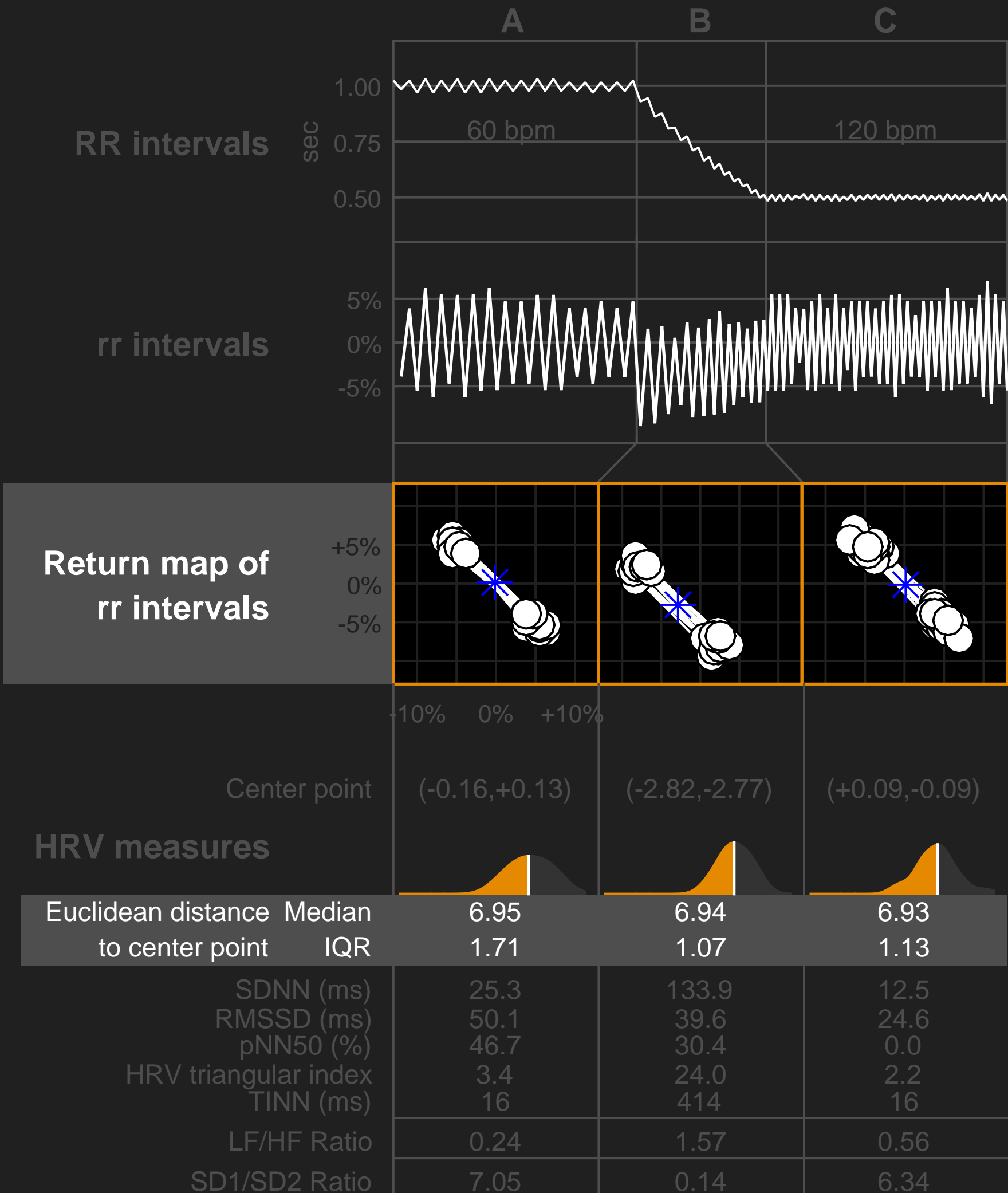


Distance to c

Robust against outliers and artifacts.

Invariant against linear transformations.

Heart Rate Changes



Try yourself!

[1] K. Hottenrott, "Grundlagen zur Herzfrequenzvariabilität und Anwendungsmöglichkeiten im Sport," in *Herzfrequenzvariabilität im Sport - Prävention, Rehabilitation und Training*, vol. 129, pp. 9–26, Edition Czwilina Feldhaus Verlag Hamburg, 2002.

[2] M. Malik, J. T. Bigger, A. J. Camm, R. E. Kleiger, A. Malliani, A. J. Moss, and P. J. Schwartz, "Heart rate variability," *European Heart Journal*, vol. 17, no. 3, pp. 354–381, 1996.

[3] A. L. Goldberger, L. A. N. Amaral, L. Glass, J. M. Hausdorff, P. C. Ivanov, R. G. Mark, J. E. Mietus, G. B. Moody, C.-K. Peng, and H. E. Stanley, "PhysioBank, PhysioToolkit, and PhysioNet: Components of a new research resource for complex physiologic signals," *Circulation*, vol. 101, no. 23, pp. e215–e220, 2000 (June 13).

