Bubble, Dispersion and Distribution Entropy for Discrimination of Cardiovascular Signals

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Aims: The goal of this study is to compare the performance of three commonly used and recently proposed entropy definitions, in the context of cardiovascular signals. Bubble (bEn), Dispersion (dispEn), and Distribution (distEn) Entropy were evaluated on long term heart rate variability series (HRV) for their capability of generating features allowing the automated detection of normal sinus rhythm.

Methods: Five datasets from PhysioNet were employed: Fantasia, Congestive Heart Failure (CHF), Normal Sinus Rhythm (NSR), MIT-BIH Arrhythmia (MIT-BIH) and Sudden Cardiac Death (SCD). Entropy features were computed for every definition and selected parameters (m=2–25 for bEn , m=2–5, c=3–9 for distEn and dispEn). Exhaustive search was applied to identify the optimal feature subset for each challenge (NSR vs each pathological condition). Binary classification performance was evaluated using k-NN, SVM, Random Forest, Naive Bayes, and Gradient Boosting classifiers with stratified 5-fold cross-validation.

Results: BEn achieved the highest accuracy in 4/4 datasets: 90% (Fantasia), 92% (CHF/NSR), 94% (MIT-BIH/NSR), and 88% (SCD/NSR). Cohen's d (Figure 1) was also computed to measure class separation, exhibiting the discriminative power for each definition and challenge.

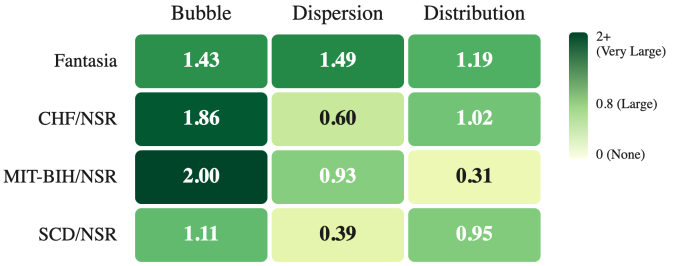

Figure 1: Class separation power (Cohen's d). Higher values equal better class discrimination.

Conclusion: The findings offer direction for the evaluation of the most recent and used entropy definitions in the context of HRV analysis. BeN presented better classification accuracy than the other examined methods.