An Open-Source Algorithm for Standardized Bullseye Visualization of High-Resolution Cardiac Ventricular Data

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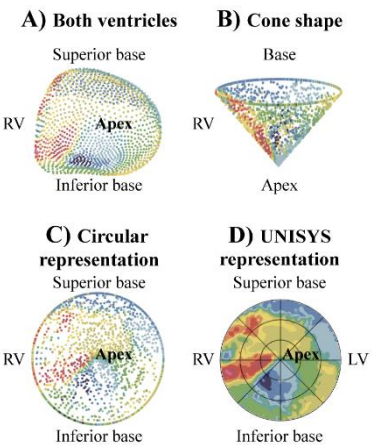
Processing electro- or mechano-anatomical results from cardiac ventricles for scientific purposes in a structured manner can be challenging. Providing a clear, unified graphical representation of data by standardization, whilst still considering inter-individual anatomical aspects, could aid researchers in gaining more insight from complex data. We developed UNISYS (Universal veNtrIcular bullSeYe viSualization): an algorithm to process the geometry of cardiac ventricular data and display them uniformly in a 2D high-resolution circular representation (bullseye plot).

The algorithm provides a semi-automated approach, programmed in MATLAB and is suitable for invasive and non-invasive electro- or mechanical-anatomical mapping data of the ventricles. Through the circular representation it employs, this works either for the epicardium for both ventricles simultaneously, or for the endocardium of one ventricle separately. The input geometry consists of vertices, and each vertex should contain an associated value to display (e.g. activation time, repolarization time, voltage, strain etc). Firstly, the user denotes the apex, base and lateral right ventricle through a graphical user interface. Subsequently, the ventricles are rotated parallel to the heart axis, with the apex pointing downwards (Fig. A). Secondly, the ventricles are morphed to a cone shape, with increasing radius from apex to base, converting cartesian to polar coordinates (Fig. B). Thirdly, the cone is translated into a 2D circular disk (Fig. C). Lastly, the initial values associated with each vertex in the ventricles are colour-coded in 2D, with apical values displayed in the centre and basal values in the outer ring (Fig. D). By visualization of the individual points' contribution to the bullseye plot, a scientifically correct interpretation is warranted (Fig. C).



The algorithm is now freely available through the consortium for ECG imaging to encourage its widespread use and contribute to the scientific development in the field of cardiac mapping, while preserving scientifically accurate interpretation of the data.