CONSTRUCTION OF PHASE PORTRAITS OF PCG SIGNALS

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Dynamical systems theory is an important ingredient in nonlinear signal processing. The dynamics of a time discrete system is determined by its possible states in a multivariate vector space (called state space or phase space).

Phonocardiographic waveforms consist of a large variety of types, ranging from impulses (snaps and clicks) through turbulence induced sounds (murmurs) to nearly periodic oscillations (heart sounds). The transition between these types could be described by switching between different linear models, but using a nonlinear setting, such transitions occur naturally as bifurcations [1].

For PCG signals we constructed phase portraits (PP) in 2-dimensional state space. To demonstrate PP of heart sounds and murmurs we extracted main sounds from PCG signals (Fig.1).

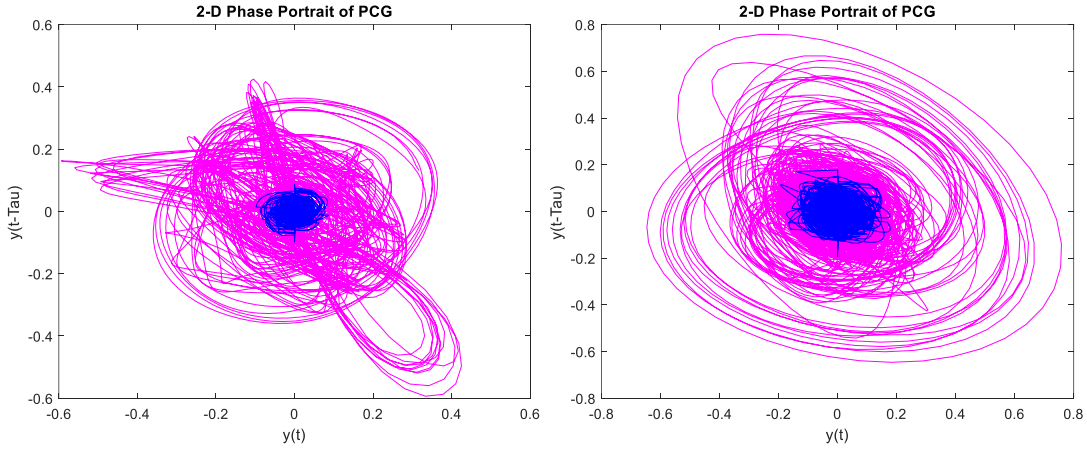

Figure 1 – PP of main sounds (light) and rest signal – murmurs (dark in the center)

Different signals have different forms of PP and samples of main sounds can be separated from rest samples using PP. In [2], [3] we showed applications of PP analysis. So, PP of PCG signals probably can be used for diagnostics of heart sounds and for segmentation of PCG signal without simultaneous ECG-recording.

References:

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