Multi-parameter Physiologic Signal Reconstruction by Means of Wavelet Singularity Detection and Signal Correlation

Wei Wu*

WEIWU INFO Portugal, Porto, Portugal

Reconstructing corrupted data from multi-parameter physiologic signals becomes essential for a real-world monitoring application. Our investigation has discovered that multi-parameter physiologic signals coming from a single human body are strongly correlated and synchronized, and it is possible to predict the waveform peaks of one signal by observing peak distribution at another signal. The Wavelet singularity analysis at signals can exactly detect the waveform rising and falling that occur in the same periodical way as the peaks occur, confirming the singularities of multi-parameter physiologic signals are also strictly synchronized. Based on the phenomenon mentioned above, we propose a novel method to reconstruct corrupted data. We use Wavelet to detect the singularity of the target signal, resulting at a time distribution curve of singularity peaks that accord with the rising and falling edge of the signal. The singularity peaks are further used to find out a basic waveform unit that appears periodically throughout the signal. Also the singularity peak distribution curve of other signals are calculated and among them, one bearing the most similar singularity peak period as the target signal bears is chosen as a reference signal. The corrupted data at the target signal is reconstructed by laying the basic waveform units one by one according to the singularity peek distribution of the reference signal at the time duration where the target data is corrupted, then, the time delay between the target signal singularity peak and the reference signal singularity peak is calculated and is used to align the reconstructed data with target signal. The reconstructed signal can reach above 99% accuracy in timing and 98% accuracy in amplitude for a target signal corrupted randomly, and variable accuracy for a target signal not only corrupted but also distorted due to the basic waveform unit extracted from the target signal may also be distorted. The reconstruction accuracy can be further improved by manually choosing the basic waveform unit that is sensitive to amplitude accuracy and by refining the reference selection that is sensitive to timing accuracy and by optimizing computation algorithm.