

Interpolation methods in the algorithms implementing change of sampling frequency for discrete signals

Abstract

The subject of the thesis concerns the issue of searching for new values of digital signal samples which are distributed in the discrete time domain according to the target sampling period on the basis of the already existing waveform. This type of operation generates, excluding special cases, some distortions that would not occur during sampling of analog signal with new frequency. The reduction of error level, which is caused by resampling algorithms, allows not only to increase the quality of output signal but also to expand the area of application of the algorithms.

The most popular and intuitive approach is the implementation of time domain resampling using classic polynomial interpolation methods of signal samples or the interpolator and decimator cascade (in practice, optimized by polyphase decomposition in order to reduce computational complexity in most cases). However, the lowest level of resampling errors is generated by algorithms operating directly on the spectrum. As the purpose of the work is to formulate such modifications in the resampling process that will allow for the reduction of distortion, hence the algorithm operating in the frequency domain in the basic version was chosen as the base method. The modifications are based on the input to output spectrum relation, specific to resampling discovered during the research and described in the work. It consists in partial reconstruction of processes that occur in the spectrum as a result of signal resampling, which has been shown to affect the quality of resampling in a positive way.

In addition, the influence of such factors as bandwidth and band position, the ratio of the original and target sampling frequencies, signal length and the number of spectrum components on the quality of resampling was tested. The factors, which relate to the spectrum structure, affect the results of processing in all tested methods and the remaining factors do so in most cases.

In the final part of the work, examples of applications requiring the use of high precision resampling are presented, as well as the description of implementations with results for the modified spectral resampling algorithm.