

Audio signal processing - resampling

For this document, the following colour coding was used:

Minimal requirements

Requirements

Extra credit

Generate a Matlab function for downsampling a signal by a factor of 6 (e.g. from $F_s=48\text{kHz}$ to $F_s=8\text{kHz}$), using decimation and custom-generated filters. Strive for lowest complexity and best quality. Upgrade the function to allow downsampling by any integer factor.

Generate a Matlab function for upsampling a signal by a factor of 2 (e.g. from $F_s=8\text{kHz}$ to $F_s=16\text{kHz}$), using interpolation (or insertion of specific values) and custom-generated filters. Strive for lowest complexity and best quality. Upgrade the function to allow upsampling by any integer factor. Upgrade the function to include partial reconstruction/prediction of high-frequency components, to increase the voice quality.

Record at least 2 instances of human speech (male and female) at $F_s=48\text{kHz}$ (or upsample them from $F_s=44.1\text{kHz}$, using the Matlab built-in resampling function). Preferably, they should contain loud, clear speech with minimal background noise. Create the 8kHz versions of the signals with the generated downsampling function. Then create 16kHz versions of the signals by upsampling the 8kHz versions with the generated upsampling function.

Evaluate the quality of the 8kHz and 16kHz versions of the signals using PESQ.

Write a report containing:

- Description and explanations for the generated functions
- Description of filters considered, analysis (frequency analysis, complexity analysis) and motivation for their adequacy for the task, as well as reasons for the final rejection/acceptance
- Spectrograms for all versions of at least one signal and comments on the effects of the functions and various filters used within those functions.
- PESQ evaluations for all signal and versions.
- Annex: functions code