Gain Control over Discrete Signal

Approach to process digital signal normalization based on maximum value in discrete sequence must be considered unacceptable.

This technique can lead to serious overloads in later stages. Specifically, digital processing units has critical sensitivity to this phenomenon. Estimated effective amplitude of discrete signal, normalized to it's strongest member, embraces relation of Nyquist frequency [f] to sample-rate [f_s] and can be expressed as:

$$u[f, f_s, A] = 1/Max[\{Cos[\pi f/f_s], A\}]$$

where:

u – actual amplitude of resulting PCM sequence
A – maximum value within input PCM sequence

And the absolute possible error for given set of frequencies:

$$u[f, f_s] = 1/Cos[\pi f/f_s]$$

According to consumer digital audio audible bandwidth exclusively limited to 20KHz. So, above function renders to:

$$u[f_s] = 1/Cos[\pi 20000/f_s]$$

Using the later function one can get set of factors for well-known sampling rates.

Sample-Rate (Hz)	**Underestimation Factor**
44 100	6.87194
88 200	1.32134
96 000	1.26047
176 400	1.06697
192 000	1.05604