COLOUR DISTANCE

Version 0.1
Computing
COMP120

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These algorithms can be used to generate different types of wave for use in creating audible tones of varying pitch, volume and timbre.

These generators assume that no phase Φ is required (the offset of the state of the wave relative to time, i.e., a shift in the position of the wave). This could be included by subtracting the intended phase Φ from time t such that $t - Phi$.

Please note that the period p of a wave is identical to it's wavelength λ when the velocity v of a wave is constant. For sound, we assume $v = 1$. You may see the terms p and λ used interchangeably in textbooks under this assumption. Also note, that the period p of a wave is related to frequency f such that frequency is the number of periods that occur in one second, or: $f = 1/\lambda v$, or: $f = 1/p$. Some textbooks use p but we use f here for simplicity, due to it's relationship to notes/pitch.

It is assumed that you will transform the output to the correct amplitude representation outside of the function with an appropriate multiplication (i.e., the maximum value of a 16-bit signed integer).

Algorithm 1 Sine Wave

Require:

$0 \leq$t≤ 1
$0 \leq$f≤ 22050
$0 \leq$a≤ 1

Ensure:

A sample s is produced from sampling the wave, which is a function with respect to time and to the properties of the wave itself:

$f(t, a, f)$:

1: $s \leftarrow a \sin(2\pi\ tf)$
2: return s

Algorithm 2 Square Wave

Require:

$0 \leq$t≤ 1
$0 \leq$f≤ 22050
$0 \leq$a≤ 1

Ensure:

A sample s is produced from sampling the wave, which is a function with respect to time and to the properties of the wave itself:

$f(t, a, f)$:

1: $s \leftarrow \begin{cases} a, \text{if } \sin(2\pi\ tf) \geq 0, \\ -a, \text{otherwise} \end{cases}$
2: return s

Algorithm 3 Triangle Wave

Require:

$0 \leq \mathsf{t} \leq 1$

$0 \leq \mathsf{f} \leq 22050$

$0 \leq \mathsf{a} \leq 1$

Ensure:

A sample s is produced from sampling the wave, which is a function with respect to time and to the properties of the wave itself:

$f(t, a, f)$:

1: $s \leftarrow \frac{2a}{\pi} \arcsin(\sin(2\pi\ tf))$
2: return s

Algorithm 4 Sawtooth Wave

Require:

$0 \leq \mathsf{t} \leq 1$

$0 \leq \mathsf{f} \leq 22050$

$0 \leq \mathsf{a} \leq 1$

Ensure:

A sample s is produced from sampling the wave, which is a function with respect to time and to the properties of the wave itself:

$f(t, a, f)$:

1: $s \leftarrow \frac{-2a}{\pi} \arctan(\frac{1}{\tan(t\pi f)})$
2: return s