# Sound analysis and synthesis with the package Seewave

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**Keywords:** time series, sound, Fourier, amplitude, frequency

`Seewave` is a package for sound analysis and synthesis. It has been first submitted to CRAN in 2006, a new version having been released about all semester. The package has been initially written to help analysing sound produced by animals. However, it is now used in different contexts such as telemetry, optical signals, high frequency vibrations, meteor signal shape and others.

Sound input can be achieved using different object classes : (*i*) usual classes (numeric `vector`, numeric `matrix`) if the sampling frequency is provided, (*ii*) time series classes (`ts`, `mts`), and (*iii*) sound-specific classes (`Wave` of the package `tuneR` and `Sample` of the package `Sound`).

`Seewave` currently includes more than 70 functions. Sounds are edited as oscillogram or amplitude envelope in single or multi-framed windows. An option can be set to move along the signal using a time slider. Signals can be modified with cutting, inserting, pasting, muting, fading, and repeating functions.

In the time/amplitude domain, signal and silence durations can be automatically measured. Amplitude filters can help reducing a background noise. Amplitude modulations can be automatically removed or quickly modified interactively and echoes can be generated through Doppler effect.

In the frequency domain, 15 statistical descriptive parameters (dominant peak, quality factor, entropy, spectral flatness, etc) are extracted from a frequency spectrum by calling a single function. The fundamental frequency of harmonic series is detected by the autocorrelation or cepstral method, while the instantaneous frequency is obtained by the zero-crossing method or Hilbert transform. `Seewave` provides a short-term Fourier transform to return mean spectra, 2D and 3D spectrograms. Fourier window size, overlap and zero-padding options allow the user to improve graphical representation, and to reduce the uncertainty principle.

To test for the temporal and frequency similarity of two sounds, cross-correlations, surface computation and coherence can be computed.

New sound is designed with sinusoidal amplitude modulations and linear and/or sinusoidal frequency modulations. Simple additions together with requency filters and linear frequency shifts ensure the modification or generation of complex sound.

## References

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