Seismo_volcanalysis:
a interactive software for the analysis of seismo-volcanic signals

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This software provides user-friendly tools to carry out detailed analysis of seismo-volcanic signals by using a large combination of methods. It can read data in various common formats obtained either from continuous recording or in trigger mode. It consists of several interactive interfaces that allow to select, filter, zoom, pick on sections of record, calculate spectral estimations and time-frequency representations, detect events and correct records for instrument response. The program is written using Matlab 7.0, its Graphical User Interfaces, and the Signal Processing Toolbox. Thus it can be easily modified and corrected.

The software includes 5 interfaces, with their corresponding source (.m) and figure (.fig) files.
The first interface - ***Seismo_volcanalysis1*** - can be considered as the main program. It allows to read data files, to select sections of record and to call the signal analysis tools.

Seismo_volcanalysis2 carries out both spectral estimations and time-frequency representations.
The available spectral methods are:

- Amplitude spectrum based on the classical Fourier Transform
- Smoothed Fourier spectrum
- Averaged periodogram (amplitude spectrum)
- Power spectral density using the Burg method
- Power spectral density using the Yule-Walker (AR) method

For the time-frequency representation, the following methods are available:

- Short Time Fourier Transform
- Burg method
- Yule-Walker (AR) method
- Scalogram (Morlet wavelet)
- Reassigned spectrogram
- Wigner-Ville Distribution
- Pseudo Wigner-Ville
- Smoothed pseudo Wigner-Ville
- Choi-Williams Distribution
- Reduced Interference Distribution
- Ridges
- Instantaneous frequency
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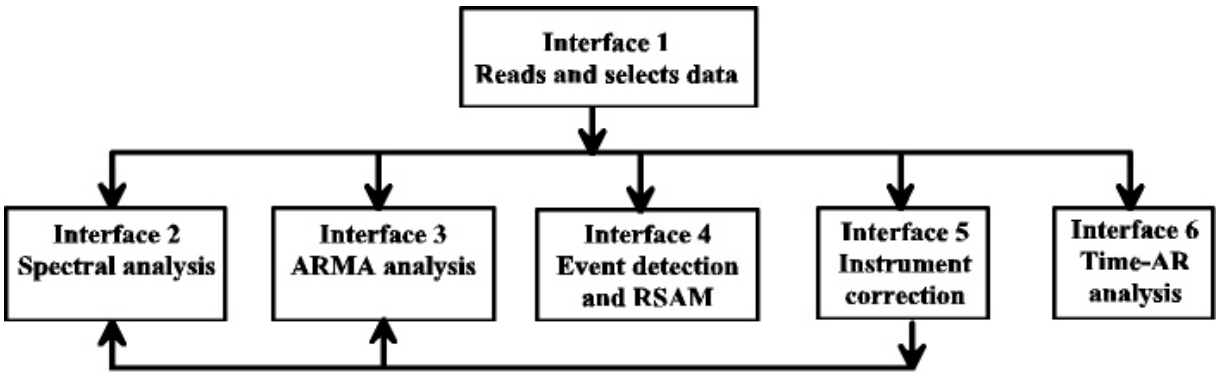
Seismo_volcanalysis3 is designed to carry out ARMA (Auto-Regressive Moving Average) modelling of a signal and to estimate the frequency and quality factor of the main spectral peaks. It also includes procedures to deconvolve the resonant part of the seismograms in order to estimate the excitation function. Its main application is the analysis of Long-Period (LP) seismo-volcanic events.

Seismo_volcanalysis4 can handle long duration (up to 12 hours) records in continuous mode. It displays the record on a helicorder-like sheet. It uses an algorithm based on STA/LTA and RSAM level to detect discrete events and tremor, displays the results also on a helicorder sheet and write them into an ascii file. It calculates also either the RSAM or RSEM time series and plots either their values, their inverse and/or their cumulative values.

Seismo_volcanalysis5 carries out instrument response correction. It reads files containing poles and zeroes and calculates either displacement, velocity or acceleration of the ground. The deconvolved records from SAC files can be written in SAC format. This interface can also call interfaces 2 and 3 with the instrument corrected records.

Seismo_volcanalysis6 applies an AR analysis on moving windows and extracts the frequency and quality factor versus time in selected spectral bands. It is useful to study the frequency gliding of the volcanic tremor.

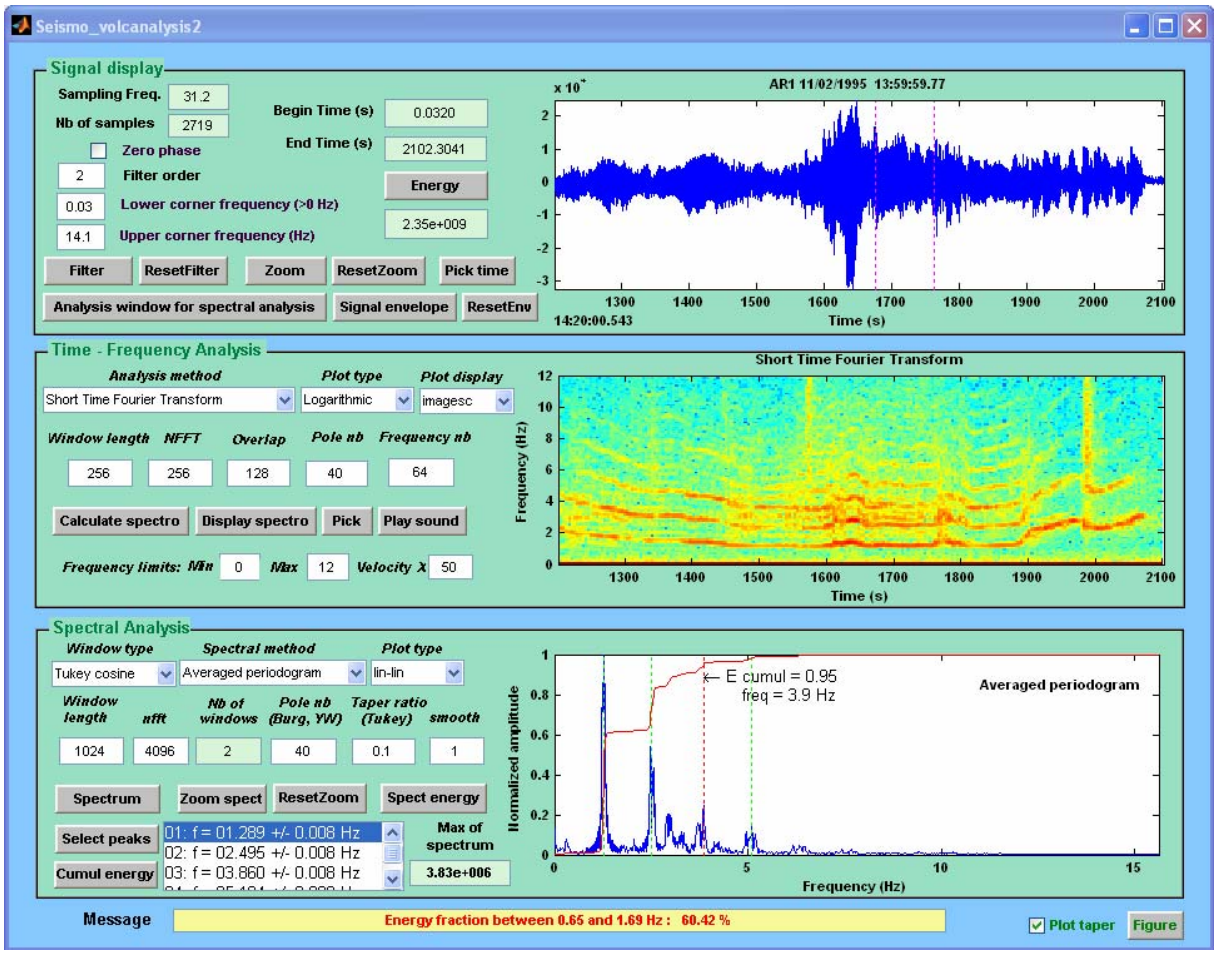
The flow diagram of Seismo_volcanalysis is as follows:



Each interface can generate one or several Matlab figure that can be easily printed and saved in different formats.

A complete documentation in PDF file describes the installation procedure and all the functions of the software.

For any software request, question, suggestion or bug report, please contact Philippe Lesage: lesage@univ-savoie.fr.
This software is free, but you are allowed to acknowledge the author, cite his papers and/or invite him to collaborate with you…



Graphical user interface of the program Seismo_volcanalysis designed to carry out the time-frequency representation (middle) and the spectral analysis (botton) of a record (top). The record taken in this example if a volcanic tremor from Arenal volcano, Costa Rica. In this case, the spectrum is calculated with the method of average periodogram for the section indicated by vertical dashed lines on the seismogram. Several sharp peaks appear in the spectrum. The position of their maximum is indicated by vertical green dashed line and their frequency is displayed in the window at the bottom left of the interface. The time-frequency diagram clearly displays the frequency gliding of the main spectral peaks.