

Session: S01.04 - Advanced and non-conventional seismic methods for monitoring active volcanoes

Methods of automatic recognition of seismo-volcanic events: State-of-the-art and perspectives

Corresponding Author: Philippe Lesage | email: lesage@univ-smb.fr

Author: Philippe Lesage (1) | Guillermo Cortés (2) | Roberto Carniel (2) | M. Carmen Benítez (3) | Manuel Titos Luzón (3) | Ángel Bueno Rodríguez (3) | Luz García Martínez (3) | Raúl Arámbula Mendoza (4)

Affiliation: (1) Université Grenoble Alpes, Université Savoie Mont Blanc, CNRS, IRD, IFSTTAR, ISTerre, 38000 Grenoble, France. | (2) Dipartimento Politecnico di Ingegneria e Architettura, Università degli Studi di Udine, Udine, Italy. | (3) Departamento de Teoría de la Señal, Telemática y Comunicaciones, E. T. S. de Ingenierías Informática y de Telecomunicación. Universidad de Granada, Granada, Spain. | (4) Centro Universitario de Estudios e Investigaciones en Vulcanología, Universidad de Colima, Mexico.

Modern volcano monitoring systems integrate a great number of sensors which produce continuously large amount of data. These observations must be analyzed and interpreted rapidly and efficiently in order to timely deliver early warning and eruption forecast in case of volcano unrest. Before most eruptions, the seismic activity increases and up to hundreds or thousands of events can be recorded in a few hours or days. This seismicity includes several types of events associated to different physical mechanisms at the source. Their interpretation requires the detection and the classification of individual events as well as specific data processing for each class. When carried out manually, the classification of seismic events is a time-consuming and tedious task which cannot be done in real-time in case of crisis.

The recent techniques of Machine Learning and automatic recognition are very promising for analyzing large databases and streams of information in real-time, especially for the recognition of seismic events. Several research groups have proposed applications and have developed prototypes for this purpose. Good results - 80 to 100 % of events correctly classified - are generally obtained using diverse methods such as Artificial Neural Networks, Hidden Markov Models, Random Forests, Self-Organizing Maps, or Support Vector Machines. Besides the algorithm used, the success rate of classification relies on the quality of the training databases, on the number and characteristics of the event classes, and on the features used to describe the signals.

In this contribution, we will present an overview of the methods of automatic recognition applied to the classification of seismo-volcanic signals. We will highlight examples of integration of these tools in monitoring systems and will draw some prospects of improvement based on novel methods, such as Deep Neural Networks, and on the sharing of large databases.