Seismic Signal Processing - Conception and realisation of a mobile seismic signal detection chain

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ABSTRACT

In order processing analogue and digital seismic signals, an acquisition portable chain was designed and achieved. It was conducted in response to the imperatives of the field of the seismic activity studies, according to some criteria such as portability, user-friendliness, optimization of energy and easy extend in hardware and software. Thus, a capture card miniature PCMCIA Keithly is exploited in this way. Units performing conditioning signals are built around the central element. It's active electronic components whose technology is CMOS type the integrated circuit T074 CMOS technology. The amplifier has to be variable-gain in order to increase the amplitude of the signal to a level suitable for scanning. The filter should look like going down to perform the function Anti-aliasing spectrum. The programme acquisition and processing developed communicates with the KPCMCIA-12AIAOH acquisition board through a library of virtual instruments (VIs) available in the LabVIEW platform. It's developed so as to become convivial interface and it can perform many procedures like pre-visualization of seismic signals, continues Acquisition seismic signals, acquired signals processing, continues components elimination, the seismometer correction, decimation, digital filtering, DFT, the spectral amplitude calculation, smoothing and display results.

The adopted sensor for acquisition channels is a seismometer L-4-3D type 'Mark Products', which is a speed probe short period with three components

To adjust the chain of acquisition and processing seismic signal, calibration is made subject to certain signals known or whose characteristics are preset, including those relating to the events recorded by the local seismic network as well as those from the response of the geological structures in background seismic noise. Tests were conducted on the ground to test the performance of the mobile channel acquisition and processing of seismic background noise. The results showed a good correlation with the geological aspect of the sites studied.

Thus done this mobile chain composed of elements sold on the market can achieve good performance.

This chain can be used in several applications, similar to seismic microzoning, and shootings career impact on structure estimation, seismic hammer exploration.

Keys words: economic acquisition chain, PCMCIA acquisition board, analogue seismic signal processing, CMOS technology component, digital seismic signal processing, signal management software, calibration.

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Seismic Signal Processing – Correlation function applied to Agadir's seismic data bank.

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ABSTRACT

The Agadir's seismic database is implemented in May 1989 via the design and the implementation of an automatic detection station of seismic events, and then in November 2001 via installing a local seismic network, managed in quasi-real time by an automatic central of detection. The digital database is fed by two types of events, the natural seismic events of tectonic origin and anthropogenic events incurred by shootings career. Thus, a large quantity of data is currently available.

In this work we tried to highlight aspects which are similar to the events, regardless of the type and the distance to the source. The correlation function, commonly used in signal processing, can reflect the overall similarity of seismic events.

The treatment at the main wavelet's signal has shown that this function can quantify the degree of no local-regional correlation, and consequently, differentiate events. Also, this work has allowed highlighting the local effect whose the characteristics are contained in the seismic coda.

Applying the correlation function to the signal seismic coda, we were able to identify the existence of a character depending neither on the distance source-station, nor on the type of event, but on the registration site.

Ultimately, we can conclude that the correlation might allow the classification in local and regional events since the events located compared to long distances, are capable of supplying a high factor of correlation. This prompts us to talk about the concept of seismic network's resolution. We believe that a distance equal at least ten times the size of the network, will allow having a perfect correlation, for an event recorded by the network. The only constraint is the spectral consideration as the events are filtered during the journey, and later on the detection by a short period network is inadequate. In opposition the correlation is not a reliable tool for the classification of local seismic events.

The correlation of the seismic coda can unequivocally provide information mainly on local conditions (soil type, heterogeneity, fault…). The seismic coda may be regarded as the local signature since it depends a bit on the type of source and the travelled path.

Key words: seismic data bank, seismic event, seismic network, correlation function, discrimination, wavelet signal, seismic coda, local effect

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Seismic activities in Southwestern Nigeria

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ABSTRACT

Though Nigeria is not located within the major earthquake zones of the world as it lies in the eastern flank of the Atlantic Ocean, it has experienced mild earth tremors especially in the southwestern part. The first reported occurrence of an earth tremor in Nigeria was in 1939 in Lagos, Ibadan and Ile-Ife located in the southwestern part of the country. Subsequent occurrences were in 1984, 1990, 1997, 2000 and 2006. The intensities of these shocks ranged from III to IV on the Modified Mercalli Intensity Scale. Remote sensing, geological and geophysical studies have revealed the presence of a 250 km long NE-SW trending fault, the Ifewara fault zone. This fault zone has also been shown to be linked with the Atlantic fracture system. A seismic network managed by the Centre for Geodesy and Geodynamics, Toro has been established with 9 stations to monitor seismic activities within these areas. Presently, there are 4 functional stations equipped with Eentec's 24-bit 4-channel seismographs and 3 broadband as well as 1 short period seismometers. The stations are operated on a stand-alone basis. There are plans to increase the number of functional stations before the end of 2008 and network all the stations by the second quarter of 2009. The major objective of this paper is to inform the scientific community of the establishment of seismic stations in Nigeria.

Key words: Nigeria, seismicity, Ifewara fault, seismic network.

PRESENTER'S BIOGRAPHY

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The New Algerian Digital Seismic Network

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ABSTRACT

A new Digital Seismic Network (ADSN) has been recently installed in Algeria to modernize the seismic monitoring. This network started to work in April 2007, with 08 Broadband (BB) stations and 02 Very Broadband (VBB) stations, located in several sites of northern Algeria. Using the Antelope system and the VSAT transmission, the network represents the first automatic alert seismic system in Algeria.

To density the coverage of the network, new stations are in the phase of installation. 35 shorts periods (SS-1) were recently connected in near-real-time using the wireless transmission. These stations complete the outdated short-period FM telemetry system and contribute in the automatic detection. In parallel, 10 Broadband (BB) stations are in construction and will be installed early 2009 in order to obtain a better coverage of the network and perform the alert system.

In a first step, automatic processing, by recording the seismic events (local, regional….) was tested as well as archiving data in databases. Accuracy of the automatic location of local seismicity is also analyzed. Periodically, calibration pulse and ambient noise are checked using PSD (Power Spectral Density) analysis to determine the noise level of the stations.

The installation of the new network gives new insight of the seismic Algerian activity and allows to determine more accurately the different parameters of the seismic events (magnitude, focal mechanism, depth ...). It will be a tool for seismic source studies and also for crustal investigations.

With the new digital seismic network, Algeria is now well equipped for the seismic monitoring and to contribute in the Mediterranean warning system.

Key words: Broadband, Antelope, VSAT, PSD, Warning system

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Toufik ALLILI,
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TITLE: Installation of Seismic Equipment in Nigeria

AUTHORS: DUNCAN DAUDA [1] , LAME GARBA [2]

ABSTRACT: Installation of Seismic Equipment and their accessories in 3 seismographic stations for Nigeria. Instrumentation, SEISAN Software for analysis and Configuration of Seismographs and calibrating seismometers for Teleseismic, Regional and local seismic activities as well as using Solar Power as alternative power supply. Calibration of the seismometer and acquisition of raw data

Key words 1. Seismic 2. Solar power 3. Configuration 4. Seismometer 5. Calibration

PRESENTER'S BIOGRAPHY

I am Dauda Duncan, System Analyst with Centre for Geodesy and Geodynamics, Toro, Bauchi State, Nigeria. I Have being with the centre for past 4 years as the pioneer system analyst. I have been trained on many GIS Software such as ILWIS and ARCGIS. I head the centre's GIS laboratory and we have executed the following projects:

1. Digitization of Geohazard Map of Nigeria
2. Digitization of Orthometric maps of Nigeria
3. Installing of seismic equipment for Nigeria yet to be completed.

Communications for volcanic risk mitigation and emergency management in international cooperation countries

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FP7 Project MIAVITA (coord. Pierre Thierry, BRGM) addresses the challenges posed by the assessment and management of volcanic risk in international cooperation countries, and includes two target volcanoes in Africa. Five volcanoes will be studied, namely Mount Cameroon (Cameroon), Fogo (Cape Verde), Merapi and Kelut (Indonesia), and Kanlaon (Philippines). The developed methodology will be critically reviewed in Soufrière Hills (Montserrat).

The approach of Project MIAVITA stems from the recognition that an integrated volcanic risk management method must be designed for local authorities and scientists, focusing in three objectives: development of prevention tools based on risk assessment through risk mapping and realization of possible damage scenarios; reduction of people's vulnerability and development of recovering capabilities after as event occurs (resilience) for both local communities and ecological systems; and improvement of crisis management capabilities based on monitoring and early warning systems and secure communications. This paper describes MIAVITA's work package 6, "Communications strategies for volcanic risk management". The issues addressed in this WP are particularly relevant for African countries, due to the vulnerabilities of telecommunications infrastructure.

Volcanic risk can be effectively mitigated through civil protection measures, provided that (1) adequate monitoring of volcanic activity is in place, and (2) efficient communications enable rapid interchange of data and information between all agents involved. Project MIAVITA deals separately with volcanological data (raw in situ and remote sensing observations) or information (bulletins, maps, etc) transmission, and with emergency communications. The approach is based on the following principles:

– It is often unrealistic to have at a local volcanological laboratory all the scientific competence required, either before or during a crisis. Besides, in a crisis the local staff may have reduced performance (no access to laboratory, family concerns, etc). So, monitoring data must be available to specialized remote laboratories that contribute to data analysis and processing. As a rule, integration into information products needs to be conducted at a remote volcanological laboratory.

– Local telecommunications infrastructure may be directly affected by the volcanic crisis, or compromised by peaks in service demand. Also, such infrastructure is often rudimentary in many volcanic areas, and particularly in Africa. Therefore, robust transmission of data and products should resort to satellite communications whenever feasible.

– The infrastructure and the procedures required for crisis management should also be employed for routine monitoring, otherwise the system cannot be trusted to be operational in emergencies.

In line with the orientations of GEO Capacity Building task CB-06-04, Project MIAVITA includes also a collaboration with Eumetsat (subcontractor to the project) to broaden the scope of the satellite-based near real time data transmission infrastructure GEONETCast in order to include environmental hazard monitoring data.

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Recent developments in seismic instrumentation in Uganda

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Abstract

Monitoring of earthquake in Uganda started way back in October 1925 after the inception of the Department of Geological Survey and Mines in 1919, and eventually came to a halt in early 1970's following the destruction of monitoring equipment in the 1979 civil war. The objective of the seismic instrumentation is to monitor the seismicity due to natural and man-made activity. To revive earthquake-monitoring activities in Uganda, a National Seismological Network, was set up to monitor the seismicity of the country and surroundings. Re-establishment of the network began in late 1989 with purchasing and installation of three (3) analogue stations at Entebbe, Hoima, and Kilembe using the funds (US$40,000) donated by UNESCO and International Programs for Physical Sciences (IPPS), Sweden.

In 1995, one broad band digital seismograph equipment was installed at Dundu near Entebbe using a for preliminary earthquake information to the public. In 1999, a Global Seismographic Station was installed at Kyahi near Mbarara, in collaboration with University of California San Diego and Incorporated Research Institutions for Seismology (IRIS) which detects local and global earthquakes. Since 1999 to-date, three analogue seismographs at Entebbe, Kilembe and Hoima have been upgraded to digital seismographs in order to improve the quality of data detected. Government has secured funds from African Development Bank under to upgrade and expand the existing network with additional seven (7 broadband) and upgrading the short period ones to 10 broadband stations. The seismic data will be transmitted to the Data Centre in Entebbe to provide on spot earthquake information in near-real time. The programme of expansion is on-going and will be completed by end of 2009/10.

The seismic network of ten (10) stations is not adequate for both short and long-term seismic observations. The long-term development plan is to install additional twelve (12) in the North and North-Eastern to monitor the Aswa shear zone and the volcanic centres in the Eastern Uganda and Kisoro in addition, monitor the induced seismicity of dams at Jinja. For needs of high quality reliable seismic data to do first class research, densification of the seismic network to cover the whole country with broadband stations is vital. The geometry of stations in a seismic network is of utmost importance as it determines both the area where earthquakes will be well analysed (within the station locations) and the detection level (how many earthquakes will be detected). It was determined that the ten stations available this project should concentrate on the high seismicity region of western Uganda and that all means should be taken to ensure that the good detection level of the upgraded network will localise all earthquakes. Concentrating the network to western Uganda is beneficial in the study of the earthquakes and the earthquake generating mechanisms. In addition high quality data will promote international collaboration in research and monitoring of seismicity due to geothermal activity, mining, oil and gas fields. In order to achieve good detection levels in the network, the distance from one station to its closest neighbour should, ideally, not be more than 100 km.

Key words: instrumentation, broadband, seismometer, seismicity, seismographs

PRESENTER'S BIOGRAPHY

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