Geophysical Research Abstracts
Vol. 16, EGU2014-6359-1, 2014
EGU General Assembly 2014

Infrasonic detection performance in presence of nuisance signal

Maurice Charbit, Stephen Arrowsmith, Il-young Che, Alexis Le Pichon, Adrien Nouvellet, Junghyun Park, and Francois Roueff

Institut Mines-Telecom, Paris (France)

Infrasonic detection performances in presence of nuisance signal
Charbit M.1, Arrowsmith S.2, Che I.Y.3, Nouvellet A.4, Le Pichon A.5, Park J.6, Roueff F.7 (1): maurice.charbit@telecom-paristech.fr, Institut Mines-Telecom Paris (France),
(2): sarrowsmith@gmail.com, Los Alamos National Laboratory, Geophysics Group (USA),
(3): che10@kigam.re.kr, KIGAM - Daejeon (Korea),
(4): adrien.nouvellet@gmail.com, CEA - Paris (France),
(5): Alexis.LE-PICHON@cea.fr, CEA - Paris (France),
(6): pjh2521920@gmail.com, Southern Methodist University, Dallas, Texas (USA),
(7): francois.roueff@telecom-paristech.fr, Institut Mines-Telecom Paris (France)
Abstract
The infrasound network of the International Monitoring System (IMS) consists of sixty stations deployed all over the World by the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). The IMS has been designed to reliably detect, at least by two stations, an explosion greater than 1 kiloton located anywhere on the Earth [1]. Each station is an array of at least four microbarometers with an aperture of 1 to 3 km.
The first important issue is to detect the presence of the signal of interest (SOI) embedded in noise. The detector is commonly based on the property that the SOI provides coherent observations on the sensors but not the noise. The statistic of test, called F-stat [2], [5], [6] , calculated in a time cell a few seconds, is commonly used for this purpose.
In this paper, we assume that a coherent source is permanently present arriving from an unknown direction of arrivals (DOA). The typical case is the presence of microbaroms or the presence of wind. This source is seen as a nuisance signal (NS). In [4], [3] authors assume that a time cell without the SOI (CH0) is available, whereas a following time cell is considered as the cell under test (CUT). Therefore the DOA and the SNR of the NS can be estimated. If the signal-to-noise ration SNR of the NS is large enough, the distribution of the F-stat under the absence of SOI is known to be a non central Fisher. It follows that the threshold can be performed from a given value of the FAR. The major drawback to keep the NS is that the NS could hide the SOI, this phenomena is similar to the leakage which is a well-known phenomena in the Fourier analysis. An other approach consists to use the DOA estimate of the NS to mitigate the NS by spatial notch filter in the frequency domain. On this approach a new algorithm is provided. To illustrate, numerical results on synthetical and real data are presented, in term of Receiver Operating Characteristic ROC curves.
REFERENCES
[1] Christie D.R. and Campus P., The IMS infrasound netwrok: design and establishment of infrasound stations, Infrasound Monitoring for Atmospheric Studies, Springer Netherlands, Editor: Le Pichon, Alexis and Blanc, Elisabeth and Hauchecorne, Alain, pp 27-72, 2010.
[2] Shumway R. H.,Advances in Mixed Signal Processing for Regional and Teleseismic Arrays 28th Seismic Research Review: Ground-Based Nuclear Explosion Monitoring Technologies, pp 503-509, 2007.
[3] Park J., Hayward C.T., Zeiler C. P., Arrowsmith S.J. and Stump B.W., A Comparative Study of Automated Infrasound Detectors - PMCC and inframonitor with analyst review, SSA Annual Meeting, 2013.
[4] Arrowsmith S.J., Whitaker R., Katz C. and Hayward C., The F-Detector Revisited: An Improved Strategy for Signal Detection at Seismic and Infrasound Arrays, Bulletin of the Seismological Society of America, 2008.
[5] Arrowsmith S.J., Whitaker R., Steven R. Taylor, Burlacu R., Stump B.W., Hedlin M.A.H., Randall G., Hayward C. and ReVelle D., Regional monitoring of infrasound events using multiple arrays: application to Utah and Washington State, Geophys. J. Int., vol.175, pp 291–300, 2008.
[6] Charbit M., Gaillard P. and Le Pichon A., Evaluating the performance of infrasound detectors, EGU, Vienne, Autriche, April 2012.