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Software to Estimate Earthquake Spectral and Source Parameters

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ABSTRACT

A software (EQK_SRC_PARA) has been developed to estimate spectral parameters of earthquake source spectrum, namely: low frequency displacement spectral level (Ω_0), corner frequency above which spectrum decays with a rate of 2 (f_c), the cut-off frequency above which the spectrum again decays (f_{max}) and the rate of decay above f_{max} (N). A Brune's source model [1,2] that yield a fall-off of 2 beyond corner frequency is considered with high cut-off frequency factor presented by Boore [3] that fits well for frequencies greater than f_{max}. The software EQK_SRC_PARA is written in MATLAB and uses input data in Sesame ASCII Format (SAF) format. The obtained spectral parameters have been used to estimate source parameters (e.g., seismic moment, source dimension and stress drop etc.) and to develop scaling laws for the study region. The cut-off frequency "f_{max}" can also be studied and interpreted to confirm about its origin.

KEYWORDS

Cite this paper

References

[1]   J. N. Brune, " Tectonic Stress and the Spectra of Seismic Shear Waves from Earthquakes," Journal of Geophysical Research, Vol. 75, No. 26, 1970, pp. 4997-5009. doi:10.1029/JB075i026p04997

[2]   J. N. Brune, " Correction to Tectonic Stress and the Spectra of Seismic Shear Waves from Earthquakes," Journal of Geophysical Research, Vol. 76, No. 20, 1971, p. 5002. doi:10.1029/JB076i020p05002

[3]   D. M. Boore, " Stochastic Simulation of High-Frequency Ground Motion Based on Seismological Models of the Radiated Spectra," Bulletin of the Seismological Society of America, Vol. 73, No. 6, 1983, pp. 1865-1894.

[4]   W. S. Joyner, " A Scaling Law for the Spectra of Large Earthquakes," Bulletin of the Seismological Society of America, Vol. 74, No. 4, 1984, pp. 1167-1188.

[5]   K. Aki, " Scaling Law of Seismic Spectrum," Journal of Geophysical Research, Vol. 72, No. 4, 1967, pp. 12171231. doi:10.1029/JZ072i004p01217

[6]   B. E. Tucker and J. N. Brune " Source Mechanism and Mb-Ms Analysis of Aftershocks of the San Fernando Earthquake," Geophysical Journal. Royal Astronomical Society, Vol. 49, No. 2, 1977, pp. 371-426. doi:10.1111/j.1365-246X.1977.tb03714.x

[7]   J. B. Fletcher, " Spectra from High Dynamic Range Digital Recordings of Oroville, California, Aftershocks and Their Parameters," Bulletin of the Seismological Society of America, Vol. 70, No. 3, 1980, pp. 735-755.

[8]   R. J. Archuleta, E. Cranswick, C. Mueller and P. Spudish, " Source Parameters of the 1980 Mammoth

Lakes, California, Earthquake Sequence," Journal of Geophysical Research, Vol. 87, No. 12, 1982, pp. 4595-4607. doi:10.1029/JB087iB06p04595

[9] M. L. Sharma and H. R. Wason, " Occurrence of Low Stress Drop Earthquakes in the Garwal Himalayan Region," Physics of the Earth and Plantary Interiors, Vol. 85, No. 3-4, 1994, pp. 265-272. doi:10.1016/0031-9201(94)90117-1

[10] A. Kumar, A. D. Pandey, M. L. Sharma, S. C. Gupta, A. K. Verma and B. K. Gupta, " Processing and Preliminary Interpretation of Digital Data Obtained from Digital Telemetered Seismic Array in the Garhwal Himalaya," Xth Symposium on Earthquake Engineering, University of Roorkee, Roorkee, 1994.

[11] B. K. Bansal, " Determination of Source Parameters for Small Earthquake in the Koyna Region," 11th Symposium on Earthquake Engineering, Roorkee, 15 May-10 July 1998, pp. 57-66.

[12] A. Kumar, " Study of Earthquake Source Parameters Using Microearthquakes and Strong Motion Data," Indian Institute of Technology, Roorkee, 2011.

[13] T. C. Hanks, " fmax," Bulletin of the Seismological Society of America, Vol. 72, 1982, pp. 1869-1879.

[14] J. G. Anderson and S. E. Hough, " A Model for the Shape of the Fourier Amplitude Spectrum of Acceleration at High Frequencies," Bulletin of the Seismological Society of America, Vol. 74, No. 5, 1984, pp. 1969-1993.

[15] A. S. Papageorgiou and K. Aki, " A Specific Barrier Model for the Quantitative Description of Inhomogeneous Faulting and the Prediction of Strong around Motion. I. Description of the Model," Bulletin of the Seismological Society of America, Vol. 73, No. 3, 1983, pp. 693-722.

[16] A. S. Papageorgiou and K. Aki, " A Specific Barrier Model for the Quantitative Description of Inhomogeneous Faulting and the Prediction of Strong ground Motion. I1. Application of the Model," Bulletin of the Seismological Society of America, Vol. 73, No. 4, 1983, pp. 953-978.

[17] E. Faccioli, " A study of spectra and peak values of strong motion accelerograms from Italy and Yugoslavia in terms of gross source properties," In: S. Das, J. Boatwright and C. H. Scholz, Eds., Earthquake Source Mechanics, Geophysical Monograph 37, Maurice Ewing Series, American Geophysical Union, Washington, 1986, pp. 297-310. doi:10.1029/GM037p0297

[18] K. Aki, " Magnitude-Frequency Relation for Small Earthquakes: A Clue to the Origin of fmax of Large Earthquakes," Journal of Geophysical Research, Vol. 92, No. B2, 1987, pp. 1349-1355. doi:10.1029/JB092iB02p01349

[19] A. S. Papageorgiou, " On Two Characteristic Frequencies of Acceleration Spectra: Patch Corner Frequency and fmax," Bulletin of the Seismological Society of America, Vol. 78, No. 2, 1988, pp. 509-529.

[20] Y. Toshiaki and K. Irikura, " Meaning of Source Controlled fmax in Empirical Green' s Function Technique Based on a T2-Scaling Law," Disaster Prevention Research Institute, Kyoto University, 1991.

[21] S. Kinoshita, " Local Characteristics of the fmax of Bedrock Motion in the Tokyo Metropolitan Area, Japan," Journal of Physics of the Earth, Vol. 40, No. 3, 1992, pp. 487-515. doi:10.4294/jpe1952.40.487

[22] M. Tsurugi, M. Tai, A. Kowada, Y. Tatsumi and K. Irikura, " Estimation of Empirical Site Amplification Effects Using Observed Records," 12 World Conferenc on Earquake Engineering, Auckland, 30 January-4 Febuary 2000, pp. 1-6.

[23] M. Tsurugi, T. Kagawa and K. Irikura, " Study on HighCut Frequency Characteristics of Ground Motions for Inland Crustal Earthquakes in Japan," 14 World Conferenc on Earquake Engineering, Beijing, 12-17 October 2008, N0. 02-0036.

[24] J. Wen and X. Chen, " Variations in fmax along the Ruptured Fault during the Mw 7.9 Wenchaun Earthquake of 12 May 2008," Bulletin of the Seismological Society of America, Vol. 102, No. 3, 2012, pp. 991-998. doi:10.1785/0120110105

[25] S. C. Gupta and A. Kumar, " Seismic Wave Attenuation Characteristics of Three Indian Regions: A