On Earthquake Source Complexity Effects on Far-field Seismic Ground-motion Spectra

B. Halldórsson
Earthquake Engineering Research Centre, University of Iceland, Austurvegur 2a, 800 Selfoss, Iceland.

A.S. Papageorgiou*
Department of Civil Engineering, University of Patras, Rio 26500, Greece.

The Specific Barrier Model (SBM) is a particular case of a composite seismic source model according to which the seismic moment is distributed in a deterministic manner on the fault plane on the basis of moment and area constraints [1]. Namely, in formulating the model it is assumed that a rectangular fault surface is composed of an aggregate of subevents of equal diameter, the "barrier interval". Furthermore, the subevents are assumed to rupture randomly and statistically independent of one another as the rupture front sweeps the fault plane [2]. The seismic radiation received by a recording station at a site depends on the location of the station relative to the fault plane, the location of rupture initiation (hypocenter) and onset times of the rupturing subevents. All the above factors are neatly taken into account by the isochrons. Furthermore, the seismic radiation is also affected by the basic assumption of equal-size subevents of the SBM.

We investigate the sensitivity of the far-field spectra of the SBM to the following two factors: (1) The distribution of the isochron curves on the fault plane, and (2) the size-distributions of the subevents. We quantify the effects and derive closed form expressions of the far-field source spectra. The effects of the former factor are manifested mainly at the intermediate frequencies while the latter factor affects primarily the amplitude of the plateau of the high frequency radiation of acceleration spectra. It turns out that the spectral amplitude of the high frequency plateau of the spectra corresponding to different size-distributions does not differ significantly from that of the SBM (i.e., constant size subevents) for constant local stress drop. We conclude that, despite its simplifying assumptions, the SBM appears to be the most simple, yet effective, way to capture the essential characteristics of a composite seismic source [2,3,4,5].

References

[1] Papageorgiou, A. S. and K. Aki (1983). A specific barrier model for the quantitative description of inhomogeneous faulting and the prediction of strong ground motion. I. Description of the model, *Bull. Seism. Soc. Am.* **73**, 693-722.
[2] Papageorgiou, A. S. (2003). The Barrier Model and Strong Ground Motion. *Pure Appl. Geophys*. **160**, 603-634
[3] Halldórsson, B. and A. S. Papageorgiou (2005). Calibration of the Specific Barrier Model to Earthquakes of Different Tectonic Regions. *Bull. Seism. Soc. Am.*, **95**(4), 1276-1300.
[4] Halldórsson, B. and A. S. Papageorgiou (2006). Spectral variations of the Specific Barrier Model from various isochron and subevent distributions. *Proceedings of the First European Conference on Earthquake Engineering and Seismology* (1ECEES), September 3.-8., Geneva, Switzerland. Paper No. 1137.
[5] Halldorsson, B., G. P. Mavroeidis, & Papageorgiou, A. S. (2010). Near-Fault and Far-Field Strong Ground Motion Simulation for Earthquake Engineering Applications Using the Specific Barrier Model, *ASCE J. Struct. Eng*. (in press).

*e-mail: papaga@upatras.gr. url: www.eerc.hi.is