

EGU21-11998

<https://doi.org/10.5194/egusphere-egu21-11998>

EGU General Assembly 2021

© Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.



High-frequency ground-motion variability for rough-fault ruptures

Jagdish Chandra Vyas¹, Martin Galis^{2,3}, and Paul Martin Mai¹

¹King Abdullah University of Science and Technology, Saudi Arabia

²Comenius University, Bratislava, Slovakia

³Slovak Academy of Sciences, Bratislava, Slovakia

Geological observations show variations in fault-surface topography not only at large scale (segmentation) but also at small scale (roughness). These geometrical complexities strongly affect the stress distribution and frictional strength of the fault, and therefore control the earthquake rupture process and resulting ground-shaking. Previous studies examined fault-segmentation effects on ground-shaking, but our understanding of fault-roughness effects on seismic wavefield radiation and earthquake ground-motion is still limited.

In this study we examine the effects of fault roughness on ground-shaking variability as a function of distance based on 3D dynamic rupture simulations. We consider linear slip-weakening friction, variations of fault-roughness parametrizations, and alternative nucleation positions (unilateral and bilateral ruptures). We use generalized finite difference method to compute synthetic waveforms (max. resolved frequency 5.75 Hz) at numerous surface sites to carry out statistical analysis.

Our simulations reveal that ground-motion variability from unilateral ruptures is almost independent of distance from the fault, with comparable or higher values than estimates from ground-motion prediction equations (e.g., Boore and Atkinson, 2008; Campbell and Bozornia, 2008). However, ground-motion variability from bilateral ruptures decreases with increasing distance, in contrast to previous studies (e.g., Imtiaz et. al., 2015) who observe an increasing trend with distance. Ground-shaking variability from unilateral ruptures is higher than for bilateral ruptures, a feature due to intricate seismic radiation patterns related to fault roughness and hypocenter location. Moreover, ground-shaking variability for rougher faults is lower than for smoother faults. As fault roughness increases the difference in ground-shaking variabilities between unilateral and bilateral ruptures increases. In summary, our simulations help develop a fundamental understanding of ground-motion variability at high frequencies (~ 6 Hz) due small-scale geometrical fault-surface variations.