

3D dynamic simulations of spontaneous rupture propagation governed by different constitutive laws with rake rotation allowed

A. Bizzarri, M. Cocco

Abstract

In this work we present a 3D Finite Difference numerical method to model the dynamic spontaneous propagation of an earthquake rupture on planar faults in an elastic half-space. We implement the Traction-at-Split-Nodes fault boundary condition for a system of faults, either vertical or oblique, using different constitutive laws. We can adopt both a slip-weakening law to prescribe the traction evolution within the breakdown zone or rate- and state-dependent friction laws, which involve the choice of an evolution relation for the state variable. Our numerical procedure allows the use of oblique and heterogeneous distribution of initial stress and allows the rake rotation. This implies that the two components of slip velocity and total dynamic traction are coupled together to satisfy, in norm, the adopted constitutive law. The simulations presented in this study show that the rupture acceleration to super-shear crack speeds occurs along the direction of the imposed initial stress; the rupture front velocity along the perpendicular direction is slower than that along the pre-stress direction. Depending on the position on the fault plane the orientation of instantaneous total dynamic traction can change with time with respect to the imposed initial stress direction. These temporal rake rotations depend on the amplitude of initial stress and on its distribution on the fault plane. They also depend on the curvature and direction of the rupture front with respect to the imposed initial stress direction: this explains why rake rotations are mostly located near the rupture front and within the cohesive zone.

Keywords

earthquake dynamics;numerical modeling;friction laws;slip time history;rake rotation

Full Text:

PDF

References

DOI: <https://doi.org/10.4401/ag-3201>

Published by INGV, Istituto Nazionale di Geofisica e Vulcanologia - ISSN: 2037-416X

USER

Username
Password
 Remember me

MOST VIEWED

- OPERATIONAL EARTHQUAKE FORECASTING....
- ObsPy – What can it do for data...
- Twitter earthquake detection...
- Magnitude and energy of earthquakes
- Comparison between low-cost and...

AUTHOR GUIDELINES





EARLY PAPERS

- ▶ Vol 61, 2018

FAST TRACKS

- ▶ Vol 56, Fast Track 1, 2013
- ▶ Vol 57, Fast Track 2, 2014
- ▶ Vol 58, Fast Track 3, 2015
- ▶ Vol 59, Fast Track 4, 2016
- ▶ Vol 59, Fast Track 5, 2016
- ▶ Vol 60, Fast Track 6, 2017
- ▶ Vol 60, Fast Track 7, 2017
- ▶ Vol 61, Fast Track 8, 2018

ARTICLE TOOLS

-  Indexing metadata
-  How to cite item
-  Email this article (Login required)
-  Email the author (Login required)

ABOUT THE AUTHORS

Sezione Bologna,
Bologna, Italia

M. Cocco
Istituto Nazionale di
Geofisica e Vulcanologia,
Sezione Roma1, Roma,
Italia

JOURNAL CONTENT

Search

Search Scope

All ▾

Search

Browse

- [By Issue](#)
- [By Author](#)
- [By Title](#)

Journal Help

KEYWORDS

Central Italy
 Earthquake GPS
 Historical seismology
 Ionosphere Irpinia
 earthquake Italy Mt.
 Etna Seismic hazard
 Seismic hazard
 assessment
 Seismology UN/IDNDR
 earthquake
 earthquakes
 historical
 earthquakes
 ionosphere magnetic
 anomalies
 paleoseismology
 seismic hazard
 seismicity
 seismology

NOTIFICATIONS

- [View](#)
- [Subscribe](#)

USAGE STATISTICS INFORMATION

We log anonymous
usage statistics. Please
read the privacy
information for details.