# STANDARD RUPTURE FORMAT

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## Introduction

The general fault surface is represented by a distribution of point sources.  In principle, there is no inherent restriction on the geometry of the fault surface or on the spacing and distribution of the point sources used to describe that surface.  Each point source description contains all the necessary information to compute the contribution of that point to the total response of the fault rupture.  However, it is recognized that most current methods used to develop or model fault ruptures are based on descriptions that employ planar rectangular segments.  To facilitate the exchange (and retention) of fault representations in this format, the description presented below allows for the (optional) inclusion of information that specifies the planar segments used to define the fault surface.

Aki & Richards convention for strike, dip and rake are used for all the source descriptions.  Slip is specified in three orthogonal directions, two within the subfault surface, and the third in the direction of the outward normal to that surface.  This allows for the possibility of time dependent rake and/or fault opening.  Figure 1 illustrates the coordinate system conventions used in this description.
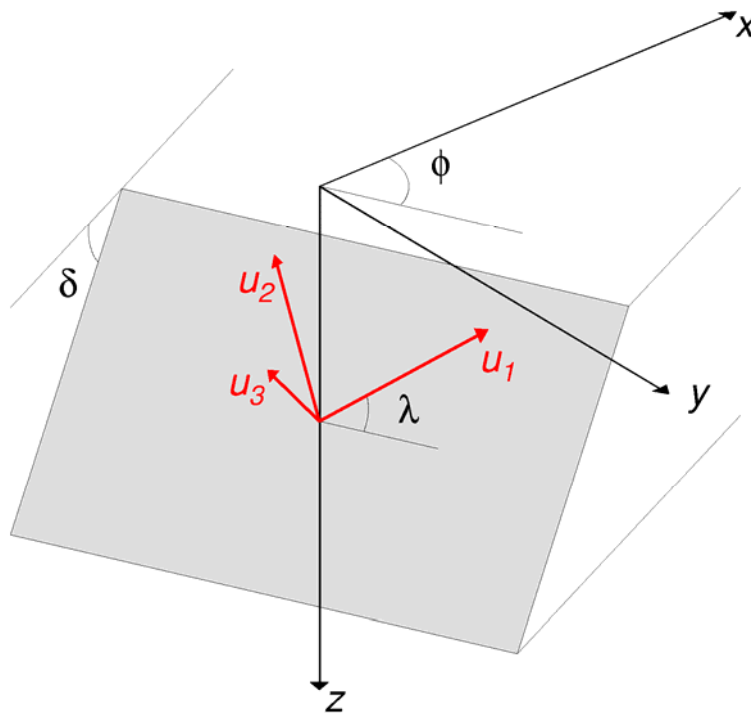


**Figure1:**  Coordinate system conventions for an individual subfault surface.  The system (x,y,z) is the global system (e.g., x = north, y = east, z = down).  The system ($u_1$,$u_2$,$u_3$) is the local system in which the slip is specified.  The axes $u_1$ and $u_2$ are tangent to the surface and $u_3$ is the outward normal to the surface.  The strike ($\phi$), and dip ($\delta$) are the same as Aki & Richards.  Strictly speaking, the rake ($\lambda$) defines the orientation of the $u_1$ axis (with $u_2$ at $\lambda+90^{o}$).

For a pure shear dislocation with constant rake, all slip will be in the $u_1$ direction, thus requiring convolution of only a single STF.  Time variable rake needs two orthogonal components ($u_1$ and $u_2$) each

with a unique STF, thus requiring convolution of two STFs.  In this case $\lambda$ can be specified such that $u_1$ and $u_2$ bracket the average rake direction.

**Format Specification**

The file type as described below is in ASCII format to allow for easy exchange and editing capabilities. The general file format is as follows:

VERSION
HEADER BLOCK (optional)
DATA BLOCK

where

| | |
|---|---|
| VERSION | = version identifier (e.g., 1.0) |
| HEADER BLOCK | = general fault description (used for general description of the fault surfaces) |
| DATA BLOCK | = general point source information covering fault surface |

*HEADER BLOCK*

The optional HEADER BLOCK consists of a series of lines describing the general features of the fault surfaces.  Given below is a description for planar segments representing the fault.  Additional descriptive formats can be developed and added as needed.

For the planar segment format, the first line is:

PLANE          NSEG

where

| | |
|---|---|
| PLANE | = flag specifying that following lines describe planar fault |
| NSEG | = number of segments in fault description |

For each segment, the following two lines are needed:

ELON  ELAT  NSTK  NDIP  LEN     WID
STK     DIP      DTOP  SHYP  DHYP

where (for this segment)

| | |
|---|---|
| ELON | = top center longitude |
| ELAT | = top center latitude |
| NSTK | = # of subfaults along strike |
| NDIP | = # of subfaults down-dip |
| LEN | = fault length |
| WID | = fault width |
| STK | = fault strike |
| DIP | = fault dip |
| DTOP | = depth to top of fault |
| SHYP | = along strike location (from top center) of hypocenter |
| DHYP | = down-dip location (from top edge) of hypocenter |

The above description is repeated for each additional segment.

*DATA BLOCK*

Following the optional header lines described above are the required DATA BLOCK lines.  The first line in the DATA BLOCK is:

POINTS          NP

where

POINTS          = flag specifying that following lines describe point sources
NP              = number of point source to follow

The remaining lines in the DATA BLOCK contain information about each of the point sources.  For each point source, the format is:

LON    LAT    DEP    STK    DIP      AREA  TINIT  DT
RAKE  SLIP1  NT1    SLIP2  NT2    SLIP3  NT3
Sv1[1]
Sv1[2]
Sv1[3]
    .  .  .
Sv1[NT1]
Sv2[1]
Sv2[2]
Sv2[3]
    .  .  .
Sv2[NT2]
Sv3[1]
Sv3[2]
Sv3[3]
    .  .  .
Sv3[NT3]

where

LON    = longitude of point source
LAT    = latitude of point source
DEP    = depth (km) of point source
STK    = strike
DIP    = dip
AREA  = area of "point" source (cm*cm)
TINIT  = initiation time (when rupture reaches subfault center)
DT     = time step in slip velocity function
RAKE  = direction of $u_1$ axis (rake direction)
SLIP1  = total slip (cm) in $u_1$ direction
NT1    = number of time points in slip velocity function for $u_1$ direction
SLIP2  = total slip (cm) in $u_2$ direction
NT2    = number of time points in slip velocity function for $u_2$ direction

SLIP3 = total slip (cm) in $u_3$ (surface normal) direction
NT3 = number of time points in slip velocity function for $u_3$ direction
Sv1[1],…,Sv1[NT1] = Slip velocity at each time step for $u_1$ direction
Sv2[1],…,Sv2[NT2] = Slip velocity at each time step for $u_2$ direction
Sv3[1],…,Sv3[NT3] = Slip velocity at each time step for $u_3$ direction


Although the general format given here allows for slip in all three directions ($u_1,u_2,u_3$), most cases will have only one ($u_1$) or two ($u_1, u_2$) non-zero slip components. In these situations, the remaining slip components, as well as the number of time points for the slip velocity, are specified as "0".