An Introduction to the Seismo-Lineament Analysis Method (SLAM)

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SLAM uses...
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- earthquake hypocenter and focal mechanism data
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• hillshade maps derived from digital elevation models
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- geomorphic analysis
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- earthquake hypocenter and focal mechanism data
- hillshade maps derived from digital elevation models
- geomorphic analysis
- geologic field work
Map

- earthquake epicenter
Map

focal mechanism diagram (beachball)
Map

--- sea level ---

focal depth

• focus
lower-hemisphere stereographic projection of earthquake focal mechanism
nodal planes at right angles to each other
ground-surface trace of blue nodal plane
Map
ground-surface trace of red nodal plane
ground surface

cross-section view

focus
ground surface

nodal plane

focus
cross-section view
Trivial case: Can we use SLAM to find the fault responsible for the M 6.0 South Napa earthquake of 24 August 2014?
South Napa Earthquake
M 6.0, August 24, 2014

Earthquake data from NCEDC
Fault observations from USGS
Polaris Fault near Truckee, North Tahoe area, California

- Discovered in 2009
- Right-lateral fault
- Surface trace confirmed with trenches and lidar-based geomorphic analysis
- No reported historic earthquakes
6.26.2005, M4.8
depth 9.7 km
hEr1 0.07 km, hEr2 0.05,
hEr1Az 93°,
vEr 0.09 km
SLAM analysis shows there have been historic earthquakes consistent with displacement along the Polaris Fault.
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The Polaris Fault extends under and adjacent to Martis Creek Dam and Reservoir.
Dog Valley Fault near Truckee, North Tahoe area, California

- Generated $M_L$ 6.0 Truckee earthquake of 1966; left-lateral focal mechanism
- Surface trace inferred but not confirmed.
SLAM analysis shows that, after the M 6.0 Truckee Earthquake sequence in 1966, several M 3-4 earthquakes occurred between 1983 and today that are consistent with displacement along the Dog Valley Fault.
Is the inferred trace of the Dog Valley Fault that is depicted in the Quaternary Fault and Fold Database of the United States accurate?
Results from SLAM suggest that the Dog Valley Fault has a different trace than has been inferred in the past, and that several small-moderate earthquakes have occurred along the DVF since 1966.
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The DVF extends under Stampede Dam and Reservoir.
SLAM applied to earthquakes that have not been associated with any known faults.

Prosser Creek Trend near Truckee, North Tahoe area, California
7.7.2001, M3.2
depth 8.0 km
e_h 0.1 km, e_v 0.1 km
SLAM results suggest that the Prosser Creek Trend might be a right-lateral fault that has generated historic earthquakes.
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The Prosser Creek Trend extends under Prosser Creek Dam and Reservoir.
SLAM applied to earthquakes that have not been associated with any known faults

Martis Creek Trend near Truckee, North Tahoe area, California
SLAM results suggest that the Martis Creek Trend might be a left-oblique fault that has generated historic earthquakes.
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The Martis Creek Trend extends through the NorthStar development and is near the towns of Truckee, Tahoe City, and Incline Village.
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- SLAM is only useful for shallow-focus earthquakes ($\leq 30$ km depth).
- SLAM is unlikely to be helpful for very gently inclined faults.
- The quality of the seismic data used as input to SLAM is very important.