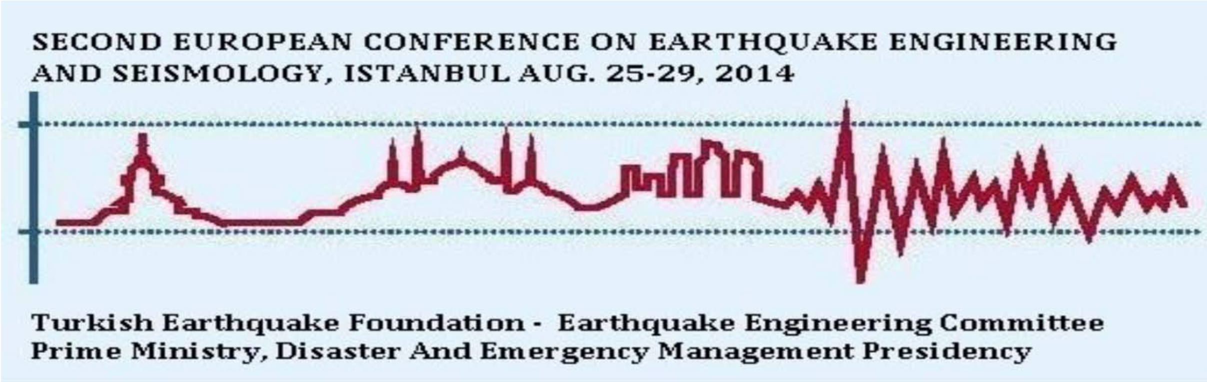

DETECTION OF ABNORMAL FAULT SLIPS USING PCA METHOD BASED ON OBSERVATIONS OF CONTINUOUS GNSS STATIONS

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The coordinate time series of continuous GNSS stations are generally used to estimate velocities and displacements of stations caused by tectonic plate motion and earthquakes (Ji, et al., 2011, 2013). In this paper, we present a method for detection of abnormal fault slips based on a set of coordinate time series of GNSS stations distributed over fault zones by principal component analysis (PCA) method. At first, a variable fault slip dislocation model is used for obtaining synthetic observations of coordinate time series. Through analysis of these synthetic data sets by PCA, time and spatial response percentages are defined and used for indentifying different fault geometry and fault slip behaviors. The results show that both time response and spatial response can detect fault abnormal slip correctly. Then, the method is applied to analyze real coordinate time series of 15 GNSS stations around the fault of 2006 aseismic slow slip event in Guerrero, Mexico, it can identify the fault geometry and slip correctly comparing with publications by other methods.

Table 1 lists the parameters of the fault for simulation. Time series of synthetic displacements of 20 chosen stations over the fault are obtained by adding theoretic displacements (Okada, 1985), white noise and random walk with 1080 epochs, which are used for getting inversion results of fault slip, see Fig.1.

Table 1 Fault Parameters

Location(N,E)/km	Azimuth/degree	Length/km	Width/km	Depth/km	Dip/degree
(50,100)	90	100	20	10	70

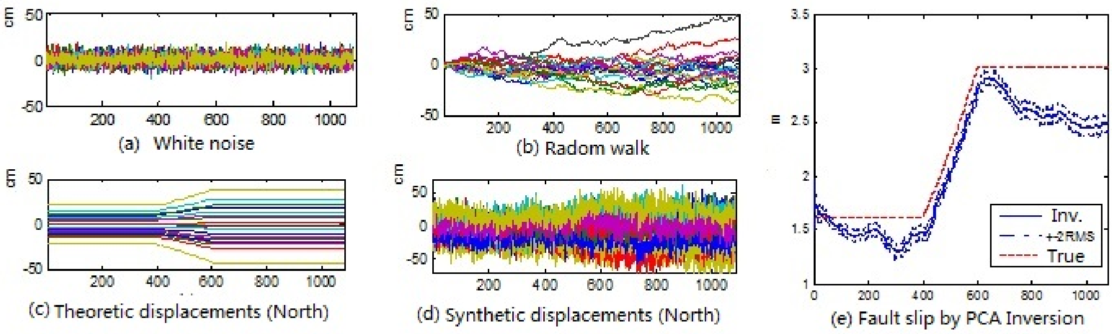

Figure 1 Synthetic time series of displacement (North component) and fault slip by PCA inversion

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In Fig.1 (e), the red dash line is the true fault slip, and the blue line is fault slip obtained by PCA inversion with synthetic displacements (Fig.1 (d)), the dash blue lines are 2 times of RMS around the inversion fault slip.

The same PCA inversion method are applied to observed coordinate time series of 15 continuous GNSS stations over the aseismic slip fault in Guerrero, Mexico, with 465 days (Radiguet, 2011; Perfettini, et al., 2010). Fig.2 shows the aseismic fault slip by the PCA invasion method.

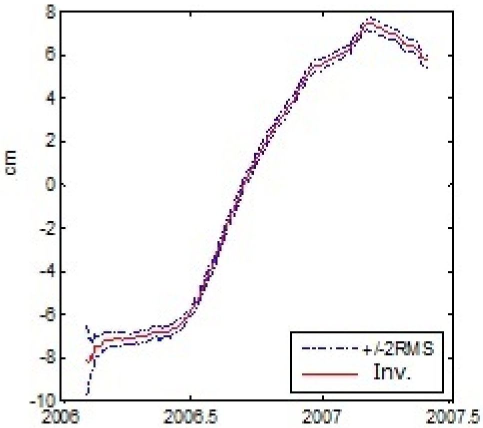

Figure 2 Aseismic fault slip in Guerrero, Mexico by PCA inversion

In Fig.2, the red line is the aseismic fault slip obtained by PCA inversion, and the dash blue lines are 2 times of RMS around the inversion fault slip. It shows that fault slip rate is highest between June to August in 2006 and decreases to stable in the end of 2006. This agrees with that in Radiguet (2011).

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