LEVEL CROSSING APPROACH IN SPATIAL AND TEMPORAL DEPENDENCE IN EARTHQUAKE

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In recent years, a vast majority of researches have been devoted to the study of seismic data that contain information about the complex events that lead to the earthquake (Park, 1997).

We live in a world where random processes are ubiquitous. Although the random values of a stochastic process at different times may be independent random variables, but in most cases they are considered to indicate complicated statistical correlations. So, over the past decade, several different methods have been introduced to study the properties of the process. Spatial and temporal fluctuations of earthquake form time series. The purpose of the application of statistical mechanics is to describe the behavior of the time series that can help to better understanding of the stochastic processes. After that, we lie in an effort to reproduce or predict some experimental facts with extraction of useful information. An important question is what is the probability of obtaining or losing a certain level of return at different time intervals? In the level crossing method no scaling feature is explicitly required and this is the main advantage of this technique for estimating the statistical information of the series (Johnston, 1997).

Level crossing based on stochastic processes that grasp the scale dependence of the time series.

The memory, non-Gaussianity and waiting time (length) (an average time (length) interval that we should wait for an event to take place again could be measured by level crossing method. Since the fractional Gaussian noises are well-known examples, their comparison with empirical data can be used as a criteria to better understanding the results obtained from the level crossing method applied to unknown empirical data Raleigh et al. (1997).

We have studied Iran and California earthquakes from 1/1/1971 to 08/03/2013. For this purpose, the statistical correlations of earthquakes in these two regions have been compared. Earthquakes with magnitude greater than of 4 in Richter magnitude scale have been selected, and time series and the spatial series have been established by using time intervals and physical distances between the earthquakes, respectively Tabar et al., (2011).

Figure 1 shows the crossing with positive slope related to the obtained date (both original and shuffled data) for Iran and California earthquakes as can be estimated by equation (4).

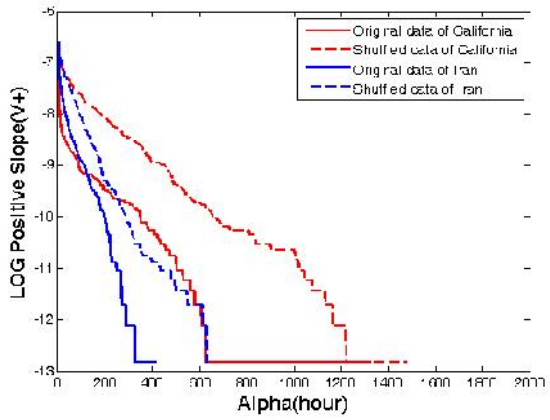

Figure 1. Plot of ν_{α}^{+} for original and shuffled date related to Iran and California earthquakes in time series.

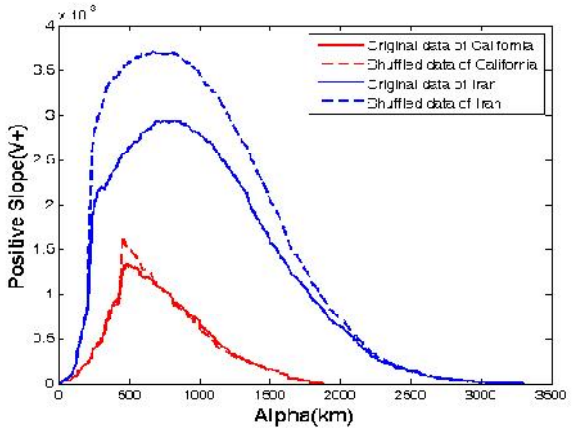

Figure 2. Plot of ν_{α}^{+} for original and shuffled date related to Iran and California earthquakes in spatial series.

The plots reveal the positive correlation of Iran and California earthquakes over time. The level crossing for both original and shuffled data related to Iran and California earthquake have been depicted in Figure 3. From the figure, the earthquakes correlation is also evident in this case. However, the correlation is lower than that related to Iran earthquakes.

The estimated crossing with positive slope from equations in the spatial series for the original data related to earthquakes occurred in Iran and California has been depicted in Figure 2. It is clear from the figure that the earthquakes occurred in Iran show a higher correlation. This means that the earthquakes affect and stimulate each other. In other word, the percentage of induced earthquakes in Iran is more than California.

In this paper the concept of level crossing analysis has been applied to Iran and California earthquakes. In level crossing method no scaling feature is explicitly required and this is the main advantage of this method in estimating the statistical information of the series. Level crossing based on stochastic processes that grasp the scale dependence of the time series. It is shown that the level crossing is able to detect the memory of series.

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