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A TRANS-SCALE SPATIAL AUTOCORRELATION METHOD FOR DETERMINATION OF HIGH-STRAIN FIELD ACCUMULATION

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Abstract. *Quantitatively describe the evolution of high strain accumulation is an important problem to understand the process of deformation evolution induced rupture. In present paper, a trans-scale spatial autocorrelation method is introduced to give a description to the evolution of the extent of strain accumulation in rock specimens. The statistic results of the experimental data reveal that the trans-scale autocorrelations of the strain pattern of rock specimens under uniaxial compression appear ahead of ultimate rupture. It can be seen that, with load continues, the autocorrelation value of stains increases. Especially close to rupture, the autocorrelation of all scales increased obviously. Moreover, the spatial autocorrelation of all samples increase with the decease of calculating window's size. This trans-scale autocorrelation not only indicates the accumulation of high strain but also plays a precursor of catastrophic rupture.*

Keywords: Trans-scale, Autocorrelation, Accumulation, Strain

1. **Introduction.** Before the ultimate macroscopic rupture of heterogeneous material like concrete, rock and other geological materials occurs, high strain always localizes in a narrow zone of the continuum [1-6]. This leads to the true scale governing the damage variable of the eventual rupture occurs is much smaller than the scale of the specimen. Therefore, the responses evolve from the global behaviour become the characters of a structure [3,6]. Especially this results in the uncertainty of the catastrophic rupture because of the unknown of the extent of the high strain accumulating. Figure 1 shows the strain pattern measured in unaxial-compress experiments of rock. It is clear that the strain become accumulating ahead of rupture. But how to describe the evolution of the strain accumulating is an open problem.

Spatial autocorrelation is a measurement of spatial dependence between values of random variables over spatial locations. The most often used one is Moran's (1948) I [7,8], which is a standardized measure of correlation between observations in neighboring areas. It is commonly employed in the analysis of spatial data and a positive autocorrelation captures the existence of both high-value clustering and low-value clustering. Global autocorrelation is a simultaneous measurement of spatial autocorrelation over the entire locations for a given area. But the correlation index calculated based on neighbors, which is defined by one element unit (the distance between two elements connected each other), can not demonstrate the high strain accumulation and the evolution of strain field. Furthermore, it also cannot unveil the characteristics size of strain accumulation. The objectives of this paper are the following: to demonstrate the presence of spatial autocorrelation in strain pattern evolution. Spatial autocorrelation is tested for different data sets at different aggregation levels to get insight in the behavior and extent about evolution of the spatial strain patterns. In present paper, a trans-scale spatial autocorrelation