



Analysis of chaotic character of the earth's surface subsidence caused by mining

A.B. Zhang, W.J. Di, X.X. Liu, and X.P. Li

School of Resources, Hebei University of Engineering, Handan 056021, China.

Abstract

Mining Area surface deformation is a complex nonlinear system. Based on the actual monitoring data, Chaotic Theory was introduced to dynamic deformation analysis. Space reconstruction, correlation dimension determination and Lyapunov exponent calculation were studied. The results confirmed that the deformation system is a chaotic system, pointed that the influencing factors is about 3 to 6. Finally, based on the phase space reconstruction, the least squares support vector machines prediction mode was established. The simulation results show that this method can be used for deformation analysis.

Key words: *Subsidence, Chaotic, Space reconstruction, Prediction model*

1. Introduction

The earth's surface's dynamic movement and the distortion are the important contents of the research field of the mining goaf, and it is also the considered important factors of mining harm and protection. The dynamic subsidence of the earth's surface is influenced by a lot of factors, so it displays intensely nonlinear (Guo, 2001). The relevant research finds that the surface distortion is a complex four-dimensional phenomenon which varies with time and space (Huang and Wang, 2006). The distortion is a space and time continual function. Consequently it brings some difficulty for the exploration and study of surface dynamic subsidence. At present, the domestic and foreign researchers have conducted lots of research about this phenomenon, and have got many meaningful results. For example, for the prediction method of the

goaf's distortion, the researchers have done a great amount of work, based on structure mechanics method, based on stochastic theory method, gray protection technique, neural network method and so on.

At present, the research achievements about the chaotic dynamics characteristic of mining goaf subsidence rule are rare. Whether the mining goaf subsidence system possesses the chaotic characteristic, and how to distinguish the chaotic characteristic, this is a problem which is worth studying. For the observation sequence which possesses the chaotic behavior, we can reveal completely the non-linear dynamics behavior of the deformable body only through the chaotic analysis method. On the other hand, the chaotic phenomenon in nonlinear system indicates the time limit of future prediction, and it provides the possibility of the prediction of complex system. Therefore, introducing the chaotic theory to goaf surface distortion is a change in the concept and way of thinking.