

饱和嵌入维数确定最大Lyapunov指数的准则探讨

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摘要

基于对大量砂岩试样裂隙系统的MTS全应力-应变时间序列的非线性动力学分析, 构造单位阶跃函数并引入到最大Lyapunov指数LE1的判别模型中, 建立了确定LE1的新准则。新准则充分考虑LE1-m关系中普遍存在的阶跃现象, 更符合确定LE1的理论条件。新准则确定的LE1与传统准则的解释结果比较, 偏离幅度巨大, 使得对系统稳定性程度的混沌判别结果迥异, 并且LE1的正负号会因此改变, 导致对系统所处状态的定性评价不同。研究成果在一定程度上克服了传统准则确定LE1鲁棒性较差的缺陷, 对混沌动力学基础研究具有一定的理论意义。

关键词 [岩石力学](#); [混沌](#); [裂隙系统](#); [相空间](#); [嵌入维数](#); [Lyapunov指数](#); [准则](#); [鲁棒性](#)

分类号

DISCUSSION ON A NEW RULE TO FIND LARGEST LYAPUNOV EXPONENT BY SATURATED EMBEDDED DIMENSION

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Abstract

Based on the analysis of nonlinear dynamics to time series of strain and stress which are tested by MTS to lots of joint systems of sandstone specimens, a new rule to find the largest Lyapunov exponent is established by introducing LE1-m mathematical model and unit-step function. The new rule involves step feature that confirms theoretic condition of finding the largest Lyapunov exponent even more. Value of the largest Lyapunov exponent erected by the new rule is very different to that of the old rule, which will lead to a very different valuing conclusion of chaos to stability of a system. Meanwhile, different sign of the largest Lyapunov exponent will produce different conclusions of system state of which the characteristic has been changed

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completely. Conclusions of the paper improve robustness to erect LE1 by old rule and are useful to basic theoretic research of chaotic dynamics.

Key words [rock mechanics](#); [chaos](#); [joint system](#); [phase space](#); [embedded dimension](#); [Lyapunov exponent](#); [rule](#); [robustness](#)

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