



论文摘要

中南大学学报(自然科学版)

ZHONGNAN DAXUE XUEBAO(ZIRAN KEXUE BAN)

Vol.32 No.4 Aug.2001



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文章编号: 1005-9792(2001)04-0339-05

非线性模型的非线性强度及其在变形分析中的应用

李志伟¹, 朱建军¹, 王仁谦², 李 陶¹

(1. 中南大学资源环境与建筑工程学院, 湖南长沙 410083;

2. 华侨大学土木系, 福建泉州 350029)

摘 要: 介绍了Bates和Watts的非线性强度度量指标——最大固有曲率和最大参数效应曲率, 提出了当模型固有非线性不显著而参数效应非线性显著时, 利用M. J. Box提出的偏差计算和模拟研究重新参数化的方法. 结合某实测边坡的变形监测资料, 选用非线性模型 $l t = \alpha - \beta_{\exp}(-\gamma t^{\delta}) + \varepsilon_t$ 描述边坡变形规律. 对该边坡上73个点的监测资料分别进行非线性回归计算, 发现其中大部分点不能收敛于LS估计, 该模型有较强的非线性特性; 研究该模型的非线性特性时, 发现其最大固有非线性曲率不显著, 而模型的最大参数效应曲率非常显著. 模拟结果表明, 估计量类似对数正态分布, 因此, 用新参数 $= -\lg \gamma$ 对模型重新参数化. 用重新参数化后的模型对该边坡的实测资料进行回归计算时, 只有4个点未能收敛于LS估计, 而模型的最大固有非线性曲率和最大参数效应曲率则基本符合要求.

关 键 字: 非线性强度; 固有曲率; 参数效应曲率; 偏差; 模拟

Research on nonlinear strength of nonlinear model and its application in deformation analysis

LI Zhi-wei¹, ZHU Jian-jun¹, WANG Ren-qian², LI Tao¹

(1. College of Resources, Environment and Civil Engineering, Central South University, Changsha 410083 China;

2. Department of Civil Engineering, Huaqiao University, Quanzhou 350029, China)

Abstract: This paper introduces Bates and Watts' index of nonlinear strength, the maximal intrinsic curvature and the maximal parameter-effects curvature. It presents a re-parameterizing method which utilizes M.J.Box bias computation and simulating studies when the nonlinear model has significant parameter-effects curvature and insignificant intrinsic curvature. Combined with an example of slope deformation analysis, several points of the method are discussed. According to the mechanism of the slope deformation, the nonlinear model $l t = \alpha - \beta_{\exp}(-\gamma t^{\delta}) + \varepsilon_t$ was recommended to describe the deformation. But when implementing the regression calculation for the seventy three points respectively, most of them could not converge to LS estimation. It can be inferred that the model has strong nonlinear nature. Study on the model shows that their intrinsic curvatures are acceptable, but the maximal parameter-effects curvature are not. It is shown that most of the parameter-effects curvature come from parameterity. Simulating research reveals that estimations $\wedge \gamma$ is approximately in a logarithm normal distribution, thus a new parameter $= -\lg \gamma$ is used to re-parametrize the model. The regression calculation for the seventy three points respectively based on the revised

model shows that only four of them can not converge to LS estimation, and both the maximal intrinsic curvature and the maximal parameter-effects curvature are acceptable.

Key words: nonlinear strength; intrinsic curvature; parameter-effects curvature; bias; simulating



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地 址：湖南省长沙市中南大学 邮编： 410083

电 话： 0731-88879765 传真： 0731-88877727

电子邮箱： zngdxb@mail.csu.edu.cn 湘ICP备09001153号