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基于Shannon奇异核理论的褶积微分算子在地震波场模拟中的应用

龙桂华[1,2],李小凡[1],张美根[1]

1 中国科学院地质与地球物理研究所，北京 100029
2 中国科学院研究生院，北京 100049

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摘要 本文在前人工作的基础上，建立了一种基于Shannon奇异核的交错网格褶积微分算子方法.文中不仅详细讨论了影响算子精度的各种因素，同时也着重分析了其在弹性波模拟中的频散关系和稳定性条件.通过和交错网格有限差分算子比较，发现该算子即使在高波数域也具有较高的精度.均匀介质中的数值试验也表明，该方法9点格式就基本上达到了解析解精度.而分层均匀介质和复杂介质中的地震波数值模拟也同时证实了该方法精度高，稳定性好，是一种研究复杂介质中地震波传播的有效数值方法.

关键词 离散奇异核 褶积微分算子 地震波模拟
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The application of convolutional differentiator in seismic modeling based on Shannon singular kernel theory

LONG Gui-Hua[1,2], LI Xiao-Fan[1], ZHANG Mei-Gen[1]

1 Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China
2 Graduate University, Chinese Academy of Sciences, Beijing 100049, China

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Abstract This article provides a technique to model seismic wave propagation in complex media using convolutional differentiator method based on Shannon singular kernel theory. The high accuracy of the differentiator has been demonstrated through comparisons with numerical results computed by staggered-grid finite difference method. Numerical tests suggest that the differentiator allows sufficient accuracy even in high wave-number domain. Dispersion and stability condition of the method in velocity-stress equation are also thoroughly discussed. Experiment in homogeneous medium shows that the 9-point scheme of this differentiator can achieve analytical accuracy. The application of this differentiator to model seismic wave propagation in homogenous layered medium and complex medium also shows high accuracy and robust stability. These appealing characters of this improved method would make it effective to model seismic wave propagation in complex media.

Key words Discrete singular kernel; Convolutional differentiator; Seismic modeling

通讯作者:
龙桂华 longgh@mail.iggcas.ac.cn
作者个人主页: 龙桂华[1;2];李小凡[1];张美根[1]