



钻柱扭转和纵向振动的等效网络分析

*闫向宏^{1,2}, 孙建孟¹, 张美玲², 苏远大¹, 陈雪莲¹

(1. 中国石油大学地球资源与信息学院, 山东, 东营 257061; 2. 中国石油大学物理科学与技术学院, 山东, 东营 257061)

ANALYSIS OF TORSIONAL AND LONGITUDINAL VIBRATION OF DRILL STRINGS USING EQUIVALENT NETWORK

*YAN Xiang-hong^{1,2}, SUN Jian-meng¹, ZHANG Mei-ling², SU Yuan-da¹, CHEN Xue-lian¹

(1. College of Geo-resources and Information, China University of Petroleum, Dongying, Shandong 257061, China; 2. College of Physics Science and Technology, China University of Petroleum, Dongying, Shandong 257061, China)

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摘要 忽略阻尼对钻柱振动的影响, 在一维钻杆扭转振动和纵向振动方程的基础上, 推导出单根钻杆和多根相同钻杆扭转振动和纵向振动的等效网络。利用等效网络级联理论, 结合钻柱系统边界条件, 给出了钻柱扭转振动和纵向振动的等效网络和机械等效阻抗表达式, 阐述了根据机械等效阻抗确定钻柱扭转振动和纵向振动机械共振频率的原理和方法。由等效网络分析法和ANSYS有限元法对两例钻柱扭转振动和纵向振动机械谐振频率的计算结果表明: 利用等效网络分析法计算钻柱系统扭转振动和纵向振动的机械谐振频率是一种行之有效的办法, 具有直观、简单易用的特点, 并且其计算结果与ANSYS有限元法的数值模拟结果一致。

关键词: 钻井工程 钻柱 扭转振动 纵向振动 共振 等效网络 机械等效阻抗

Abstract: Ignoring the influence of damping to the vibration of drill strings, the equivalent networks have been given out for a single drill pipe or more of the same drill pipe according to the one-dimensional torsional and longitudinal vibration equation of a drill string. In accordance with the series connection equivalent networks, considering the boundary conditions of the drill string system, the equivalent networks and mechanical equivalent impedance of torsional and longitudinal vibration were derived, and then the principles and methods for determining the mechanical resonance frequency of torsional and longitudinal vibration have been given by using the mechanical equivalent impedance. The resonant frequencies of two drill string systems were calculated by the equivalent network method and ANSYS finite element method. The calculation results indicate that using the equivalent network method to calculate the resonant frequency of torsional and longitudinal vibration of a drill string system is an effective method. It is easy to use and its calculating results are same with those calculated by the ANSYS finite element method.

Key words: drilling engineering drill string torsional vibration longitudinal vibration resonance equivalent network mechanical equivalent impedance

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