Research on Continuous Dynamic Scratch Test Technology for Rock Cores Postprint

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Date: 2025-07-17T00:00:00+00:00

Abstract

Rapid and accurate acquisition of rock strength parameters is a necessary prerequisite for the safe construction of rock engineering projects. The traditional sample preparation and testing cycle involving core cutting, end face grinding, and compressive crushing is lengthy, whereas continuous core scratching tests are quick and convenient, causing only minor scraping damage to the core surface and enabling rapid acquisition of rock uniaxial compressive strength, internal friction angle, and cohesion parameters. To address the limitation of conventional static scratching that cannot account for surface irregularities of the core, this study proposes a technology for precisely sensing the surface undulation characteristics of cores and real-time dynamic adjustment of scratching depth, and develops corresponding continuous dynamic core scratching test equipment. Based on three scratching modes—static, dynamic equal-division, and dynamic point-selection—a series of continuous scratching tests were conducted on tight sandstone. The results show that, compared with standard compression tests, the maximum error of rock strength parameters obtained from dynamic scratching tests is 10.57%; compared with static scratching, the testing accuracy of uniaxial compressive strength for dynamic equal-division and dynamic point-selection scratching is improved by 44.44% and 53.09%, respectively. Furthermore, the reasons for strength testing errors arising from different scratching modes are discussed, and the applicable scratching modes and application scenarios for sharp and blunt cutter heads are clarified. The continuous dynamic core scratching test technology can rapidly and accurately measure strength parameters without compromising the integrity of the rock mass, optimizing the load measurement errors caused by the inability of static scratching to maintain a constant actual cutting depth, and providing a simple and efficient new technical approach for rapid testing of rock mechanics parameters.

Full Text

Study on Continuous Dynamic Scratching Testing Technology for Rock Cores

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Abstract

Rapid and accurate acquisition of rock strength parameters is a prerequisite for safe construction of rock mass engineering. Traditional sample preparation and testing procedures—including core extraction, end-surface grinding, and compressive crushing—are time-consuming. In contrast, continuous rock core scratching tests offer a rapid and convenient alternative that inflicts only minor surface damage while enabling quick determination of uniaxial compressive strength, internal friction angle, and cohesion parameters.

To overcome the limitation of conventional static scratching methods, which cannot account for surface irregularities on rock cores, this study proposes a real-time dynamic adjustment technique that accurately senses surface topography and continuously regulates scratching depth, along with the development of a corresponding continuous dynamic rock core scratching apparatus. A series of continuous scratching experiments were conducted on tight sandstone using three modes: static, dynamic equal-interval, and dynamic selective-point scratching.

Results demonstrate that, compared with standard compression tests, the maximum error for rock strength parameters obtained via dynamic scratching was 10.57%. Furthermore, compared to static scratching, the accuracy of uniaxial compressive strength measurements improved by 44.44% and 53.09% for dynamic equal-interval and dynamic selective-point modes, respectively. Additionally, the study discusses the sources of measurement error associated with different scratching modes and identifies the optimal modes and application scenarios for both sharp and blunt cutters. The continuous dynamic rock core scratching technique enables rapid and precise determination of strength parameters without compromising sample integrity, thereby eliminating load measurement errors arising from non-constant cutting depths in static scratching methods. This provides a simple yet efficient new approach for rapid testing of rock mechanical parameters.

Keywords: continuous rock core scratching, dynamic scratching, crushing specific energy, scratch strength, tight sandstone

Note: Figure translations are in progress. See original paper for figures.