Postprint: A Comparative Study on Screening Efficiency of Different Particles in Drilling Fluid Shale Shakers under Dual Vibration Modes Based on the Discrete Element Method

Authors: Liu Hongbin

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Abstract

Linear vibrating screens and translational elliptical vibrating screens represent two developmental forms of drilling fluid vibrating screens. Investigating the screening efficiency of these two vibration-mode screens under different operating parameters holds value and significance for practical production and equipment selection. Based on the Discrete Element Method and employing EDEM computational analysis software, simulation calculations were conducted on the screening efficiency of drilling fluid vibrating screens under linear vibration mode and translational elliptical vibration mode; the motion parameters, bonding effects, and number of throwing motions of multiple particle types under the two vibration modes were studied, and the screen penetration and outlet discharge screening rates were calculated. The study revealed that under identical vibration parameters, the linear vibration mode exhibits superior discharge screening performance for non-screen-passing particles compared to the elliptical vibration mode, whereas the translational elliptical vibration mode demonstrates superiority in preventing particle agglomeration formation; the greater the particle bonding effect, the more throwing motions particles undergo on the screen surface, and the formation of particle agglomerations reduces particle transport velocity, leading to decreased processing efficiency of non-screen-passing particles by the screen within unit time—in practical operations, formation of particle agglomerations should be avoided as much as possible; within the vibration frequency range of 25–30 Hz, the influence of bonding effects on particle velocity increases rapidly, reducing the outlet discharge screening rate.

Full Text

Preamble

We introduce a comprehensive mathematical framework that integrates Conditional Random Fields (CRF), Maximum Entropy (ME) models, and Robust Parameter Refinement and Selection (RPRS). The foundational relationship is established in the core probabilistic structure. Building upon this, we extend the formulation to incorporate CRF-based dependencies, while introducing the ME component for flexible feature integration. The model specification continues through equations which define the potential functions and parameter spaces. Computational aspects are addressed in the optimization framework, followed by optimization procedures. The inference framework is presented with additional theoretical results. The complete consolidated formulation appears in the final equations.

6 Experimental Evaluation

This section details the experimental configuration and empirical evaluation. The experimental setup is specified in equation MATH_{0024} , with training procedures detailed in the methodology section. Model parameters are estimated using the RPRS framework, as described in equation MATH_{0025} . We evaluate the system across multiple configurations, with comparative analysis presented in equations MATH_{0026} through MATH_{0043} .

The CRF-ME integration demonstrates consistent improvements over baseline methods, with the RPRS algorithm ensuring robust parameter estimation across varying data conditions. Results indicate superior performance on structured prediction tasks, confirming the effectiveness of the unified framework.

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

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