Assessing the Potential of CFA Piling Rig Telemetry Data for Stratigraphic Profiling and Optimised Pile Installation

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Continuous Flight Auger (CFA) piling is widely adopted due to its speed, cost-effectiveness, and minimal environmental disruption. However, a key limitation is that operators have no direct visibility of what is being drilled, making it difficult to determine when critical strata, particularly rock, are encountered in real time. This leads to conservative designs with excessive socket lengths and increased material use.

This research addresses that challenge by exploring whether machine learning (ML) can identify the boundary between superficial materials and rock using high-frequency CFA rig telemetry data. Real-time predictions will allow contractors to terminate drilling more precisely, enabling optimised designs that remain safe while delivering significant commercial and environmental savings.

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A comprehensive methodology was developed based on literature from the construction and subsurface drilling industries. Time-series telemetry data was gathered from over 2,000 CFA piles across three UK sites. Various supervised learning models were tested, with Random Forests proving most effective when trained on manually labelled strata transitions. K-means clustering was the most successful unsupervised method, demonstrating the potential for large-scale analysis of historic data, where labelling would be impractical due to the dataset size. Feature selection techniques such as mutual information were used to reduce model complexity and improve interpretability. Boundary detection, error analysis and spatial smoothing were applied to ensure accurate practical deployment, providing safety nets for potential anomalous predictions.

The results demonstrate that supervised ML approaches can reliably identify rock levels with minimal risk of under-prediction, making them suitable for use on live projects. Unsupervised approaches, while less precise, are valuable for gaining insights from historical project archives. A straightforward workflow is proposed for implementation on live projects, and a collaborative framework between contractors is suggested to enhance the model's predictive capabilities, especially if combined with other collaborative datasets containing pile load test results or sensor measurements within working piles.

This research demonstrates a clear opportunity for the foundation industry to evolve its use of telemetry data, shifting from quality assurance alone to smarter, data-informed decision-making across design and construction.