Diggability in Open-Pit Mines

Ted Branscombe

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Abstract

"Diggability" is a rather nebulous term. It in its broadest sense, it can be interpreted as some metric related to the effort or ease with which material can be excavated, or related to the characteristics of the material being excavated. For the purposes of this thesis research, the term diggability is intended to convey a broad measure of excavator digging behaviour and effort, rather than a narrow correlation of digging effort with fragmentation characteristics or muckpile size distributions. In order to be relevant, diggability metrics must be shown to be consistent with other forms of empirical assessment of digging or operating conditions, such as qualitative ranking by operators or fragment size distributions derived from image analysis. To be practical and feasible, diggability metrics must be capable of on-line, near real-time, implementation and rely solely upon sensing of variables which are internal to excavator.

A number of diggability metrics and algorithms have been developed in the past, for a variety of purposes. However, both the scope of their application and the level of analysis of their performance has been somewhat limited. In addition, advances in sensing and computing technology now enable far more comprehensive data acquisition and analysis.

This thesis research project aims to rigorously evaluate prior diggability metrics and algorithms, as well as exploring novel approaches to shovel data analysis, as means towards enhancing existing algorithms or formulating new techniques. A key component of the research is the comparative evaluation of diggability metrics under a range of geological and digging conditions. In particular, fragmentation analyses will be used in the investigation of the correlation of diggability metrics with muckpile size distributions. Sensitivity analyses will also be applied to investigate the importance of correctly identifying the dig state with the shovel operating cycle.

Biography

Ted Branscombe graduated from Queen's University in December 2005 with a degree in Mining Engineering. He subsequently completed a Master's degree in 2010 in Mechanical Engineering at Queen's University, working on open-pit drill rig vibration analysis. He has worked in the engineering consulting world on various projects related to open-pit mining equipment technology. He now works in a part-time capacity for the Robert M. Buchan Department of Mining, while in his first year as a Doctoral student in Mining Engineering under the supervision of Professor Daneshmend.