

Assessment of excavation technologies for a small-scale mining robot and development of future concepts

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ABSTRACT

Future challenges in mining due to sustainability and ecological aspects require additional efforts in research and development. With the help of fully automated machines and/or autonomous robots, new deposits can be accessed, or abandoned mines can be re-opened and operated economically. Possible tasks for robots in mining are the maintenance of machinery, exploration (e.g. of abandoned mines) and excavation (especially in difficult to access areas). With the development of a small-scale, modular robotic miner, the H2020 - ROBOMINERS project will identify trend-setting approaches.

This paper will be discussing various excavation technologies for small-scale mining robots, assessing their applicability and highlight the challenges being faced. The comparatively small weight and low available power are the most limiting factors and therefore require – in addition to adaptations to COTS products - new approaches . The interaction between an excavation tool and rock creates reaction forces, which the machine needs to be capable of handling. Excavation methods can be separated in drill and blast, mechanical, alternative and hybrid excavation technologies, whereas the first two listed are the most commonly applied in standard excavation engineering. Besides reasonable advance and excavation rates, the manoeuvrability of the excavation tool must be given in order to ensure a flexible and mobile application. A methodology has been developed to compare the most promising excavation methods by defining certain parameters (specific energy, traction force, etc.) and to assess their application for different rock strengths. Based on those studies, concepts of production tools for different scenarios and rock strengths have been developed. Eventually, a mining tool concept of a prototype for a modular robotic miner will be demonstrated, which will be built and tested in a full-scale prototype.