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Deep Learning for High Throughput Decision Making on Diamond Content of PET Activated Kimberlite Rocks

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The MinPET research team is developing novel computer-vision capabilities for crushed rock sorting in diamond mines. Traditional diamond extraction methods employ multi-stage rock-crushing where stages are chosen such that a mine's diamond-size distribution is balanced against the crush size at each stage so that an overall acceptable rate of diamond breakage is maintained. Positron emission tomography (PET) techniques can be used to reconstruct a density map of the distribution of PET isotopes within the rock. PET isotopes in diamond ores such as kimberlite can be activated with a high energy gamma ray beam, and can penetrate to a depth of more than 30 cm. An upper bound of 10 to 15 cm on the crush size is given by the attenuation of 511 keV gammas in the rock. This sorting capacity decreases the rate of diamond breakage. Computer-vision and deep-learning methods can produce autonomous agents capable of on-the-fly decision making, these agents can then identify which rocks contain diamonds and extract them for further careful processing. The expected mass ratio of kimberlite to diamond is about a few billion to 1, thus a fairly accurate agent can reduce processing needs by at least 1000 times, we aim to reduce it by 10,000 times. This talk describes the combination of synthetic data generation and AI training needed to create such agents and outlines our current achievements.

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