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Earth observation from large platform and Moon

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The large manned objects flying in low Earth orbit, e.g., the U.S. and Russia's human space vehicles, the International Space Station, and Chinese Tiangong experimental space laboratory, provide unique platforms for Earth observation. On the other hand, as the only natural satellite of the Earth, the moon can become a brand-new Earth observation platform. Both of these space vehicles and the moon can be categorized as large Earth observation platforms, which have many common advantages, such as holding various different kinds of Earth observing sensors, which can measure multiple environmental parameters simultaneously under the same view geometry, illumination and atmospheric conditions. Accompanying the development of manned space flight programs, Earth observation activities from large space vehicles have acquired various and large amount of datasets using both handheld cameras by crewmembers and automated sensors installed onboard these platforms. These datasets have been applied in multiple geoscience studies, demonstrating the importance and uniqueness of studying Earth from a vantage point of large platforms. For instance, the first near global digital elevation model (DEM) was produced by data obtained during the shuttle radar topography mission (SRTM). Our humanity is ambitious in deep space exploration and has achieved gratifying progress. One objective of the exploration is to build the livable base in other planets. Moon base building could be the most achievable step in the near future. After the moon base being constructed, Earth observation could be one of its three main objectives (two others are studying the moon itself and observing the deep space from it). Extending Earth observing activities from the traditional artificial satellites in lower Earth orbit to the moon may trigger revolutionary applications for the Earth system science study. The Earth-moon distance is far enough to ensure the sensors can collect datasets covering half of the Earth surface. By studying events captured in these datasets may reveal some new large scale natural phenomena on Earth. Furthermore, utilizing different kinds of Earth observing sensors deployed on moon, detecting different parameters of the Earth, we can study the mechanism of the global environmental change system. It is our believe that the Earth observation from large platform and moon can play more important, and even unique role on Earth study in the future.

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Alternative fragmentation concepts for possible space mining applications

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Extra-terrestrial mining means operating in remote areas under extreme radiation conditions and low gravity. These circumstances necessitate rethinking current excavation methods used for extracting raw materials from the earths' crust. Especially the low-gravity conditions will change the way forces are applied to the rock mass in order to use its fragment size and subsequently processing it. With currently used machinery and technology, mining machines are comparably heavy and apply high forces to the rock mass. Blasting will apply an even bigger shock wave causing fragmentation of ores. Since the application of high forces will not be possible in space and it is extremely expensive to transport heavy equipment to space alternative ways of rock fragmentation and excavation which mitigate these issues are widely investigated. This paper will discuss the problems associated with mining in remote environments, especially under low gravity conditions as on asteroids or the moon. An overview will be provided on different alternative fragmentation concepts highlighting their pros and cons in this context. Special insights will be provided on the use of microwave irradiation of hard rocks and the consequences on excavation forces. Experimental results will be provided showing how microwave irradiation of hard rocks leads to a reduction of cutting forces by 10%.

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