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Asteroid Mining: Opportunities and Challenges

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ABSTRACT

Online marketing will encourage future asset search. The governments of several countries have recently taken important steps to develop laws that will apply to new, more challenging asteroid missiles. This paper discusses the opportunities and challenges of asteroid mining, as well as the level of complexity involved in addressing the location and operation of the mission, as well as the complexity and concepts involved in reducing the chance of failure.

Keywords: Asteroid Mining, Near Earth Asteroids, Challenges, Issues.

INTRODUCTION

Small asteroids, remnants of rocks left over from the beginning of our solar system began, when a huge cloud of gas and dust collapsed made up of minerals and metals. Near-Earth-Asteroids (NEA) can be an unimaginable and effective strategy for overcoming the problem and may disrupt the repository of basic human development. Spectral analysis and grounded data suggest that NEA may contain water, volatiles, and other high-value materials. In the future, space sales will begin the space services journey. Space exploration will be compounded by a shortage of assets as the transfer of natural resources to the development of space enterprises will not take place here as the role of aerospace mines will provide potential resources to support the establishment of aerospace industry. Many things can be categorized and managed in NEAs that are important for development, supporting construction life, agriculture, metallurgy, semiconductors, and precious and valuable metals.The NEAs are very diverse in their spectral properties, ranging from metallic iron (M-type) to stony (S type) to very black carbonaceous (C-type) material. The main steps of the mining will be Exploration (NEA disclosures and assessed populace), Analysis (topographical portrayal of NEA), Extraction (different strategies to concentrate and procedure the assets), Economical viewpoints (financial investigation and its noteworthiness in upcoming days). Two main approaches can be considered for the mining strategies. The first method is to collect asteroid material in its green form by holding a large rock in space. or to hold a small asteroid completely through the bag. This process is currently being considered by the NASA Asteroid Redirect Mission (ARM) [14]. Asteroid mining will be one of the next major steps in the development of human civilization. This paper will discuss the potential for asteroid mining in the future commercialization and challenges faced by the current asteroid explored ideal models and methods used.McInnes C. et. al. (2019) investigated that, the influence of the cost and payload capacity of launch vehicles on asteroid mining profitability. Increased interest in asteroid mining recognized that asteroid mining could provide a long-term solution to alleviating shortages of easily-accessible key natural resources on Earth, on which sustainable technology development is dependent. Moreover, asteroid resources could provide bulk material in (Earth) orbit, for example for propellant for crewed deep space exploration missions or material for the fabrication of space-based habitats. Also, explain the mission architecture with the help of schematic diagram [1]. Trajectory optimization and economic modelling also discussed here. Author also found there are several issues for the success of asteroid mining missions are being addressed: classification of Near-Earth Asteroids (NEAs), trajectory optimization to and from NEAs, [2] mining equipment and economic modelling of these missions.

Opportunities

As asteroid mining is becoming an engineering and commercial reality, it is necessary to systematically study the feasibility of large-scale mining activities that might happen in the future. To address specific issues of asteroid mining missions, the above studies can be seen as components of the prefeasibility study, enable the framework to have greater fidelity and flexibility. The exploration programs of the asteroids from space agencies could open the door to exploitation of natural resources by the private sector, not only through the development of technologies to reach and land on the asteroids, but also through the identification of anear-Earth asteroids and the verification in situ of their composition, thus helping to push the commercialization of space beyond low Earth orbit and into deep space.Asteroid Mining technology could also have a tangible environmental impact. Most notably, asteroid mining would prevent the need for traditional in-the-ground methods

of mining, which release toxic chemicals such as lead and arsenic into waterways and contribute to acid mine drainage. Asteroid mining could also provide an avenue for the creation of solar power satellites, a potentially consistent source of clean energy. Most of the progress that has already been made on asteroid mining technology has been focused on extracting water, reflecting concerns of growing water shortages around the world.

The possibility of capturing a small NEO or a segment from a larger object would be of great scientific and technological interest in the coming decades. It is a logical stepping stone towards more ambitious asteroid exploration and exploitation missions.The utilization of asteroid resources may be a viable mean of providing substantial mass in Earth orbit for future space ventures. A statistical population of near-Earth asteroids allows us to determine the approximate amount of accessible asteroid resources within a given specific transfer energy. These results devise an energy-cost framework, or resource map, that provides some hints for the future utilization of asteroids.

Despite the largely incomplete survey of very small objects, the current known population of asteroids provides a good starting platform to begin with the search for easily capturable objects.The samples of asteroids that will be provided by asteroid miners will allow planetary scientists to completely define the populations of asteroids in the Solar System. Equipped with a complete set of asteroid samples, scientists will be able to accurately catalog the asteroids by specific composition. Such knowledge will advance our understanding of the formation of the Solar System.The development of asteroid mining will require the development of many technologies. On the other hand, asteroid mining technologies improvements, could lead to more research and applications for now elements in the future.

CHALLENGES

High cost of spaceflight

It's quite costly to take your spaceship into outer space, and because the earth's gravity is so strong, we'd end up spending more fuel to get out of the earths gravitational pull than we'd spend exploring space. To tackle this problem, an alternative has been suggested, which is utilizing electric spaceships rather than classical rockets, the idea is to use classical rockets to take our spaceship out of the earth's gravitational pull because electrical spaceships aren't powerful enough to do so, and when our spaceship is safely out of orbit, we could use electrical spaceships to explore the solar system for asteroids. This suggestion doesn't solve the whole problem, but it's very cost-effective compared to other alternatives.

Unreliable identification of asteroids which are suitable for mining

This might not seem important on the surface, but it's an important step in asteroid mining because you can't just mine any asteroid that looks profitable, instead, you have to compare the pros and the cons of mining that asteroid, for example, a factor you have to consider when selecting an asteroid is orbital economics, in this context we're talking about its velocity (its speed in a direction) and travel time (to and from the asteroid), with this in check, we should also consider the option of using some of the asteroid's resources to fuel our spaceship's return to earth to reduce the burden of transporting its resources to earth.

Conflicts between multiple states

The Outer Space Treaty requires State parties to conduct all their activities in outer space 'with due regard to the corresponding interests of all other States Parties'. Without specific coordinating rules, conflicts between multiple States are likely to happen. Private entities may choose to arm themselves to safeguard their own interests. In extreme cases, States may also protect them by placing weapons of mass destruction in outer space if necessary. As a result, priority rights should not be absolute but subjected to some arrangements.

Inequalities in benefits sharing

Under current space law, developing countries hardly benefit from space mining. Because of the competing views and interests among different countries, substantial disagreement also exists with regard to benefits sharing. This issue has become more tangible and pressing especially given that space mining would become a reality soon. Specifically, space-faring countries are reluctant to sacrifice the 'hard earned' benefits to those who don't have the capacity to invest or gain them on their own, while developing countries are pressing for equitable distribution of benefits.

Environment Contamination

Space resources activities are per se ultra-hazardous activities, which may be harmful to both the outer space and the Earth environment. Forward contamination arising from Earth affects the environment of outer space. This type of contamination may include: all forms of debris found in outer space of non-hazardous nature; hazardous waste which is chemically or physically dangerous; radioactive waste which is the residue of nuclear-powered space objects; biological material from

Earth to a planetary body with space probes or human space missions, etc. While backward contamination arising in space adversely affects the surface or atmosphere of Earth. In particular, returning spacecraft may also spread pollution or bring back waste, such as radioactive debris and extra-terrestrial material. For this reason, we should carry out these activities with a high standard of care and due diligence, in spite of uncertainties about specific contamination at present.

Critical Metals

It implies metals essential for future technologies but with limited access due to few countries with mining possibility. These include cobalt, neodynium and platinum. The industries for similar material grow as a consequence of low-carbon emission policies worldwide, where many low-carbon energy technologies use critical metals to function. The side-effects of mining, processing, recycling and disposing of these metals have many risks, including environmental hazards and public health issues.

Protecting Earth

A hypothetical asteroid impact is a significant, though amendable, danger to our very existence. Since the air burst over Siberia 2013 which injured about 1.500 people, the interest for anticipating threatening NEOs awoke anew. To protect the planet, it would be practical to track, categorize, investigate and develop techniques to divert the trajectories of NEOs threatening Earth. One such technique is sending a robotic spacecraft, which gradually changes its orbit to oppose the direction of Earth and most NEOs, its relative velocity to the Earth-threatening NEO would be approximately 60 km/s. The resulting collision could alter the NEOs route towards Earth and divert a catastrophe, if sent out in time and with high precision. Exploring and colonizing space would most likely contribute in the development of similar planetary defense against any future asteroidal threat.

CONCLUSION

The analytical observations and analysis performed over the time reveals that almost half of the NEA's which range from few meters to kilometer in size are carbonaceous in nature and thus are enriched with water and life supporting minerals. These can prove to be potentially good for human's relating deep space missions if utilized aptly. The degree of the complexity when dealing with space is very high which presents a high risk to the mission and its feasibility, however the concept proposed uses this complexity of to its use, thus curtailing the risk of failure. The concept uses the phenomena of absence of gravity in space, which aids it in the take-off phase, in the storage process and other stages of the mission. The absence of any kind of atmosphere on the surface of the asteroid also curtails the risk of mission failure such as burning of module at time of arrival.

The Water is essential to "living off the land" in space. So, this is first thing to be 'mined'. There is a strong commonality of interests between asteroid science, asteroid mining, and planetary defense, and that is likely is likely to continue for some time to come. The proposition is risky, the long-term payoff from asteroid mining will be immense. This is truly a game-changing possibility for space exploration and for humanity.

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