



TECHNOLOGY SOLUTION

Manufacturing



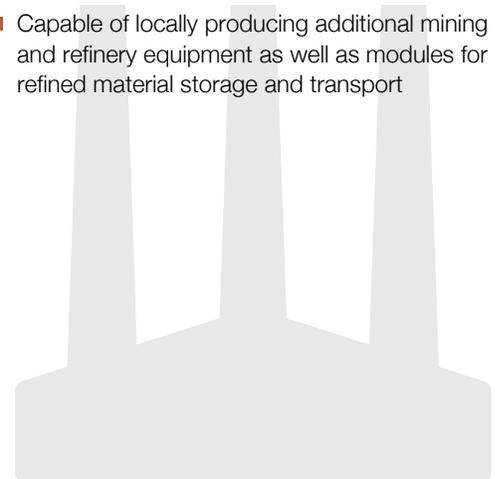
Modular Artificial-Gravity Orbital Refinery Spacecraft

Space mining and in-situ resource utilization

The Modular Artificial-Gravity Orbital Refinery Spacecraft is a novel, patent-pending technology from NASA Ames Research Center for in-situ refining or recycling of materials in space, including mass from asteroids, Mars moons, orbiting "space junk" debris, and for in-situ creation of products from operations in low or micro-gravity environments. There has been considerable interest in the exploration and mining of asteroids with spacecraft as well as mitigating the growing threat of space debris. Refining operations, such as centrifugal refining processes, introduce challenges for operating in space that are not relevant on Earth, including the need for gravity in order for refining operations to function properly. This technology provides an effective and efficient approach to address these needs and challenges.

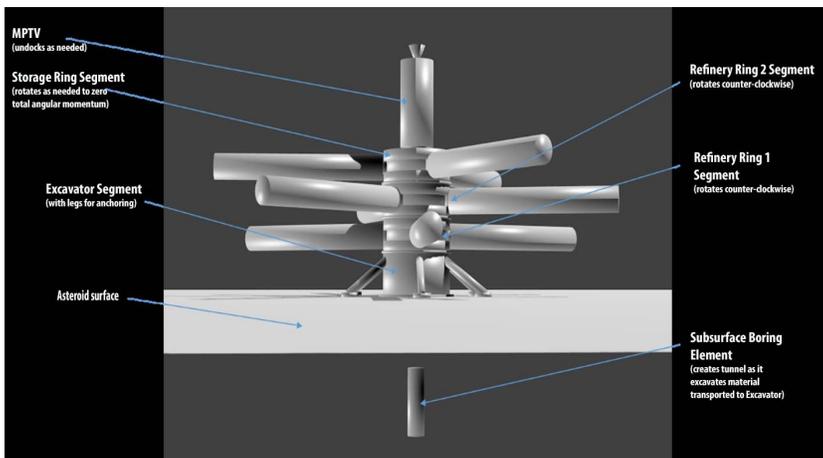
BENEFITS

- Relevant to emerging industry of asteroid mining
- Refines materials locally in space using artificial gravity rather than using materials mined, refined, and transported from Earth
- Recycles orbiting debris including spacecraft components no longer operational and provides economic incentive for reducing orbital hazards for space travel and on Earth
- Uses zero-angular momentum artificial-gravity spacecraft for minimal-propellant operation
- Uses dynamic balancing to compensate for changes in its center of mass during the refining and casting/extruding processes
- Scalable design for a wide array of applications from spacecraft less than ten meters to greater than one hundred meters in diameter
- Capable of locally producing additional mining and refinery equipment as well as modules for refined material storage and transport



THE TECHNOLOGY

Modular Artificial-Gravity Orbital Refinery Spacecraft is a solution for refining in-situ materials collected in space, such as from asteroids and Mars moons, as well as recycling spacecraft debris, while orbiting in micro-gravity conditions. The spacecraft is coupled with refining modules for refining and recycling different types of materials. It generates artificial gravity for operation in low-gravity environments. The spacecraft is comprised of rotating rings, each generating artificial gravity and angular momentum. When the rotating rings are combined on the spacecraft platform, however, they have a net near-zero angular momentum such that the spacecraft can change its attitude with minimal propellant or rotate at the rate of the object the spacecraft platform is attached to. The spacecraft platform can self-balance to accommodate different sized modules and modules with moving loads. The refined and recycled materials can be used to create products in-situ as well as products too large to launch from Earth, such as construction of orbiting space habitats, large spacecraft, solar-power stations, and observatories.



An illustration of the MAGORS system overview deployed on an asteroid surface

APPLICATIONS

The technology has several potential applications:

- Space industry
- Deep space industry
- Mining and refining asteroid and Mars moon mass
- In-situ space resource utilization
- Orbital refinery
- Orbital debris recycling
- Orbital construction
- Space manufacturing

PUBLICATIONS

Patent No: 11,738,891