SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies for Enable Future Building Blocks in Space Exploration and Development (3)

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THE SPACE TUGS: AN AFFORDABLE AND FEASIBLE ASTEROID DEFLECTION SYSTEM

Abstract

Near Earth Asteroids (NEAs) can be regarded as both a threat to mankind and a profitable opportunity. We know that the damage a medium or even a small asteroid (or comet) could cause would be unimaginable. However, even a small asteroid could be worth a trillion dollars after mining its resources. Therefore, we propose the "Transfer Unmanned Gravitational Service" (TUGS) concept. Consisting of a fully robotic system, it will function similar to tugboats by helping guide and maneuver large ships at port entrances. We outline this concept to illustrate a possible method to deflect and "park" asteroids for mining by a manned space facility. Relocation of candidate asteroids will be at "near and accessible" orbits, such as the libration points L1 or L2. Depending on the asteroid's size, this system will consist of at least two unmanned spaceships. They would fly over the space rock and after a complete scan with on-board instrumentation, take positions on the asteroid's surface by a controlled descent, each at the opposite sides over the longitudinal (or transversal) axis and as close as possible to the gravitational center. Once the TUGs are on the asteroid's surface; a drill, with a bore head, will penetrate several meters into the crust to secure the TUGs at a fixed point. Then the TUGs separates into two parts; one remaining anchored on the surface position while the other, still connected to the orbiter by a strong tether, flies into an orbital position relative to the asteroid. This origin of this concept is the idea of utilizing the angular momentum that could be generated by the induced rotational motion of the TUGs relative to the rock's gravitational center. Depending on the type of asteroid, the anchoring method and how loads are transferred; this system could be used to spin "at will" the rock around its rotational axis, simultaneously providing directional thrust and thus allowing for differential corrections of the asteroid's trajectory. We argue that this concept could be feasible with current technologies and this solution could well "be combined" with other concepts to provide an affordable efficient system for the business operations of space mining companies.