

IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
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STARTING A TOUR TO THE MOON FROM INTERNATIONAL SPACE STATION

Abstract

Abstract: Human beings have utilized space around the earth-revolving orbit, occasionally going to the other celestial bodies than the earth for investigation purposes. It is becoming possible to reach the orbit with reasonable cost. The next target for human beings is to explore the moon. In order to reach the moon in the past, huge rocket vehicles were used: For example, R-7 rocket for Luna 2 explorer in SSR, 1959, the most powerful rocket Saturn 5 for Apollo manned missions from 1968 in USA, and H-2A for Kaguya in Japan, 2009. However, such huge and disposable rockets cannot realize a continuous series of inexpensive launches. On the other hand, International Space Station (ISS) is in the hands of human beings for actual space utilization. Before terminating the operation in 2026, a large amount of money of 154 B USD should be invested from the beginning to end phases. Therefore, it is quite important to fully utilize this precious infrastructure. Recently, the utilization objective is extended from only exploration to even commercial utilizations. Transportation cost from the earth to ISS will be greatly reduced in the near future, as reusable rockets are now being developed by Space-X, Blue Origin and Virgin Galactic in US. In consideration of these circumstances, we propose in this paper, to utilize ISS as a relay platform for a tour from the earth to the moon. The journey between ISS and the moon including a lunar swing-by was studied in terms of trajectory and time-line. The simulation was carried out seeking for as smallest rockets as possible to realize the journey. Resultantly, it is concluded that a rocket of 400kN propulsion can be used to carry out the journey of six crew members in 5.8 days. The rocket is accelerated by an impulsive propulsion on the revolving orbit, and takes a free-return trajectory. A rocket of this capability is correspondent to Japan's solid propellant rocket Epsilon. An even smaller rocket with 2kN propulsion can realize a similar journey giving continuous impulsive accelerations on the revolving orbit. The required time is 6.5 days. A concern is that crew members have to stay in the radiation belt in the acceleration phase on the orbit. Technical problems exist in launching a rocket from ISS to the moon. Though the rocket is not required a great propulsion, safety should be kept strictly.