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ROTATING TETHER LUNAR SAMPLE RETURN MISSION OR MISSIONS, ROTSAR (ROTATING TETHER SAMPLE RETURN)

Abstract

A lunar orbiting tether with weights at each end rotates such that the tether is always in the orbital plane, and the axis of its rotation is orthogonal to the orbital plane.

The speed of the tether tip equals the orbital speed, the lower tip velocity vector is opposed to the orbital velocity vector, so the speed of the the tether tip, when at the lunar surface, will be near zero relative to the Earth-Moon inertial frame . For a tether in polar orbit around the Moon, the rotation of the Moon about its axis is slow [15 km per hour = 17 cm/s] so would not introduce significant transverse forces on the tether tip at the lunar surface. Since that lunar rotation is the largest residual relative motion [between the tether tip and the lunar surface] it is therefore practical for the tether tip to rendezvous with objects on the lunar surface and attach to them, and to release payloads which will soft land on the lunar surface.

Payloads can be soft landed on (or collected from) any latitude on the lunar surface. We would use the equatorial zero longitude and the antipodal 180 degrees lunar longitude points as depot sites, accessed by a stationary lunar elevator, for further transport to/from Earth or cislunar trajectories.

Polar lunar orbits are significantly disturbed by the Earth's gravity, therefore frequent station-keeping burns will be needed to extend the life beyond a few months. The orbit in a plane orthogonal to the Sun is in continuous sunlight, maximizing solar energy to power the electric thruster. This is known as a dawn-dusk orbit.

Over a lunar sidereal month ROTSAR would overfly the entire range of lunar longitudes. Depending on the phasing around the lunar orbit, it could access any point on the lunar surface. For a typical orbital period of 3 hours, there would be approximately 120 orbits per month. The distance between each successive swath of each orbital pass at the lunar equator would be about 100 kilometres depending on the precise orbital period.

A ROTSAR acting in conjunction with a stationary lunar elevator can establish a two-way supply chain between the Earth and any point on the lunar surface, accommodating delicate payloads, e.g humans. It can also collect samples from any point on the lunar surface, and deposit them near the base of the lunar elevator for return to Earth.