

A simulation study of Lunar Farside Lander positioning with a Four-way Lander-Orbiter Relay Tracking Mode

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The in-situ exploration of lunar farside is still an international blank until now. The reason is the synchronous rotation of the moon, which results in the unachievable between the lunar farside lander and earth tracking station. The traditional direct tracking mode, such as two-way range/range rate, VLBI delay/delay rate, will be ineffective for the farside lander tracking, therefore it is essential to relay the signal using a relay satellite. In this paper, we firstly give the updated mathematical formulas and the partials for the Four-way Lunar-Orbiter relay tracking measurement. Then, based on the independent precise orbit determination software system WUDOGS, the precise positioning of the lunar farside lander is studied with simulated tracking data. The results show that: with 0.1 mm/s measurement level, the positioning precision of the farside lander could reach the maximum of centimeter level using a circumlunar relay satellite (Fig. 1 a); while for the L2 halo relay satellite (Fig. 1 b), its accuracy could reach about 10 meters level. The conclusion could provide an important reference for the future lunar farside landing mission, especially for Chinese lunar exploration mission Chang' E-4.

Keywords: lunar farside, lander positioning, precise orbit determination, four-way relay tracking, Chang' E-4

