THE COMMUNICATION ACCESSIBILITY OF THE LUNAR ROVER BASED ON LUNAR DEM DERIVED FROM KAGUYA/SELENE. W. F. Hao[1,2] and F. Li[2], [1] State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan University(129 Luoyu Road, Wuhan 430079, China, hwf_369@126.com), [2] Key Laboratory of Geoscience Environment and Geodesy, Ministry of Education, Wuhan University(129 Luoyu Road, Wuhan 430079, China).

Introduction: The communication accessibility of the lunar rover from the Earth to the Moon is a prerequisite for working of deep space tracking system and can be as one of conditions for the choice of ideal landing sites. The mathematical model can be established by lunar digital elevation models (DEM) and known parameters related to lunar and earth's orbit,to study the communication accessibility affected by topography. We judge the communication condition by a ray-tracing method. Here the lunar-fixed,lunar-centered coordinate system is adopted, and we change coordinate of the Earth's tracking stations into this system. We select a cell and extend the communication direction vector from the cell toward the tracking stations. If the altitude of the topography in the direction of communication exceeds the Z component of the vector,this cell is judged as the unreachable region for communication of the lunar rover from the Earth to the Moon.

Data and Research Region: The laser altimeter data obtained by Kaguya/SELENE, can provide high accuracy digital elevation models (DEM)[1] for the analysis of communication accessibility.The research region is Sinus Iridum region (the preferred landing area of Chinese lunar exploration) and the lunar polar regions. The calculation period is from Oct. 1, 2013 to Oct. 31, 2013.We choose VLBI station in Shanghai(China) as tracking station.

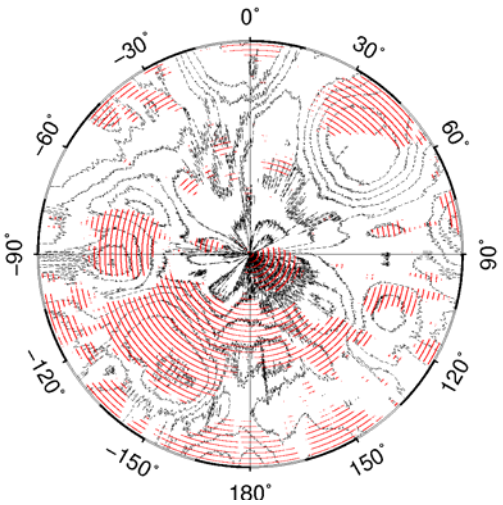
Results and discussion:

The communication accessibility of the rover.The results show: (1) In the Sinus Iridum region, the communication condition between tracking stations (Beijing, Kunming, Shanghai and Urumchi) and the lunar rover is expedite, which is consistent with the region's flat terrain; (2)The communication condition of south polar region influenced by topography is great because of the topography complexity(Fig.1(top)).

Improvement of Communication Condition from Lunar Rover to Deep Space Tracking Station in Antarctic Great-Wall Station. The lunar south pole is the main area for the lunar rover and the permanent base. Because of location and local distribution of Chinese deep space tracking stations, the communication accessibility between the rover in lunar south pole and the tracking stations is influenced greatly by topography and discontinuous control. If a deep space tracking station is founded in Earth's Antarctic area, communication conditions will be greatly improved attributing to its broader vision. We assumes the deep space station is established in Chinese Antarctica Great-Wall station, and simulates the communication accessibility between the lunar rover in lunar south pole and the Great-Wall tracking station. Through the comparison with the domestic tracking station's communication condition, the results show: (1) the influence of communication condition by topography between the lunar rover in lunar south pole and Great-Wall tracking station is less than that between the lunar rover in lunar south pole and the domestic tracking stations (Fig.1(below)). (2) The longitude is about 180° from the Chinese Antarctic Great-Wall station to the domestic tracking station. The fig.2,3 and 4 describe the communication condition of the point close to the rim of the Shackleton crater, which is the most iulluminated point[2]. We can find integrated with all of the tracking stations, including Chinese Antarctic Great-Wall station, the impact of the tracking stations away from the Moon due to the Earth's rotation can be reduced and the tracking time can be longer.

The simulation and analysis of communication accessibility for choosing Antarctic Great-Wall station as deep space tracking station, can provide a suggestion for the feasibility of construction of the next deep space tracking stations.

References: [1] Araki H. et al. (2009) *Science*, *323*, 897–901. [2] Bussey D. B. J. et al. (2010) *Icarus*, *208*, 558-564.



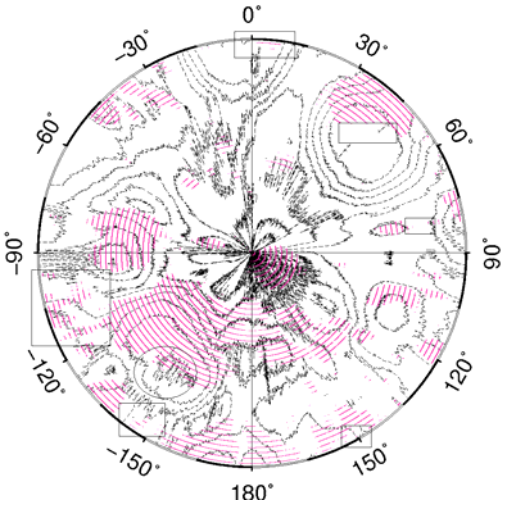


Fig.1 Unaccessible communication region(red and pink line) of the lunar rover from the Earth to the Moon in the lunar south polar based on DEM of Kaguya/SELENE, between tracking stations and lunar rover, the top is Shanghai tracking station, the below is Chinese Antarctic Great Wall station.The black box and circle describe the region that communication condition improved.

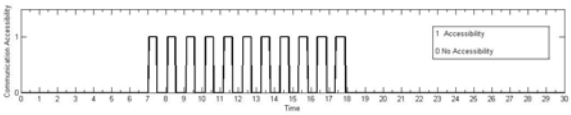


Fig.2 Communication condition of the point(88.74ºS,124.5ºE) located close to the rim of Shackleton crater（Shanghai station,Oct. 2013）

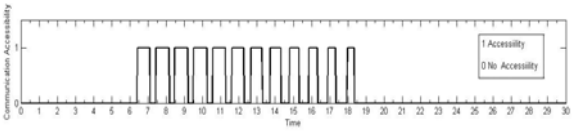


Fig.3 Communication condition of the point(88.74ºS,124.5ºE) located close to the rim of Shackleton crater（Chinese Antarctic Great Wall station,Oct. 2013）

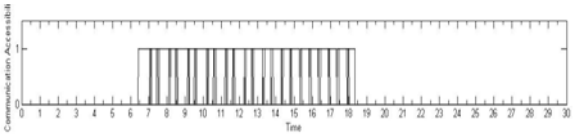


Fig.4 Communication condition of the point(88.74ºS,124.5ºE) located close to the rim of Shackleton crater（Combined Chinese Antarctic Great Wall station with Shanghai station and Urumqi station, Oct. 2013）