OVERVIEW OF A JAPANESE LUNAR POLAR MISSION. M. Ohtake[1], T. Hoshino[1], Y. Karouji[1], and H. Shiraishi[1], [1]Japan Aerospace Exploration Agency (JAXA) (ohtake.makiko@jaxa.jp).

Introduction: In addition to the scientific interest, the Moon is considered as the next destination of human activity. The Japan Aerospace Exploration Agency (JAXA) identified lunar landing exploration as the next step for technology development in space exploration after the successful lunar orbiter SELENE (Kaguya) mission. It is carrying out a mission called Smart Lander for Investigating Moon (SLIM). The SLIM mission [1] is a technology demonstration mission targeting a pinpoint landing, which is mandatory for future lunar and any planetary explorations.

In parallel, the International Space Exploration Coordination Group, organized by the space agencies of 15 countries and regions, is discussing future space exploration plans based on international collaborations. Planning of manned lunar surface exploration via a manned cislunar space station and precursor robotic (unmanned) missions prior to the manned mission is being studied in this framework.

Lunar polar exploration is an intensely studied candidate missions of the precursor robotic mission by many countries. In this presentation, we discuss an overview of the lunar polar mission studied in Japan.

Mission objectives: Recently, it has been suggested that water ice might be present in the lunar polar region based on spectral measurements of artificial-impact-induced plumes in the permanently shadowed region, and remote sensing observation of the lunar surface [2]-[4]. In addition to the scientific interest about the origin and concentration mechanism of the water ice, there is strong interest in using water ice (if present) as an in-situ resources. Specifically, using water ice as a propellant will significantly affect future exploration scenarios and activities because the propellant generated from the water can be used for ascent from the lunar surface and can reduce the mass of the launched spacecraft of lunar landing missions.

However, currently it is unclear if water ice is really present in the polar region because of the currently limited available data. Therefore, we need to learn that by directly measuring on the lunar surface. If there is water ice, we also need to know it's quantity (how much), quality (is it pure water or does it contain other phases such as CO_2 and CH_4), and usability (how deep do we need to drill or how much energy is required to derive the water) for assessing if we can use it as resources. Therefore, JAXA is studying a lunar polar exploration mission that aims to gain the above information and to establish the technology for planetary surface exploration [5]. JAXA is also studying possibility of implementing it within the framework of international collaboration.

Spacecraft configuration: The spacecraft system comprises a lander module and rover system. The launch orbit is a geostationary transfer orbit (GTO), and the spacecraft system is transferred from GTO to lunar orbit (or the spacecraft is directly transferred to the lunar transfer orbit (LTO)) using a propulsion module. After landing onto the lunar surface, the rover is deployed using a descending ramp. The rover then prospects for water ice using observation instruments on board.

Landing site selection: Considering the mission objectives and condition of the lunar polar region, we listed the following parameters as constraints.

1) Presence of water
2) Surface topography
3) Communication capability
4) Duration of sunshine

As a first trial of the landing site selection, sunshine is simulated using digital elevation models to obtain the sunlight days per year and the number of continuous sunshine periods at each site. Also, slope and the simulated communication visibility map from the Earth are created. These conditions can be superimposed to select the landing site candidate.

Technology Development: We currently focus on developing technologies required for the exploration of polar regions and are promoting the following research and development.

- Sunshine in the polar region is from the horizontal direction, and it is affected by the local topography. Solar panels therefore need to be deployed vertically in a tower.
- Normal image based navigation is difficult in the polar region. Therefore shade image collation navigation using images of shadows created by the terrain is being studied.
- A prototype model of a rover equipped with a 1.5 m drill is being developed to examine basic functions.
- Currently, for rover deployment, we plan to develop ramps in forward and backward directions to secure redundancy. It is therefore important to develop a lightweight ramp structure.

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