Paper ID: 81250
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IAF SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration including Ocean Worlds (5)

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INVESTIGATION OF DESIGN CHARACTERISTICS OF A LANDER FOR MAKING A MANEUVERABLE DESCENT TO THE VENUS SURFACE

Abstract

At present, the question of Venus research becomes relevant. The exploration of Venus as a terrestrial planet is interesting not only from the standpoint of fundamental science, but also from the standpoint of comparative planetology. And despite the impressive results of previous missions such as Soviet spacecraft of "Venera" and "Vega" series, American spacecraft of "Mariner", "Pioneer-Venus" series, "Magellan", some other flyby missions and more recent spacecraft of other agencies: Japanese spacecraft "Akatsuki", the spacecraft of the European Space Agency "Venus Express", many questions still need to be answered. American and European space agencies are currently working on scientific programs for various missions to Venus, such as "Venus Flagship", "VERITAS", "DAVINCI +" and "EnVision". The concept of the "Venera-D" mission with international cooperation is being worked out in Russia. Projects "Venera-D" and "DAVINCI +", among other elements of the mission, assume lander for making measurements on the surface. Moreover, in addition to the simplest task of the descent to the surface, the lander may face the task of achieving the required landing area, the most rational from the view point of making research, which is a separate task need to be solved by the scientific community. This paper discusses various types of landers for the descent to the Venus surface, including those with the ability of making maneuvers during the descent in the atmosphere for increasing the latitude of coverage of the landing zones and for landing in the required areas. A comparative analysis of these landers is carried out and their design capabilities are determined in terms of maneuverability and mass characteristics. Aerodynamic characteristics of these landers are calculated, as well as the investigation of ballistic and thermal modes of the descent for various entry angles into the planet's atmosphere, the possibility of maneuvering during the descent in the atmosphere and its range are assessed. The advantages of using maneuverable "lifting body" type of a lander over a ballistic type of a lander, which does not have the ability of making maneuvers during the descent, are shown, which imposes some restrictions on the range of reachable landing sites for the expected launch dates in 2029-2034 years. In addition, the use of such maneuverable landers will expand the range of tasks and scientific research that can be carried out not only on the surface, but also at the stage of descent in the atmosphere before reaching the surface.