

IAF SPACE EXPLORATION SYMPOSIUM (A3)
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RTC DEVELOPMENTS IN THE FIELD OF ROBOTICS FOR FUTURE ON-ORBIT AND
PLANETARY MISSIONS

Abstract

This year marks the 50th anniversary of the beginning of the mission to explore the Moon using the Lunokhod-1 automatic apparatus which operated on the lunar surface since November 17, 1970 to September 14, 1971 and which became the first ever moving object (rover) on the surface of another celestial body. Not so long ago, in 2018, we celebrated two more dates that are important: 45 years since the successful lunar expedition between January and May 1973 with the participation of the Lunokhod-2 automatic self-propelled vehicle and 30 years from the day of the triumphal flight in the fully automatic mode of the Russian space shuttle Buran. All these events are, of course, very significant in the history of Russian and world astronautics. As a result of two lunar missions using the Lunokhods, invaluable scientific information about the Moon was obtained, as well as the experience in creating and managing autonomous remote-controlled planetary vehicles – planet rovers, which remain relevant to this day. The creation of the reusable space shuttle Buran and space transport system Energia became a real breakthrough which in many respects outstripped their time. This report provides information on the role of the Russian State Scientific Center for Robotics and Technical Cybernetics (RTC) in the successful implementation of these space missions, which largely determined the emergence of a new area of scientific and applied research – space robotics. The history of the RTC began 52 years ago with the creation of a soft landing system for landing vehicles of manned spacecrafts, known as the Kaktus. The successful implementation of the soft landing system for spacecraft descending to Earth and the experience gained during its creation allowed in the late 1960s to develop a similar system, but for the implementation of a soft landing on the Moon's surface of automatic interplanetary stations (AIS) of the Luna series. This system provided landing on the Moon of all AIS starting from the station Luna-17 (Lunokhod-1) and ending with the Luna-24 station. With the beginning of Buran space shuttle developing, the task of creating a system of its on-board manipulators for was set in front of the RTC. The system included two 6-DoF manipulators (main and reserve) of 15 m in length, placed along the sides of the spacecraft on both sides of the cargo compartment, a control unit with a control panel, and two transmitting cameras with lamps having two DoF and controlled with control panel of manipulators. The current development trends of the RTC in the field of space robotics to support future orbital and planetary missions are discussed in the main part of the report. These works are connected with research and creation of robotic systems for: support of Extravehicular activity (EVA) of cosmonauts in the implementation of inspection, repair, installation work on the surface of the spacecraft; orbital maintenance of space vehicles (repair, refueling, etc.); support for future planetary missions.