PANEL 4

Actual Problems of Engineering and Technical Sciences and Modern Information Technologies

(DNU, Zoom)

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LUNAR PROGRAMME – A LOOK THROUGH THE YEARS

Apollo-11 was an American space flight that landed humans on the Moon for the first time in July 1969. Commander Neil Armstrong and lunar module pilot Buzz Aldrin landed the Apollo Eagle lunar module. Armstrong became the first man to set foot on the lunar surface. Aldrin joined him 19 minutes later, and they spent about two and a quarter hours together exploring the place they called the Sea of Tranquility after landing. Armstrong and Aldrin collected lunar material to bring back to Earth while pilot Michael Collins operated the Columbia command module in lunar orbit.

The Saturn-V was an American super-heavy launch vehicle developed by NASA as part of the Apollo programme for human exploration of the Moon. The rocket was designed for human piloting, had three stages and used liquid propellant. The third stage was used to fly to the Moon and to launch Skylab, the first American space station.

As of 2023, Saturn-V remains the only launch vehicle to have carried humans beyond Low Earth Orbit (LEO). Saturn-V holds the records for the heaviest payload launched and the largest payload to LEO: this includes the third stage and unused propellant required to send the Apollo command and service module and lunar module to the Moon.

The Saturn-V was constructed primarily from aluminium, but also from titanium, polyurethane, cork and asbestos. Drawings and other Saturn-V plans are available on microfilm at the Marshall Space Flight Center [1].

Saturn-V is a three-stage rocket. The first stage of the S-IC was built by Boeing at the Michaud Assembly Plant in New Orleans, where Lockheed Martin would later build the space shuttle's external tanks. It was equipped with five Rocketdyne F-1 engines. The central engine was held in a fixed position, while the four outer engines could be rotated by hydraulic pendants to control the rocket. During flight, the central engine was shut down about 26 seconds earlier than the outer engines to limit acceleration. During the launch, the S-IC ran its engines for 168 seconds, and after the engine shutdown, the vehicle was at an altitude of approximately 42 miles (67 km), and travelled for about 58 miles (93 km), travelling at about 7,500 feet per second (2,300 m/s). The vehicle then descended and fell into the ocean [2].

The S-II second stage was built by North American Aviation in Seal Beach, California. Using liquid hydrogen and liquid oxygen, it had Rocketdyne J-2 engines similar to the S-IC and also used external motors for control. S-II was the largest cryogenic stage.

The S-IVB third stage was built by Douglas Aircraft in Huntington Beach, California. It had a single J-2 engine and used the same propellant as the S-II. The S-IVB used a common baffle to separate the two tanks.

The instrumentation unit was built by IBM and was placed on top of the third stage. It was built at the Space Systems Centre in Huntsville, Alabama. This computer controlled the rocket's operation just before liftoff until the S-IVB was ejected. It included the rocket's guidance and telemetry systems. By measuring the spacecraft's acceleration and position, it could calculate the rocket's attitude and velocity and correct any deviations.

The astronauts used the Eagle lander to ascend from the lunar surface and join Collins in the command module. They returned to Earth in the Pacific Ocean on 24 July after more than eight days in space.

Armstrong's first step on the lunar surface was broadcast live on television to a worldwide audience. He described the event as «One small step for man, but a giant leap for all mankind» [3].

Saturn-V marked the beginning of the development of advanced technologies. But what would this project have looked like if it had been developed using modern algorithms? According to preliminary calculations, which need to be refined and verified, the Saturn-V launch vehicle could have carried a much larger payload. This is because the first and second stages of the launch vehicle would be lighter, keeping all their characteristics unchanged, and replacing the F-1 and J-2 engine sets with modern designs with the same fuel components. At the same time, the Lunar Programme would become more affordable.

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BASIC PRINCIPLES OF BEES` AND BUTTERFLIES` FLIGHT

For the movement of artificial devices there is a commonly used impulse, which is created by a path for expelling a part of the air into the opposite direction directly or behind the pulse of the reactive mass. At the same time, due to the run-up of the flow, control is carried out under the action of a force that compensates the force of gravity and ensures flight along a given trajectory.

Concerning insects, their flight is traditionally explained through Newtonian mechanics as the wings generate a downward flow of air, which propels the insect upwards. Nonetheless, a more accurate explanation of insect flight can be achieved by utilizing Newtonian mechanics that rely on the concept of mass flow rate [1].