**Prof. dr. sc. Zdravko Terze**
Faculty of Mechanical Engineering and Naval Architecture
University of Zagreb

## Space Robotics in Planetary Explorations – Croatian Perspective

Space robotic systems are crucial technology for success of contemporary planetary explorations and related space missions. From missions that landed rovers on Mars surface in 2021 (NASA rover 'Perseverance' and Chinese rover 'Zhurong'), 'Change' 6' mission in 2025 (Chinese lunar mission that returned samples from the far side of the Moon) to USA 'Astrobotics Technology' mission to the Moon's South Pole that is scheduled for this year – to name just a few recent and future ones - robotic systems were (and shell be) the backbone technology that assures success of these missions.

It is less known, however, that Croatian scientists also take part in development of the robotic technologies for such challenging endeavours. At the Chair of Flight Vehicle Dynamics at the Faculty of Mechanical Engineering and Naval Architecture (FMENA), University of Zagreb, the two ESA contracts for development of the cutting-edge space robotics systems have already been won, with two more being in ESA reviewing process.

Most of these activities are focused on the development of new propulsion technology for atmospheric flight on other planets, such are Mars and Venus (or Saturn's moon, Titan). The technology is based on the flapping wing propulsion for new generation of the unmanned aerial vehicles (UAVs) (popularly called 'drones') that are planned to be flown in future missions to other planets. Researchers at FMENA actually pioneer development of this technology for the extraterrestrial use by developing – for the first time - flight physics mathematical models and computational procedures for design optimisation of such UAVs, while experimental validation of this technology in the ESA certified Mars chamber is currently ongoing. The main goal is to build the aerodynamic prototype of such a vehicle, and to prove that a new technology is more efficient in terms of aerodynamics and energy consumption than rotary wing (helicopter) technology, which was - for example - used by NASA for the development of their own Mars drone 'Ingenuity' (that was the first controlled UAV that has flown on another planet).

Beside UAVs, the research group from Chair of Flight Vehicle Dynamics at FMENA is also involved in design of planetary rovers. More specifically, their activities are related to dynamics and control of rover's locomotion on granular irregular terrain. Here, collaboration with EU industrial partner that develops a small lunar rover (under umbrella of ESA funding) needs to be mentioned, but also collaboration on Mars rover design with Harbin Institute of Technology (where Chinese rover 'Zhurong' was partially designed) as well as collaboration with the universities in EU and USA on granular mechanics modelling and robotic design.

All the issues mentioned above will be targeted in the lecture, together with the presentation of the main research results, supported by the selected video material on laboratory tests and experiments.