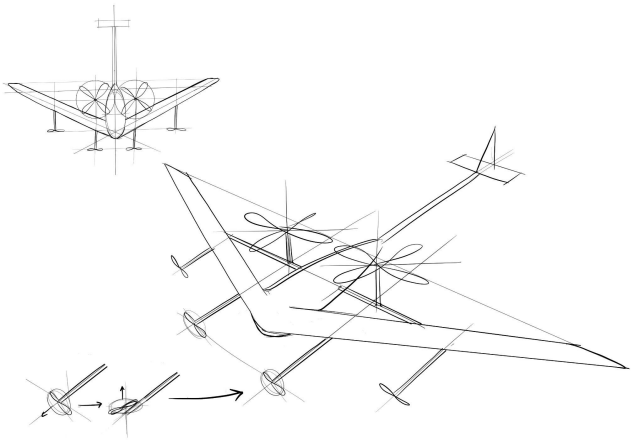
Drone for Mars Exploration - DSE Group 27

Finding life on another planet is the next giant leap for humankind. To make this leap, we have designed a revolutionary new vehicle. In this design process, we have *reinvented flight* for the purpose of exploring the hostile Martian environment for signs of life.

Over the past decades, orbiters and surface rovers have been sent to explore Mars. While orbiting satellites can observe remotely, they cannot study the lower atmosphere and surface characteristics up close. Robotic rovers were sent to the Red Planet to measure and gather in-situ information on the atmosphere and soil composition. But rovers are constrained by their slow speeds and their inability to traverse challenging terrain. These shortcomings result in the need for a new product that can perform detailed surface imaging, in-situ atmosphere measurements, *and* access soil samples from otherwise inaccessible places. Thus, our project objective is to design an unmanned aerial vehicle (UAV) that can assist human Martian exploration.

Mars is an extremely challenging environment for flight: the atmosphere is 100 times thinner than on Earth, extreme temperature swings, harsh solar radiation, and fine abrasive dust suspended in the air and covering the ground. However, NASA's Ingenuity helicopter performed the first ever powered flight on another planet earlier this year, proving that flight on Mars is possible. This flight was the beginning of a new era of space exploration and has served as an inspiration for this mission, which aims to build on the achievements of Ingenuity.



The design that we have developed to meet these demands is a semi-autonomous Vertical Take-Off and Landing (VTOL) winged aircraft (pictured above). Each flight, it is capable of autonomously observing remote areas 50 km^2 and collecting soil samples of up to 500 g. This means that the UAV can collect as much soil in one flight as a robotic rover can collect in its entire lifetime. The payload contains instruments for visual imaging and height mapping of the surface, collecting subsurface rock and soil samples, and assessing atmospheric dust and gas composition. Together, they are capable of delivering scientific data beyond what any previous mission has achieved. The resolution we can achieve for surface mapping is almost 1000 times better than past satellites. This drone has been designed for exceptionally low Reynolds numbers, pushing the limits of aerodynamic possibilities. It also features an innovative layout for the propulsive components.

The next era of other-worldly flight will learn from past mistakes by ensuring sustainable practices and the solitary use of renewable energy sources. This new era of space exploration will embody the science fiction dreams of past generations.