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ROVERS AND HELICOPTERS COOPERATION FOR MARS MISSION IN SEARCH OF THE  
ORIGIN OF LIFE

**Abstract**

Mars and Earth, two siblings which follow different paths 3 or 4 billion years ago. While Earth continued to evolve, Mars stopped changing at a point. The first scientific missions from ESA and NASA confirmed the existence of methane and water on the Red Planet. So, does life have time to exist and in which form? These questions have animated the scientific community for decades. One of the latest missions on Mars is the NASA one with Perseverance performing samples looking for biosignature.

While waiting for the samples to be brought back, we have seen the birth of a new era of space exploration with the success of Ingenuity. This small helicopter, which was planned to make only five flights, performed more than 70 which means 14 times more. With its 2 kg, it managed to survive almost 3 years and to travel more than 10 miles. Planned initially as a technology demonstrator, the achievement of Ingenuity opens a new era for the space exploration.

Looking for life, the scientific focus on places with signs of past water. Water which could have come from bubbling underground springs or rain-fed rivers which were stuck in craters. As these terrains have been sculpted by water, it can be made challenging for rovers to explore them. Taking to the air would give scientists a new perspective on a region's geology and even allow them to peer into areas that were not accessible. This is where the helicopter can play a key role.

The target of this study is to evaluate a Mars mission considering a collaborative operation between a rover and helicopters to extend the area of exploration and the access of new sites with scientific interests which were not reachable by rovers only. The mission profile will be oriented to the search of ancient life. It will consider how the scientific tasks can be shared between the rover and the helicopters but also the operational needs such as the power supply chain, the communication management, and the navigation system.

The methods combine the latest requirements from the different key space actors and the scientific community. The paper will conclude with a proposal of a mission profile to illustrate the operational concept.