S8.P3 Mars Technology 2, Plaza Room P3, November 20, 2024, 16:00 - 17:40

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Conceptual Design of a Rover for a Multi-Vehicle Wide Area Mars Exploration System

[1*]Sungmoon Joo, [1]Dongjun Hyun, [1]Ikjune Kim, [1]Jaehyun Ha
*lead presenter
[1] smjoo@kaeri.re.kr, Korea Atomic Energy Research Institute, Republic of Korea

The Republic of Korea is making significant strides towards becoming a leading space power by implementing the Space Development Promotion Plan and investing heavily in space exploration initiatives. In May 2024, Korea AeroSpace Administration (KASA) was established, and by September, a comprehensive roadmap for space exploration, including lunar and Martial lander development, will be introduced.

As part of the preparatory efforts for space exploration, Space Challenge program (’20.6~’28.12) has been supporting the development of post-2030 and innovative space technologies. Korea Atomic Energy Research Institute (KAERI) has been participating one of the projects in Space Challenge program since 2023. This paper introduces a wide-area Mars exploration system utilizing a rover and a reusable fixed-wing aircraft, and the conceptual design of the rover proposed by KAERI.

The proposed Mars exploration system features a collaborative approach between a fixed-wing aircraft and a supporting rover. Key features include replaceable inflatable wing modules designed to overcome spatial constraints within launch vehicles and enable aircraft reuse. Additionally, the rover assists with final approach guidance in Mars's navigation-aid-limited environment, retrieves the aircraft after landing, and relocates it to a base station for wing module replacement and recharging (Figure 1).

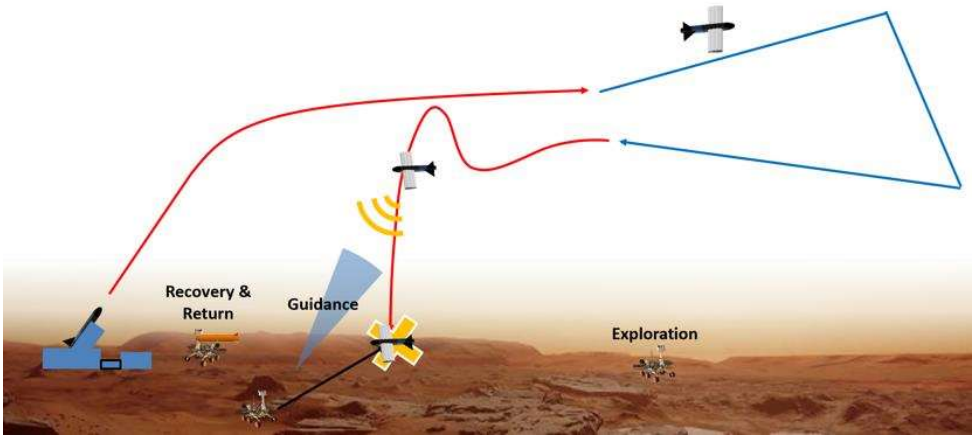

Fig. 1 Collaborative Approach for Wide-area Mars Exploration

The operational sequence begins with the aircraft, equipped with inflatable wing modules, being launched from the base station. Upon reaching a pre-set altitude, wings expand, transitioning the aircraft into stable flight for mission execution. The aircraft then returns, guided by the rover’s final approach system, descends to an optimal location and altitude, before a controlled free fall to the Martian surface (Figure 2). After landing, the wing modules detach, and the rover transports the aircraft back to the base station for wing module replacement and data download, preparing it for subsequent missions (Figure 3). This system promises a sustainable approach to Mars exploration, leveraging the synergy between reusable aircraft and supportive rovers.

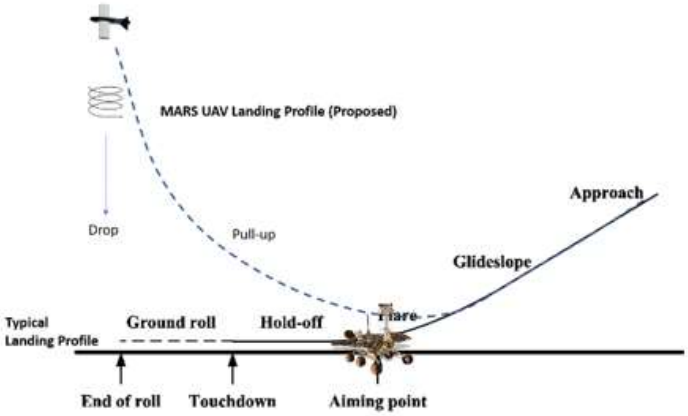

Fig.2 Approach & Landing Guidance

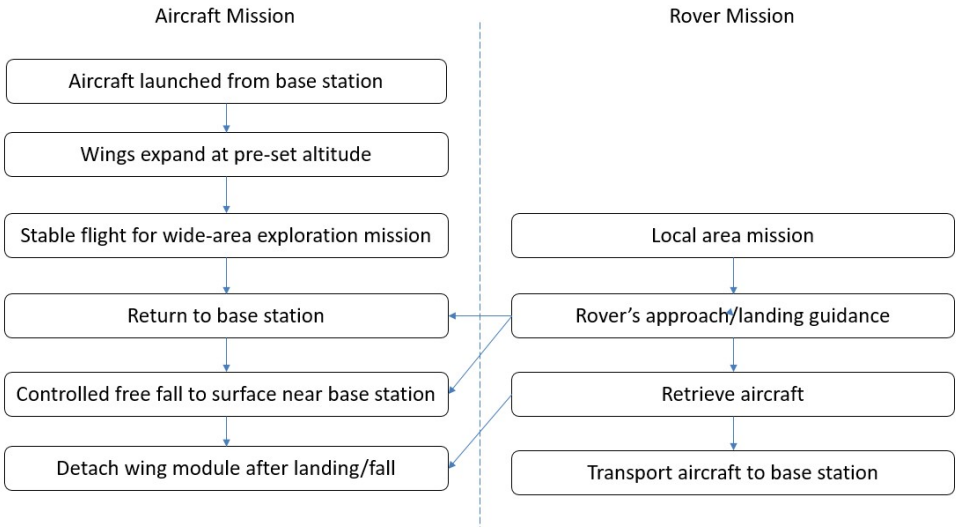

Fig.3 Martian Aircraft-Rover Collaborative Operation