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A HYBRID SYSTEM ARCHITECTURE THAT COMBINES A CENTRALIZED ROVER WITH A FLYING SWARM OF ROTARY WINGED DRONES FOR MARS EXPLORATION

Abstract

Rovers played a vital role in planet Mars terrain exploration. The exploration range of these rovers was limited due to its complete reliance on analyzing the terrain within its on-board camera line of sight that typically does not exceed a few meters. This made maneuvering the rover through the rough terrain a slow process. In 2018 NASA demonstrated the feasibility of flying a rotary winged drone in a very low-density Martian like atmosphere. They plan to deploy such a drone as part of the Mars 2020 mission, due to be launched in July 2020. This paper proposes a hybrid system architecture that combines a centralized rover with a flying swarm of rotary winged drones. The system consist of a rover that acts as a centralized base station that hosts a number of drones. The drones are set to fly in a predefined pattern to scan an area surrounding the rover. This will allow the rover navigation system to characterize a significantly larger area compared to what can be achieved using its stereoscopic cameras. The drones will be solar powered rotary winged that will carry a stereoscopic camera, altitude and ranging measuring system. This will reduce the complexity of the drone system, all processing will be centralized and done on-board the rover. The drones will communicate their sensor readings and images to the rover. The flight plan of the drones will be preplanned based on earlier observations, by the rover's mission planning software. They will be set to return to the rover in time to avoid depletion of their power source below acceptable limits. To provide some degree of drone autonomy and system robustness, the drones can be equipped with inter drone ranging capabilities as well as with the rover. This will provide additional information that will allow more precise relative position determination of the drones and the rover. The propose system will be have the capability to allow the drones to continue to operate and track as well as return to the rover even when the rover is moving.