IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

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4D LIDAR AND SENSOR FUSION FOR AUTONOMOUS ROVERS MISSIONS

Abstract

The most effective way to explore an undiscovered territory is to conduct experiments on site. However, the outer space environment is often too dangerous and unpredictable for humans. Thus, using robotic rovers would be advantageous since they cover a wider land area and perform experiments providing ground-truth data and information safely.

The recent advance of 4D LIDAR (Light Detection and Ranging) technology has opened up a new set of possibilities to explore space in much greater detail. This innovative technology is based on the principle of the Doppler effect, which enables it to compute instant velocity in real-time and hence adds a fourth dimension to its preceding technology. In 2022, AEVA, a company specialized in the production of autonomous driving sensors, developed the 4D LIDAR, a new tool that will revolutionize autonomous driving. This new generation of lidars offers a better performance in terms of depth, instant velocity, reflectivity and vision.

In recent times, the exploration of the lunar surface and utilization of lunar resources has become a dominant agenda of several government space agencies and private companies. Furthermore, with the rapid growth in the New Space sector, organizations would continue to highly invest in lunar exploration. With an apparent increase in rover missions in the near future, the ability of the rover system to identify other moving rovers and compute its velocity would become a critical design parameter.

The purpose of this paper is to study the performance of the 4D LIDAR combined with other onboard components using sensor fusion and how it can help achieve better results when covering an undiscovered area with unknown environmental parameters. Moreover, we will study its impact in the future with

muli-rover communication or even in planetary settlements where two or more independent rover systems need to avoid collisions and ensure successful data collection throughout their mission life cycle.

We plan to integrate the 4D LIDAR technology with different onboard sensors, evaluate its performance theoretically using software simulation, and present our final data illustrating the overall results. This would help us demonstrate the higher performance parameters and precision levels that could be achieved for future rover missions.

Our group consists of members from the Space Exploration Project Group at the Space Generation Advisory Council. Please note that the present abstract is submitted as a part of the Space Exploration Project Group's research, under the supervision of the Space Generation Advisory Council.