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WESTERN AUSTRALIAN OPTICAL GROUND STATION READINESS FOR LUNAR COMMUNICATION

Abstract

NASA is returning to the Moon for the first time in fifty years since the Apollo program, a precursor to a new era in human spaceflight involving a continuous human presence on the Moon and eventual voyages to Mars. The first crew to set foot on the Moon since Apollo 17 in 1972 will be taken up in the Orion spacecraft.

In the 1960s and 1970s, deep space communication was achieved with radio-frequency techniques, on which we have been reliant for all free-space communication until very recently. Lunar missions will now be able to leverage five decades of technological development, not the least of which is high photon efficiency deep space optical communication systems. These systems will be capable of downlink speeds thousands of times faster than were possible in the Apollo program.

Optical communication, despite having surpassed radio frequency communication for long-distance terrestrial communication, has historically been limited in free space. The main difficulties faced by free space optical communication include pointing, atmospheric turbulence, and availability of key optical and photonic components. However, practical free space optical communication is soon to be realised due to technological advances since the 2000s. Orion will carry a modern high photon efficiency free space optical communication terminal for returning large data payloads and streaming high-definition video to Earth. This mission will require support from optical ground stations around the world in locations with clear blue skies. The University of Western Australia (UWA) is commissioning a 0.7-metre optical ground station that will be suitable for optical communication between Earth and cislunar space.

We report on demonstrations of high photon efficiency free space optical communication through turbulent air from our optical ground station to a drone acting as a proxy for the Orion spacecraft, to prove the suitability of our ground station to provide communication support to the Artemis program.

We also describe the design of UWA's optical ground station and show its compatibility with the Orion optical communication terminal and other optical communication payloads in deep space.