FIBER OPTIC REFERENCE FREQUENCY DISTRIBUTION[1] TO REMOTE BEAM WAVEGUIDE ANTENNAS

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ABSTRACT

In the NASA/JPL Deep Space Network (DSN), radio science experiments (probing outer planet atmospheres, rings, etc.) and very long-base interferometry (VLBI) require ultra-stable, low phase noise reference frequency signals at the user locations. Typical locations for radio science/VLBI exciters and down-converters are the cone areas of the 34 m high efficiency antennas or the 70 m antennas, several hundred meters from the reference frequency standards. Over the past three years, fiber optic distribution links have replaced coaxial cable distribution for reference frequencies at these antenna sites. Optical fibers are the preferred medium for distribution because of their low attenuation, immunity to EMI/RFI, and temperature stability. A new network of Beam Waveguide (BWG) antennas presently under construction in the DSN requires hydrogen maser stability at tens of kilometers distance from the frequency standards central location. The topic of this paper is the design and implementation of an optical fiber distribution link which provides ultra-stable reference frequencies to users at a remote BWG antenna.

The temperature profile from the earth's surface to a depth of six feet over a time period of six months was used to optimize the placement of the fiber optic cables. In-situ evaluation of the fiber optic link performance indicates Allan deviation on the order of parts in 10^{15} at 1000 and 10,000 seconds averaging time; thus, the link stability degradation due to environmental conditions still preserves hydrogen maser stability at the user locations. This paper reports on the implementation of optical fibers and electro-optic devices for distributing very stable, low phase noise reference signals to remote BWG antenna locations. Allan deviation and phase noise test results for a 16 km fiber optic distribution link are presented in the paper.

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1 This work represents one phase of research carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract sponsored by the National Aeronautics and Space Administration.