Preface

The increasing demand of high data rates for wireless space communications has resulted in exploring of an unallocated frequency spectrum, viz., the terahertz spectrum, ranging from 300 GHz–30 THz. Space communications systems using THz spectrum can resolve the problems of limited bandwidth and spectrum scarcity of present wireless communications. Further, radio frequency interference can also be avoided by using THz frequencies for space applications. Apart from providing wider bandwidth, other advantages of THz spectrum for space communication are reduced-size antennas and low-power devices compared to that of microwave frequencies.

Although the use of THz frequencies for space applications has many advantages, the advancement in this region is slow due to the lack of suitable devices in THz range. The recent progress in semiconductor technology has resulted in development of terahertz devices, which has increased the interest of scientists in exploring this terahertz region for wireless space communications.

There are some factors that limit application of THz waves for communication. They are high atmospheric attenuation and high free-space path loss, which limit its application for short range communications. However, atmospheric attenuation of THz waves is not an issue for space applications as it is atmosphere-free. The high free-space path loss of THz waves can be compensated by using an antenna with high gain and directivity. Thus, the main aim of this brief is to design an antenna with high gain and high directivity for aerospace platform.

Microstrip patch antennas are low cost, light weight, portable, conformal, and can be easily installed and fabricated. These characteristics of microstrip patch antenna have proven to be advantageous for wireless space applications. However, they have a disadvantage of low bandwidth and low gain. The performance of the patch antenna can be improved by increasing the size of the patch and using thick substrate with low dielectric permittivity. The use of thicker substrate however results in surface wave loss because most of the radiated power of the patch antenna is trapped within the substrate. This loss can be overcome by the use of photonic band gap (PBG) substrate, which is obtained by implanting air gap cylinders periodically on a substrate. This reduces the effective dielectric permittivity and attenuates wave propagation in certain frequency band gaps. Thus the gain and directivity of the microstrip patch antenna can be improved by using a PBG substrate.

In this brief, design of such high-gain antennas and their performance enhancement using various mechanisms has been provided. Further, optimization of antenna models using multi-objective evolutionary algorithm has been described. The designed antenna may be used for various wireless applications, such as aircraft collision avoidance system, global positioning systems, telemetry, on-vehicle satellite links, missile radars, inter-orbital communications, communications inside space vehicle, etc., because of its compact size and enhanced performance characteristics.

Balamati Choudhury
Bhavani Danana
Rakesh Mohan Jha

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Choudhury, B.; Danana, B.; Jha, R.M.

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