Ain Shams University
Faculty of Engineering
Electronics and Communications Engineering Department

ON BOARD X-BAND COMMUNICATIONS SATELLITE ANTENNAS ARRAY FOR REMOTE SENSING

A Thesis

Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Electronics and Communications Engineering

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2018

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سورة يوسف، الآيــة الكريمـة رقم {٧٦}

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Statement

This thesis is submitted to Ain Shams University for the degree of Master of Science in Electronics and Communications Engineering.

The work included in this thesis was carried out by the author at the Electronics and Communications Engineering Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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Abstract

Onboard X-Band Communications Satellite Antennas Array for Remote Sensing

Technologies such as direct broadcast satellite system (DBSS), Geosynchronous Earth Orbit (GEO) and Low Earth Orbit (LEO) satellite communications, remote sensing satellite, global positioning system (GPS), high accuracy airborne navigation system and a large variety of radar systems demand a high level of antenna performance. Similar is the requirement for upcoming land-based wireless systems such as cellular and indoor communication systems that are needed some more specific and additional features added to the antenna to compensate for the deficiencies encountered in system's performance. Increasing bandwidth of the communication link has been a challenge for CubeSat class satellite. Traditional satellites usually utilize high gain antennas for this purpose, but these antennas are rarely seen in CubeSat because of its power, volume, and weight constraints. To solve these issues, this thesis presents eight antennas designs with single patches and multiple arrays. Single patch designs presented as microstrip Archimedean spiral antennas are appropriate for wideband CubeSat communications due to its light weight and small size. The wideband frequency response of the spiral antennas can be achieved by properly choosing their outer and inner radii. This thesis presents a spiral microstrip antennas designed on FR-4 achieving an ultra-wideband from 6 to 61 GHz covering all working satellite bands and specially X-band. The proposed antenna is characterized by high gain and directive beam with suitable radiations at multiple frequencies. Array designs presented as microstrip Archimedean spiral antennas serial arrays also deployed for satellite communications because of a high gain directive beam with suitable radiations in multiple frequencies for onboard satellite communications is obtained. The wideband frequency response of the spiral array antennas can be achieved by properly choosing their outer and inner radius. In this thesis a spiral microstrip array antennas are designed on FR-4, giving an ultra-wideband from 6-to-22GHz which covers most of working satellite bands. Testing for all antennas have been completed and detailed results will be presented

Keywords

Satellite, Microstrip antenna, UWB, Serial Array, Parallel Array, FR-4, X-Band, CST, HFSS, VNA, Simulation, MASMA, DASMA, RT 5880, Gain enhancement, Beam steering.

Published Papers Extracted From The Thesis:

1- Mahmoud Rajab, Fatma El-Hefnawi and Salwa H Elramly"UWB with Gain Enhancement Archimedean Spiral Microstrip serial Array Antennas for On-board Satellite Communications" Communications on Applied Electronics vol.7, no.11, pp 16-22, December 2017.

2- Mahmoud Rajab , Fatma M. El-Hefnawi, Salwa H. Elramly and Marwa H.Bannis, " UWB with Gain Enhancement Archimedean Spiral Microstrip Antennas for On-board Satellite Communications" AP-S International Symposium (Digest) (IEEE Antennas and Propagation Society) IEEE 2018.

Table of Contents