SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Systems (3)

Author: Mr. Haider Ali
Politecnico di Torino, Italy, haider.ali@polito.it

Mr. Antonio Aru
Politecnico di Torino, Italy, antonio.aru@studenti.polito.it
Prof. claudio sansoè
Politecnico di Torino, Italy, claudio.sansoe@polito.it
Mr. Anwar Ali
Politecnico di Torino, Italy, anwar.ali@polito.it
Mr. M.Rizwan Mughal
Politecnico di Torino, Italy, muhammad.mughal@polito.it

RECONFIGURABLE ANTENNA DESIGN FOR NANO-SATELLITES

Abstract

Innovative Antenna and RF Design has recently become as one of most vital subsystem of Satellite Communication. In small satellites however, this subsystem is overlooked, either due to consideration of weight or available space. Using traditional design approach is not feasible and does not offer any significant benefits. With increasing availability of COTS in S and Higher bands it is now possible to design Antenna and RF subsystem which comply with given requirements.

This paper deals with design of such Reconfigurable Patch Array Antenna Subsystem that could serve this dual operation. This antenna subsystem has to perform not only as conventional communication link between the ground station and satellite but must also serve as a beacon to acquire and identify the ground station signal.

The S-Band Patch Array Antenna is designed at operating frequency of 2.45GHz. The whole subsystem is realized on Rogers RT Duroid 6006 microstrip technology which makes it efficient in terms of weight and dimension. It includes four radiating elements (patch with linear polarization); arranged in 2 x 2 array orientation. To make most of available space, the beam forming network and patches are designed over the same substrate. Furthermore, each array element is fed such that there is a 90 phase shift with respect to the adjacent element, minimizing inter-element coupling and cross polarization levels; therefore, resulting in a circularly polarized electromagnetic radiation. Instead of conventional geometries, special patch design is employed which provides considerable advantages in terms of Gain, size and input impedance. Most importantly the return loss is kept significantly below -10dB in 36 MHz bandwidth around the center operating frequency with acceptable gain and half power beam width. The same antenna (single patch) can be used to identify and track ground station signal link providing significantly wider beam width and with high enough gain. An electronic controlled feeding circuit is also designed that can switch between the two operational modes.

For CAD design and simulation of the given antenna “Ansoft HFSS” and Matlab is used. Optimization and tuning of different array and antenna parameters is performed in order to acquire the desired results. Once simulation results are in agreement with our requirements we move forward with prototyping and testing. Simulation and measurement results for both operating modes i.e Return Loss, 3dB Beamwidth, Co and cross polarization along with other parameters are compared with a conventional single patch antenna at same frequency bandwidth.