Open Archive Toulouse Archive Ouverte (OATAO)

OATAO is an open access repository that collects the work of some Toulouse researchers and makes it freely available over the web where possible.

This is an author's version published in: https://oatao.univ-toulouse.fr/20739

To cite this version:


Any correspondence concerning this service should be sent to the repository administrator:

tech-oatao@listes-diff.inp-toulouse.fr
Graphene-Based Ka Band Tunable Antenna for Nanosatellites Applications

Renato S. Feitoza¹, Eric C. Romani², André Pierre Mattei³, Pierre de Saqui-Sannes⁴, Gláucio Lima Siqueira⁵, Eduardo Augusto Bezerra⁶

¹ Université Grenoble-Alpes, Grenoble, France;
² Senai Innovation Institute for Virtual Production Systems, Rio de Janeiro, Brazil;
³ Senai Innovation Institute for Embedded Systems, Florianópolis, Brazil;
⁴ ISAE-SUPAERO, Université de Toulouse, France;
⁵ Pontifical Catholic University of Rio de Janeiro CETUC/PUC-Rio, Rio de Janeiro, Brazil
⁶ NanoRaven, Montpellier, France.

The increase in the number of connected objects and the new commercial possibilities associated with nanosatellites for both remote sensing and data relay require communication systems with small volumes, low consumption, and high capacity of data transmission. This work presents preliminary results for the development of a Ka-band tunable antenna for a nanosatellite software defined communication system. A tunable antenna based on graphene and a software-defined radio composes the communication system. System design applies Model Based System Engineering (MBSE) for engineering process and Systems Modeling Language (SysML) to define, trace, validate requirements, and establish relationships among various design elements [1]. The Software Defined Radio (SDR) allows a flexible communication system and it is well adapted for nanosatellite applications due to its flexibility in signal processing, but the antenna design and limitations remain the same [2]. In recent years, graphene has attracted major attention in scientific and technological communities due to its atomic thickness, excellent mechanical, optical and electric properties, which point to its many potential applications such as sensors, analog RF transistors, metamaterials and antenna-based devices. Graphene appears to be a very promising candidate for use in tunable antenna for a communication system which will enable greater efficiency to transmit different frequency signals due to the effect of Surface Plasmon Polariton (SPP), high electric mobility and lower ohmic losses [3]. The reconfiguration of the signal will be possible from the variation of the conductivity of the FLG with the electric field. In this work FLG (few layer graphene) was used as element to tunable frequencies in antenna-based devices. The proposed reconfigurable antenna structure for Ka band satellite application is shown in Fig. 1. The inner resonator consists of a classical circular patch antenna. It has a radius of 1.4 mm, and its resonance frequency is 39.10 GHz. The outer part of the structure consists of an annular ring antenna, and its external radius is 2.9 mm. When the input DC voltage is 0V, the graphene layer presents low conductivity, and hence the annular ring has low influence on the resonating structure. This is guaranteed by keeping a relatively large gap g (here, it is 0.4 mm). When an DC input voltage is superimposed on the antenna input signal, the electric field increases the FLG conductivity, virtually connecting the outer resonating structure and hence generating a lower frequency resonance. The lower frequency resonance happens at 30 GHz, assuming a resistivity of 80μ ohm.cm. The gains are 7.8 and 1.7 dBi, and the efficiencies are 93.22% and 88%, respectively. Fig. 2 illustrates the obtained reflection coefficients as a function of having or
not a superimposed DC voltage. As can be observed, this topology has potential to be implemented as a reconfigurable antenna for Ka band applications.

![Image of antenna structure](image1.png)

**Figure 1:** The classical circular patch antenna (inner resonator) for reconfigurable antenna structure for Ka band.

![Graph of reflection coefficients](image2.png)

**Figure 2:** Reflection coefficients as a function of DC voltage.

References


Preference for presentation: Oral

Symposium topic(s): Technology Demonstrations

Author for correspondence: Pierre de Saqui-Sannes
ISAE-Supaero
10 avenue Edouard Belin, 31055 Toulouse Cedex 4
+33 5 61 33 84 81
pdss@isae-supaoe.fr