Abstract

With the name of Frequency Selective Surfaces (FSS) are commonly indicated some particular resonant structures obtained combining dielectric layers with metallic array elements ("*patch*"), or/and openings ("*slot*") on metal sheets. This type of surfaces are used in a lot of electromagnetic applications from UHF frequencies to infrared frequencies. At microwave wave-length, periodic surfaces are widely used as phased array [1-3], diffraction gratings [4-5], frequency selective reflectors for antenna applications [6-7], and spatial filter [10-13]. New topic is to use sandwiched FSS to compose radome (**rad**ar d**ome**) structures, because improves fully dielectric radome characteristics.

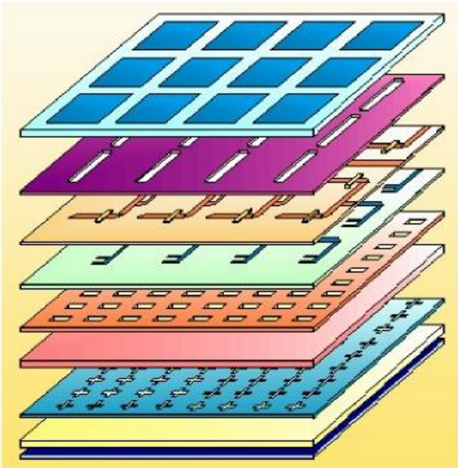

Fig. 1 Example of multilayer FSS

Basically FSSs are filters designed to show, when lighted by an incident wave, some transmission and reflection properties at different frequency values. Unlike common lumped filters, FSS's frequency response changes also with incident angle and incident wave polarization.

To obtain a structure which is independent by incident wave's polarization, *slot* and *patch* must have a specific geometric shape. Much more difficult is to have an FSS's transfer function not depending by incident angle, because it causes a resonant frequency shift, and an amplitude and phase change.

An FSS is based on *slot/patch* structure or a combination of them.

FSS *patch* has a notch frequency transfer function:

- near *patch* resonant frequency, because the strong induced current, surface reflects the electromagnetic incident waves, otherwise is transparent elsewhere.

Slotted metallic surface gives a band-pass frequency transfer function:

- near *slot* resonant frequency, slot fields allow electromagnetic incident waves to pass. Otherwise surface behave like a reflective surface elsewhere.

FSS radome improvement compared to well known standard dielectric radomes, is a frequency band-pass structure that cover the antenna allowing to receive only desired signals.

In FSS analytic analysis have to be considered two different regions:

- a central region far from the edges (how much far depends by the incident wavelength) where the surface behaves like a double infinite surface then the structure can be analyzed with Floquet theorem and Wave- Expansion Technique.
- a region near the edges where the influence in changing of mutual coupling can be investigated using numerical electromagnetic techniques such as method of moments [8] and finite element method [9]. Over the last years there have been lot of works to evaluate the effect of truncating infinite FSS [14-17].

As well as common plane FSS that have been widely analyzed [18], are also more important Cylindrical FSS (CFSS) because are as simple as the previous but include curvature effect [19]. Furthermore CFSS can be used to approximate more general surfaces with constant curvature.

In this work are analytically analyzed *patch*/*slot* CFSS, and some numerical result are given for free-standing structures (without a dielectric support slab).
In particular are considered *patch* and *slot* with dipole shape (see Fig. 2), axial placed on cylindrical surface, having width (w) much smaller than length (l), and much smaller than incident wave-length (λ).

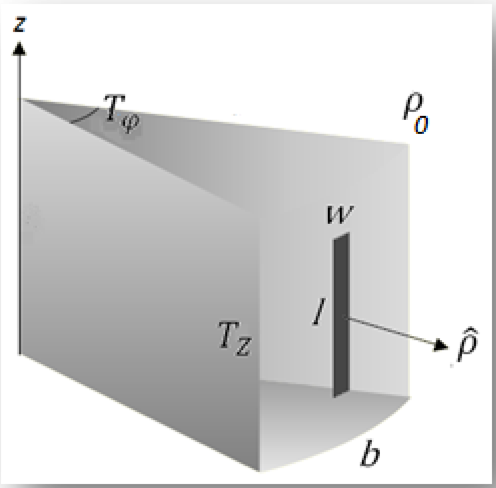

Fig.2 Unit cell with axially placed dipole and geometric parameters

Cylindrical incident waves are considered and cylindrical Floquet modes are used to express scattered fields.

Through boundary conditions an integral equation with unknown patch current or slot fields is obtained and solved by Method of Moments (MoM) using Galerkin approach and sinusoidal entire domain expansion functions.

Formulation explained is the same used in [19] but effort has been focused on approximated Bessel functions form [20], needed to numerically analyze CFSS with much more elements than 64 considered in [19].

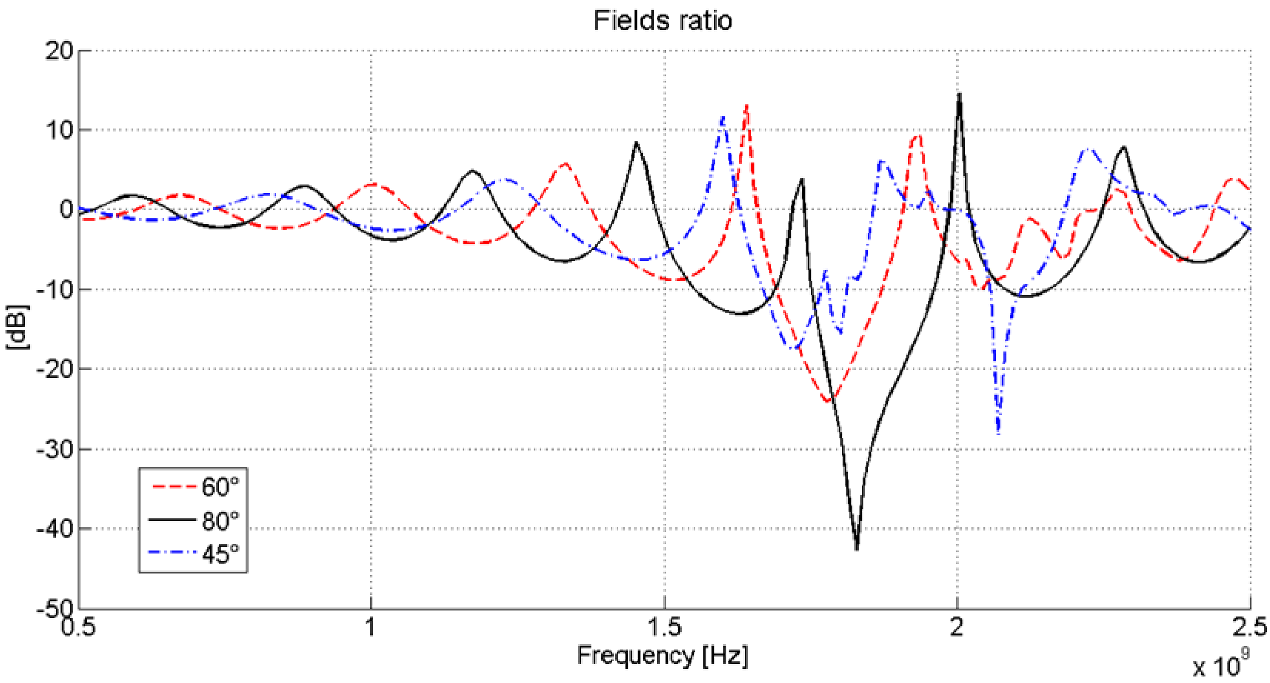

Fig.3 Electrical fields ratio measured on cylinder axis with and without patch-CFSS for different plane wave incident angle.

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