SLOTTED PATCH ANTENNAS FOR SPACE APPLICATIONS

Salvatore Contu[1], Claudio Vegni[1], Filiberto Bilotti[2], Lucio Vegni[2]

[1]Alenia Spazio S.p.A.
Via Saccomuro n°24 – 00131 – Rome – Italy
Phone: +39.06.41514451 – E-mail: c.vegni@roma.alespazio.it

[2]University of Roma Tre – Department of Applied Electronics
Via della Vasca Navale n°84 – 00146 – Rome – Italy
Phone: +39.06.55177003 – E-mail: vegni@uniroma3.it

The present work has been developed in a recent cooperation between the University of ROMA TRE and Alenia Spazio (ALS).
ALS has been and is currently involved in National, European and International programs on Remote Sensing, Telecommunications and Science applications from UHF up to Ka band frequencies. In that frame, one of the main activities of the ALS Antenna Department is the design of planar array antennas using microstrip technology. Typical antenna designs for space applications have to match the following requirements: impedance bandwidth, gain, radiation pattern polarization purity or ellipticity bandwidth (in case of circular polarization), coverage requirements (shaped beams), port-to-port isolation (mutual coupling in case of arrays), low weight and low profile, structure stiffness, thermal stability, easy technology and manufacturing repeatability. In order to accomplish the previous constraints, a wide typology of patch antennas can be designed and the choice of the final radiator has been derived after a trade-off evaluation. For example, impedance bandwidth requirements can be achieved in some cases using a stacked patch configuration through direct feeding, aperture feeding (COSMO-SKYMED program), electromagnetic coupling feeding (WRAS and LAGRANGE programs); weight requirements can be matched using Kapton–Kevlar materials (MARE-SS, SICRAL program); polarization purity can be optimised with sequential rotation techniques (WRAS program). In that scenario, the design of new patch antenna layouts exhibiting *enhanced* electrical and mechanical performances with respect to *standard* microstrip radiators can be considered as a challenging aspect for the electrical engineer. From that point of view, the present work deals with the design of a novel patch radiator for both array and “stand-alone” configuration. More in detail, the design refers to slotted patch antennas, with linear or circular polarization features and fed by probes or microstrip lines. The slots etched on the patch surface increase the design freedom degrees (shape, allocation and size of the slots) with respect to *standard* microstrip radiators and permit the control of the antenna resonant frequencies, impedance bandwidth, surface current densities, radiation pattern, through a proper design. Particularly, the obtained features of the proposed antennas are broadband or multi-frequency operation, working frequency shift, antenna compactness and mass saving.
The electrical design of such radiators have been performed by a numerical code implemented by the University of Roma Tre. This tool is based on a rigorous full-wave Electric Filed Integral Equation (EFIE) approach developed in the spectral domain and assisted by a combined Genetic Algorithm (GA) - Method of Moments (MoM) optimisation module allowing a very fast, easy and accurate design of slotted patches matching some prescribed requirements. The numerical results obtained through this code have been compared with those of commercial software employing the same theoretical method (e.g. Ensemble) and with measured data.