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SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Design and Technology for Small Satellites (6A)

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SMART ANTENNA SYSTEM FOR SMALL SATELLITES

Abstract

Antennas are probably one of the most important subsystems in spacecrafts. In scientific missions they provide for a consistent part of the link-budget and in telecommunication satellites they may set the mission requirements themselves. In small satellites however, this subsystem is often overlooked, either because of consideration on weight/available space or because of the low frequencies used, where approaches other than the traditional ones would not offer significant benefits. But with the increasing availability of COTS components in S and higher bands, it is now becoming easier to adopt more flexible architectures in the telecommunication subsystem.

The approach proposed in this paper extends the concept of a Software Defined Radio to the antenna segment. With the use of an array of elements and individual frequency-conversion chains (in transmission or, eventually, reception), it becomes possible to keep the individual excitations separated in the digital domain. With a dynamic phasing of the signals, the smart antenna concept can then be implemented on-board, allowing for an array utilization that depends on the link needs.

As an example, an array beam configured to obtain a range attenuation compensation with some out-of-phase elements, could be set in a maximum gain configuration bringing these elements back in phase. Or, with a sufficient number of elements, the beam of an array could be steered dynamically with a least squares algorithm to the strongest authenticated signal. Even further, a second channel could be obtained exploiting the polarization separation, compensating for cross-polarization effects with additional digital processing at the transmitting or receiving side.

Trying to achieve these goals, the implementation of the proposed architecture also takes into account the limited resources available in a typical small-satellite mission. Cost reduction is obtained through the use of COTS components and low-power consumption requirements are considered in all the design stages.