

Nanosatellite activities at ENAC: the TETX receiving ground station and the EYESAT mission control center

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This paper describes the activities of ENAC (École Nationale de l'Aviation Civile), Toulouse, around the nanosatellites. Firstly, the TETX (Telemetry Earth Terminal X-band) receiving antenna and its accompanying satellite signal processing unit are presented. Although educationally oriented, they constitute a fully operational ground station. Secondly, the mission control center dedicated to the EYESAT nanosatellite is described. Its development is also an important source of interesting educational projects.

In 2015, ENAC received the TETX ground station, an X-band tracking dish antenna (3.40 m in diameter), and the associated control hardware, given free-of-charge by CNES (Centre National d'Études Spatiales). This donation was done in the context of the JANUS (Jeunes en Apprentissage pour la réalisation de Nanosatellites au sein des Universités et des écoles de l'enseignement Supérieur) program (an educational CNES project). The TETX ground station was formerly used for MYRIADE missions. In 2015, the condition of the mechanical and electrical subsystems were fully satisfactory, but the electronic control parts were obsolete and had to be replaced. The work of ENAC around the TETX then focused on this upgrade task. It has been done by students tutored by ENAC educational staff members. At the time of this writing, the station is operational, not only able to track a satellite from ephemeris generated locally from orbital elements, but also to demodulate the received signal using a CORTEX HDR XXL equipment (a free-of-charge donation of CNES too). As an end-to-end test, in 2016, the GOMX3 nanosatellite was tracked several times, its signal being successfully received, demodulated and decoded (error correction, deinterleaving, descrambling, ...). Since this date, signals from PLEIADES 1(a, b) and SENTINEL 1(a, b), 2(a, b) and 3a are received on a regular basis, assessing continuously the capacities of the station.

ENAC is also the mission control center of the EYESAT nanosatellite, a LEO (Low Earth Orbit) 3U cubesat project involving CNES and several French universities. The mission of EYESAT is to map the zodiacal light in the blue, green, red, and near-infrared bands, while being a technology demonstrator at the same time. The main task of its mission center is to establish the EYESAT workflow, that is the sequencing of the picture captures. The optimisation of this workflow is specifically a valuable educational challenge which involves the ENAC Dynamical systems Optimization (OPTIM) research team. However, the mission center has also the responsibility to process (e.g. picture decompression and denoising) the data received by the TETX ground station. As of this writing, the work on the mission center is still in progress but in a good way. The overall architecture is set and the software development is steadily progressing. Nevertheless, the data processing part is on hold, waiting for the EYESAT picture format to be definitely validated.

Beyond EYESAT, to be launched in late 2019, ENAC is looking for cooperation around scientific or educational X-band nanosatellites which would use its TETX ground station. The availability of an X-

band receiving ground station, providing access to high data rates, should trigger new nanosatellites project with more demanding, but also promising, missions.



Figure 1: TETX Antenna

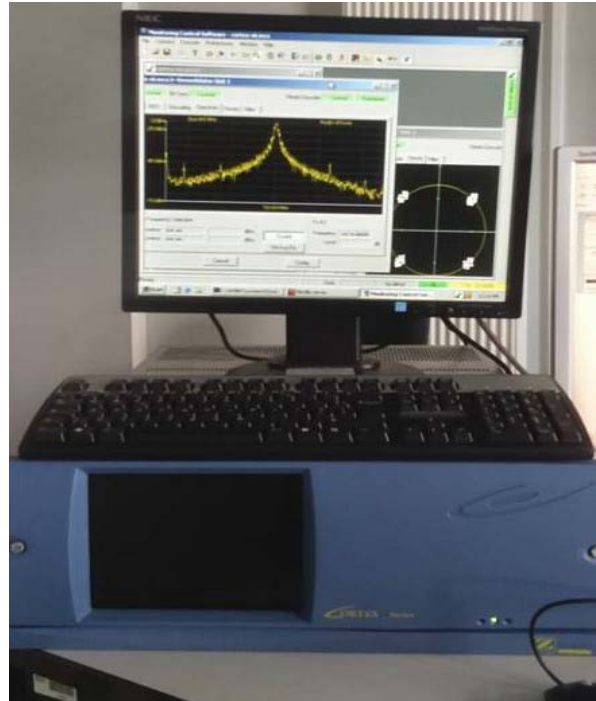


Figure 2: received signal on ENAC CORTEX

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