HYPSEO: DEMONSTRATION MISSION FOR A NEW EARTH OBSERVATION HYPERSPECTRAL SENSOR

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The Italian Space Agency is promoting and funding a Constellation of Satellite for Earth Observation using both SAR and Optical Sensors. For the Optical satellites, a new advanced Hyperspectral camera is under development. In order to demonstrate the functionalities of the camera and the explore all the possible fields of application of such new sensor, it has been decided to have a dedicated flight to be performed in the very near future (beginning of year 2003). The satellite to be used for the flight will be a small satellite not exceeding 300 kg mass at launch, one third of the total weight being represented by the optical sensor.

The aim of the Hypseo mission, mainly demonstration and experimental, has stimulated the idea to perform also science experiments by using the data collected by the camera under almost any illumination conditions of the target sites. This idea had lead to consider for the mission the possibility to use medium inclination orbits instead of the classical sun-synchronous orbit.

The paper describes the mission analysis studies performed as well as the satellite configurations considered at this time.

Because the satellite does not have any propulsion system, a decay analysis was performed in order to assess the orbit initial attitude that would provide the best compromise between the natural decay due to the atmospheric drag and the sensor's functional characteristics. This altitude was found at 620 km.

Successively the mission analysis consisted in a detailed study of the coverage, data take opportunities an ground stations contact times for both sun synchronous and inclined orbits. The coverage analysis was performed for a classical sun-synchronous orbit with a local time at the ascending node of 9.30 a.m., and an orbit having 46 deg. of inclination.

Several simulations have been performed and the main result was that inclined orbits would allow a much larger number of opportunities for taking data over the Italian territory with respect to the sun synchronous orbit. Also the possibility to select almost any target over Italy for every illuminated pass is a characteristic of the inclined orbits. The Sun synchronous ones provide lesser flexibility in doing the above because of the reduced access area over the same target area.

In the following figures (Fig. 1 and 2) the ground tracks for the two orbits considered are plotted.

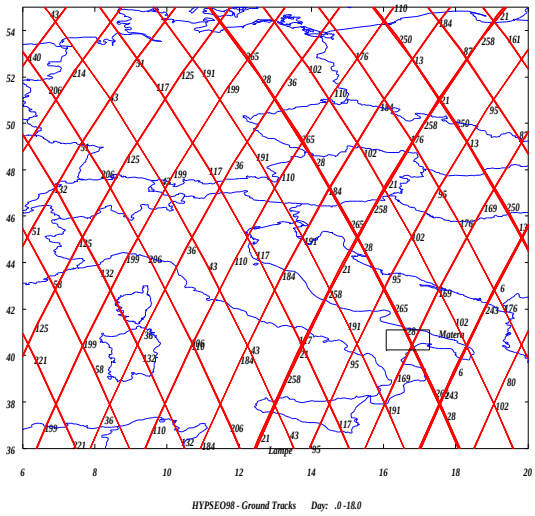

Fig. 1 – Ground tracks for Sun-synchronous Orbit

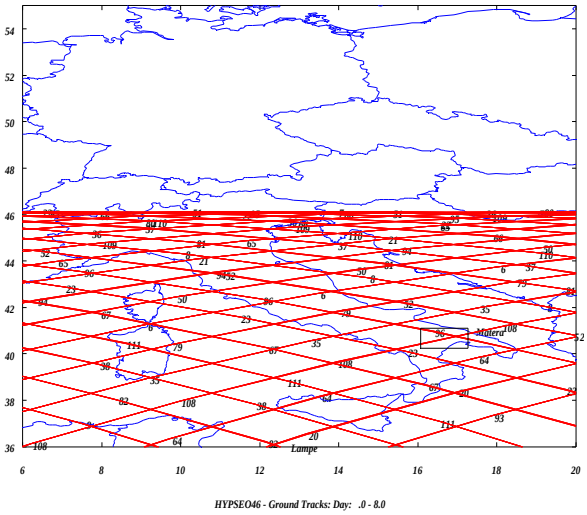

Fig. 2 – Ground tracks for inclined orbit

It can be seen that in the case of the inclined orbit, the ground tracks remain below the northern border of Italy, but since the Hypseo sensor has built-in the feature to be directed within 22 deg from the nadir in both right and left direction with respect to the satellite velocity direction, the accessible areas cover completely the Italian territory. Some examples of the areas accessible by the sensor for the two orbits are given in the following figures.

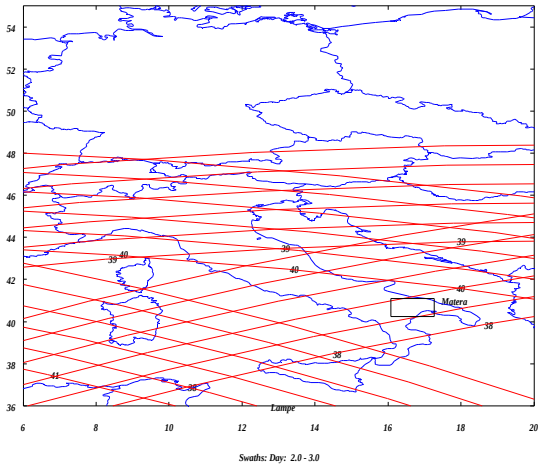

Fig. 3 – Access areas for inclined orbit

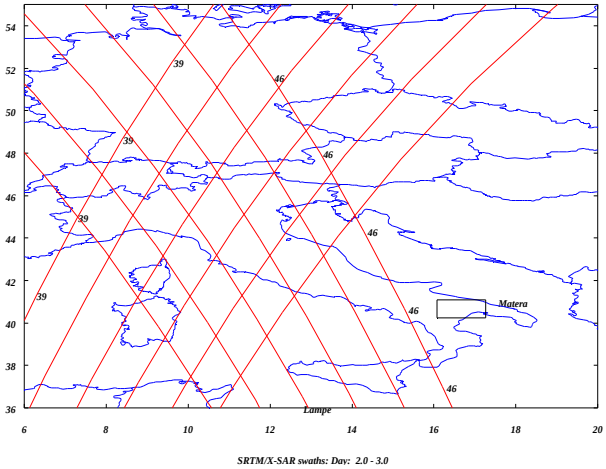

Fig. 4 – Access ares for Sun-synchronous orbit

The impact on the spacecraft design of the varying Sun angle during the mission for inclined orbit has been evaluated with respect to both power and thermal constraints. In this case the satellite design require larger solar panels and additional radiators to cool down the spacecraft, increasing the satellite mass and overall dimensions.

The last point investigated was the contact time with ground stations for TT&C activities and data transmission. Four stations have been considered two of them located in Italy. The result of the coverage study is summarised in Fig. 5.

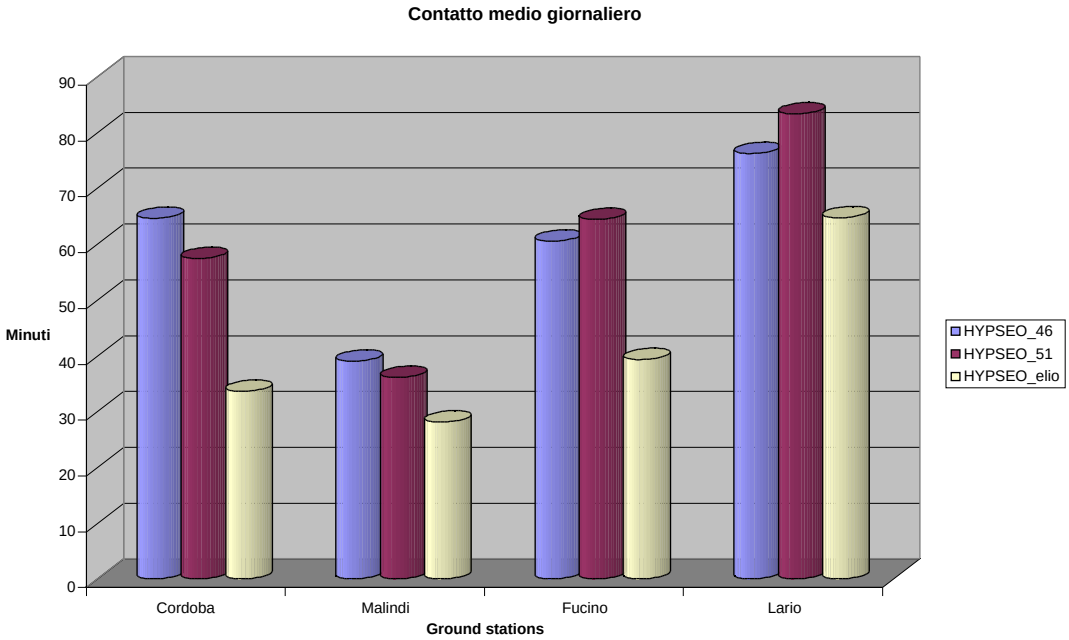

Fig. 5 – Ground Stations daily mean contact

In the paper the analysis performed is described in detail and the current status of the Project, which has seen the officially start of phase B on December 2000, is reported. The final orbit and the satellite reference configuration will be decided before the end of February 2001 in order to start the detailed design of the system.