Development of 3D Synthetic Vision by Pico-Satellites Network

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Earth Observation applications cover activities related to data collection and to imagery. Remote sensing using low-cost small satellites which allow direct data downlink to various, small, ground stations, eliminates the need for a centralized processing and distribution system while yet providing the advantages of real-time access to the observations concerned; small size databases and, easy information distribution within areas not well served by communications systems. Furthermore, in the area of disaster prevention, demands exist for earthquake forecasts, early detection of tropical storms and predictions of volcanic activity.

The satellite imaging presents besides numerous advantages with regard to the other springs of observation of ground as the air imaging, the statements of ground and maps. It is better because the time required to obtain the satellite images of a specific region depends exclusively on the planning of the orbit of the satellite. The performance of the images sequences for the vision and object recognition is a complex process which imposes to create specialized modules. Their respective roles are in the order, the detection, and the follow-up of the mobile objects and the classification of objects.

In a natural space environment, space systems are likely to be subjected to threats from artificial space environment. It is therefore relevant to focus on board means of anticipating and responding to these threats. There are several sources of uncertainty that technical uncertainty where examples might be a failure of a component, a software bug, a design flaw or faulty operation Concepts of innovative space missions are under development. Among them, the reactive space, this aims to carry out missions with small, inexpensive satellites, assembled and launched at the request.

One can consider a satellite with its effective capacity would be issued by a handful of smaller modules. The system called satellites constellation. A constellation is a group of similar satellites with coordinated ground coverage, operating together under shared control, synchronized so that they overlap well in coverage and complement rather than interfere with other satellites coverage. The concept of constellation mission is to replace a large satellite with a cluster of smaller satellites, flying in very precise relative positions. Rather than using a single, large, expensive satellite to perform a given mission, many small, inexpensive satellites can be flown in a constellation more effectively.

Thus, a constellation of Pico-satellite is important in the vision missions and the ground supervision.

Pico and Nanosatellites, especially CubeSats, have become popular in the past decade and the amount of developers and projects is increasing. They are not only built by universities but also larger space organizations like NASA, Boeing and The Aerospace Corporation.

It was identified that the constellation of satellites and formation flying is an excellent opportunity for Pico and Nanosatellites, opening new perspectives for operational assignments.

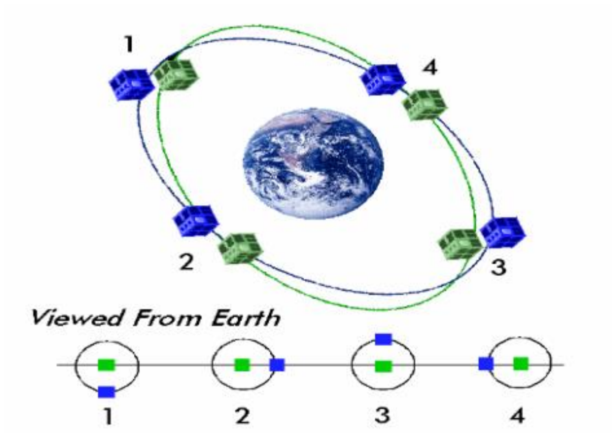
In our project, we propose then logical architecture of a Pico and Nanosatellite network system for follow-up of objects, operating on vast scenes.

Because of the time of revisit and of the wanted precision, a constellation in orbit LEO (Low Earth Orbit) is the most effective. Satellites in LEO enable high spatial resolution on ground and offer interesting potential for applications like disaster monitoring. Due to the low orbit, these satellites exhibit a high relative velocity to reference points on ground, resulting in short observation and communication contact periods in the target areas. One approach to that problem is a higher temporal resolution by satellite constellations with several satellites in the same orbit.

In this approach, the proposed solutions are based on dual or more of microsatellites.

Two Nanosatellites thrusters are located on one face only. Therefore, attitude pointing requirements are placed on the attitude determination and control system for accurate thruster pointing. In addition, the two satellites must communicate with each other to relay position, velocity and attitude information. The inter satellite communication system must accommodate the desired relative distance of the satellites in each formation as well as the required data rates. One of the two satellites will be assigned the role of support and run a series of recovery begin to drift sinking maneuvers back to the other satellite. Two different types of training are demonstrated. Along Track Orbit (ATO) and a Projected Circular Orbit (PCO). In each formation, the support spacecraft performs active orbit maintenance and control to achieve the desired relative motion with respect to the chief spacecraft.

In the ATO formations, both satellites will essentially occupy the same orbit, but with one satellite leading the other by a particular separation distance. In the PCO formation, the satellites have slightly different inclination and eccentricity values so that, when viewed from earth over the course of one orbit, the support appears to orbit the chief satellite.



Dual Nanosatellites in a projected circular orbit

This architecture is effective for observing the Earth from LEO and more effective for the attitude control. This technique allows controlling groups of satellites, and engaging these positions and coordinates in space and in orbit.