European Space Agency

SysNova

Remote sensing with multiple cooperative nanosats

NAME-O

NAnosatellite Multiple channel Earth-Observation

Challenge Analysis Executive Summary

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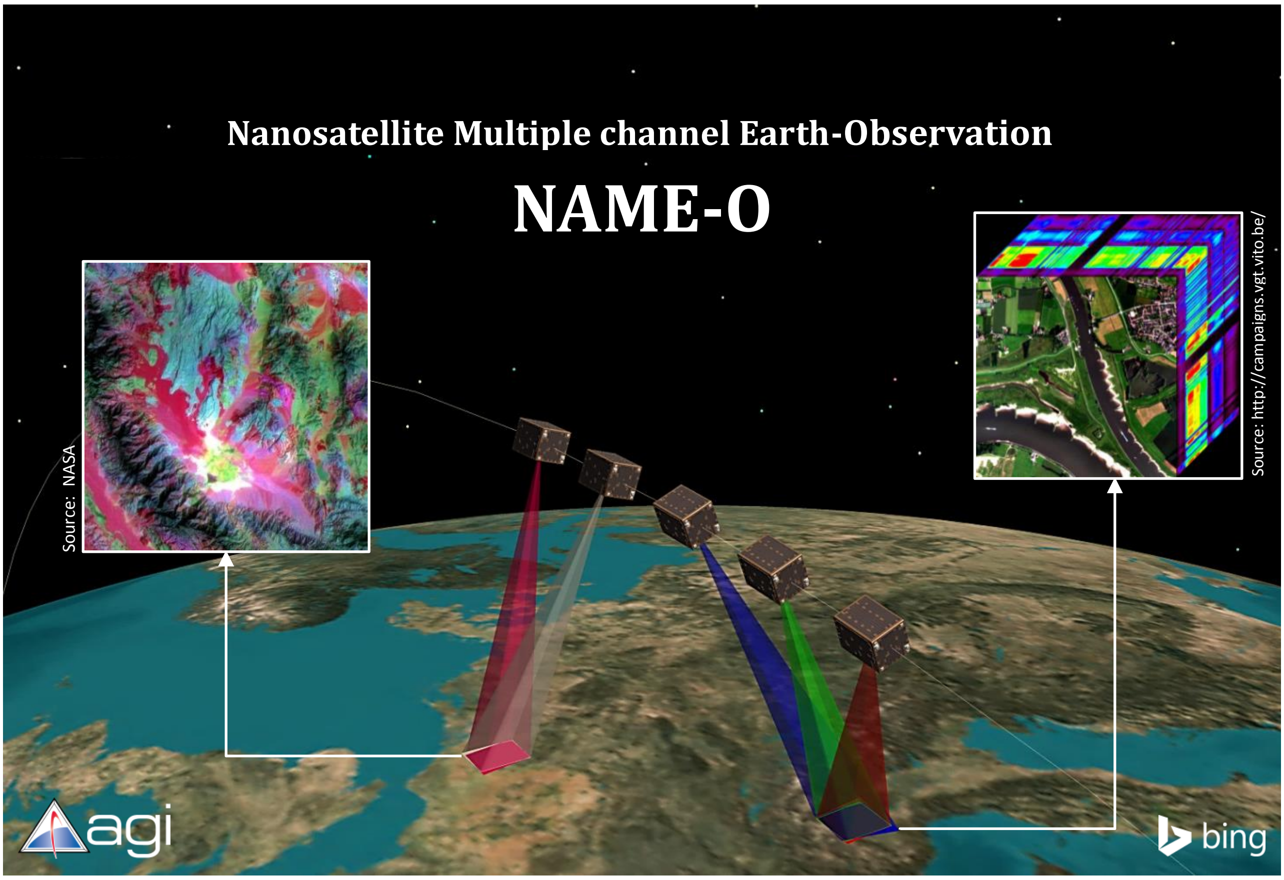

Motivation

Performance of nanosatellite systems is reaching a level sufficient for supporting Earth Observation applications, while instrument development focuses on miniaturization. By using a multitude of cooperating and cost effective satellites, nanosat technology could be a serious competitor for conventional EO missions.

Methodology

The first stage of the study started with formation of the team, which consists of multiple partners with varying areas of expertise. At the start of the challenge analysis it was decided to, in addition of following the challenge requirements, select a number of EO applications and let the requirements flowing from those applications drive the mission design. In the next phase various design options for all the different mission parts and subsystems were identified. From that a selection was made and two concepts were generated. The most promising concept was selected and the various subsystems were worked out in more detail. Also an investigation was done to find mission performance parameters, create a cost overview and estimate the engineering budgets. The final phase encompassed the creation of a roadmap in which is indicated what technology is required to make this mission a success and what could improve the performance in the future.

Results

- The required platform resources for the envisaged VNIR, SWIR and TIR instruments in terms of mass (especially for the TIR instrument), power (to cool the SWIR and TIR instruments) and data volume (VNIR hyperspectral instrument) are more demanding than current nanosatellite technology can provide. To achieve high quality data but still use a nanosatellite platform, it was decided to use a fractionated approach. The VNIR part of the optical spectrum will be covered by three satellites with the SWIR and TIR instruments both having a dedicated platform.
- Since downlink opportunities usually occur less than once per orbit or at most twice per orbit, there will be times the satellite is neither imaging nor transmitting. This “dead time” is used to perform the first steps of data processing already on board to minimize data latency and provide customized data products for the users of the system. Onboard processing will only be done up to a level where no significant increase in data volume is expected.
- A reference data set on board shows to be very useful for two reasons. Firstly the images can be co-registered with the reference data where the transformation algorithms can already be found onboard (the actual mapping will take place on ground). Secondly those algorithms can give an indication of the attitude of the satellite, which can virtually improve the performance of the ADCS. This in turn leads to relaxed requirements on the satellite platform.
- A first order cost estimation showed the given budget of 60M Euro is challenging but close to being achievable for this mission. However, with the current setup of three clusters of five satellites each, having a revisit time of 2 times per day is not possible.

Highlights

The proposed mission uses a fractionated approach by covering the complete VNIR – TIR spectrum with five different satellites in three clusters. In the near future, this approach could be expanded by adding a sixth satellite to each cluster that is specialised in providing on-board processing and a high downlink capability. This gives the possibility of directing more resources to improve the performance of the imaging satellites. Taking into account the trend of developing ring-shaped launch adapters for secondary and cluster launches for nanosatellites, this sixth platform could be provided by the launch adapter itself. Taking this even a step further it could be possible that the all satellites will remain fixed to the launch adapter and share other resources. This provides the advantage of modular CubeSat design with standardised interfaces as well as improved performance of each individual unit.