"The Smartest Satellite in the Class" - Jury Summary

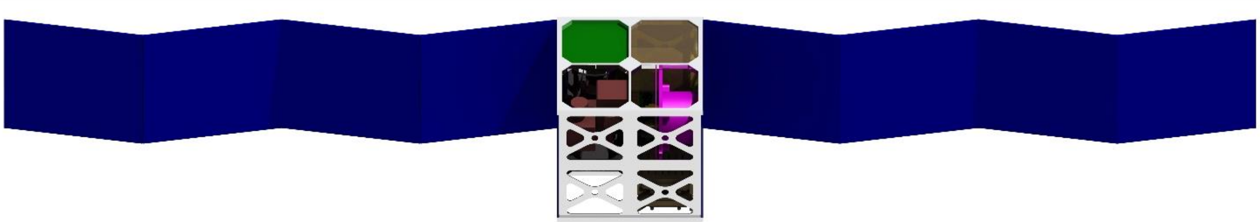
Solutions for reducing greenhouse gas emissions are paramount under the current environmental circumstances. With methane and carbon dioxide being the most critical emission gasses, SigmaSat set out to find a way to reduce these emissions and simultaneously fulfill its scientific mission. While executing the scientific mission of designing a small satellite mission to demonstrate the latest advances in artificial intelligence, SigmaSat managed to devise a design that allows players in the energy production industry (such as refineries) to drastically reduce their methane and CO2 emissions.

It is the combination of innovative, never before flown AI applications that enable SigmaSat to call itself the smartest in the class. Besides a cloud-detection algorithm, with proven flight heritage on Phisat, SigmaSat packs a novel target-detecting algorithm that revolutionizes on-board data handling, by processing data cubes generated by a hyperspectral camera before downlinking them. Through this technology an emission detection alarm signal is fitted on the satellite, ensuring costumers can reduce their response time to emission leaks and thus their emissions even further. Innovative AI usage within the Control Data Handling System enables a predictive maintenance algorithm to run along with autonomous retargeting and satellite autonomy algorithms. As a result of these groundbreaking innovations, the space industry is one step closer to Space 4.0.

Guaranteeing these AI capabilities required an innovative and complex design. In order to run the AI algorithms, the satellite has been equipped with the Antelope On-Board Computer, as it is best suited for the desired AI applications. The Chameleon Hyperspectral Imager equipped on the satellite will allow SigmaSat to outperform the competition with respect to gas detection. This camera will provide a higher spatial resolution than any past space missions, allowing for a more accurate detection of leaks. Another contributing factor for the higher spatial resolution is the low earth orbit of 6656.1 km. This Earth repeat and sun-synchronous orbit requires the use of a propulsion system. Having first selected a chemical propulsion system, the switch was made to a far greener and more sustainable, electric, Field-emission Electric Propulsion module that fires constantly.

Moreover, a complex thermal model of the satellite, created through ESATAN, ensures satellite temperatures are within the operational ranges of the subsystems. Astrodynamic properties of the mission allow for a passive thermal management system, averting the reduction of available power for the critical AI processes. Using an off-the-shelf 8U CubeSat (1U = 10x10x10cm) structure allowed for an optimized internal layout, able to shield the subsystems from the harsh space environment. The AI processing allows data to be downlinked using the less power-hungry S band and UHF antennas, with availability to down link every half orbit due to the usage of a ground station service provider. As a result of the orbit, solar panels with only 1 degree of freedom are used for optimum power generation. The EPS system has a high-power output to meet power requirements of the subsystems.

As a result of the above-mentioned technological innovations and decisions, a sustainable, 8U, LEO, emission monitoring CubeSat was designed. The result of this design is a class-smartest, competition outperforming, budget-friendly emission detection solution, with potential to revolutionize the emission leak detection industry and help save the planet.



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