Danish Institute of Agricultural Sciences

Suggestions for a Sensor on the proposed Student Satellite from Aalborg University

Definitions used in this document

Along Track - Actions that occur in the direction of the satellite orbit.
Across track - Actions that occur across the track of the satellite.

We suggest three alternatives for your consideration;

1 Hyperspectral Camera

1.1 Physical Description

A CMOS camera with long focal length would have a linear variable wavelength filter placed in front of the CMOS array so that the wavelength varies from blue through to Near Infrared in the along track direction but not in the cross track direction. Images are taken at a moment in time. The next image is taken when the satellite has progressed one scanline on the ground surface. In this way multispectral images of a location are accumulated as the separate images are acquired. These sorts of technology currently exist: http://www.ocli.com/products/ir_europe.html http://www.photobit.com/

Technical challenges are involved in the energy levels coming into the camera system, the rate of data acquisition and transmission. Given the tradeoffs that are likely to need to be made, ground resolutions of 20 - 300 metres would be acceptable.

1.2 Potential Applications and Users

The image data could cover a significant part of Denmark. It would provide valuable information on ground conditions in agriculture, forestry and of water bodies. Amts, Kommune, large agri-businesses and Agricultural advisory services could use the data to appreciate ground conditions across more extensive areas, to address questions like;- when to harvest sugar beets across Denmark, progress of harvest and yield, etc. Such a camera system would introduce a new scientific dimension to those already in space as long as it can provide more than about 100 wavebands of information (Achievable using existing sensors on ground based units now).

2 High Spatial Resolution Camera

2.1 Physical Description

A CMOS camera with long focal length lens designed to give high resolution (1 - 10 m pixel resolution) images in two or three wavebands.

The lens would provide the most significant challenge. It may be necessary to have it arranged in a "packed" condition for launch, and then have it "unpacked" in orbit, so that it no longer needs to meet the spatial constraints imposed on it for launch, so that it can be used to provide the necessary resolution.

2.2 Potential Applications and Users

Spatial resolution sets the constraint on many applications of sensors. High spatial resolution will create opportunities for new applications in farm, Kommume and Amt management. Comparison on daytime and night-time images will show the relationship between ground illumination, buildings and other features. The imagery could be used to assess the environmental distribution and density of plumes (from heating factories, aircraft, etc) of different sorts. It can be used for the mapping and monitoring of other fine resolution features, such as the existence of narrow environmental corridors, such as hedges, the assessment of wetlands status and the condition of waterways, including rivers..

The science community is not driving the development of new high spatial resolution image data from space, this segment is being left to industry. Scientific applications of space science that need high spatial resolution image data are likely to suffer due to this attitude. Such a camera would receive significant public interest.

3 Geostationary Orbit Camera

3.1 Physical Description

Place a CMOS camera with about three wavebands into geostationary orbit. The camera would need to be able to acquire such images at hourly intervals, or shorter at ground resolutions of 100 - 300 m pixels. The camera will need to be pointed at Denmark and its environs. The selection of wavebands still needs to be made.

The proposed system may pose challenges in lifting it into geostationary orbit, and then in the transmission of data to the ground. Power requirements are likely to be another challenge.

3.2 Potential Users and Applications

If such a camera could acquire images with a resolution of 100 - 300 m then it could provide weather data in a very timely way to all TV stations. It could also be used to show the greening up across the country in spring, show the progress of agriculture in summer and show the onset of autumn. It could also be used to show the distribution of snow in winter and it may be useful to show the extent of national catastrophes, when these are extensive enough to be recorded in this data. Such would be the case with extensive snowstorms and blizzards, hurricanes, floods and should be the case with extensive wild fires.

Current geostationary imaging devices are at very low resolution and thus are not suitable for many of the applications listed above. However Danish interest in these issues mean that it could meet a real community need.

The ideas expressed in this document result from discussions held between Keith McCloy, Niels Broge and Rene Larsen on Monday 17 September 2001.