ISPRS Technical Commission I Symposium, Sustaining Land Imaging: UAVs to Satellites
17 – 20 November 2014, Denver, Colorado, USA, MTSTC1-82

ON THE DESIGN OF HIGH RESOLUTION IMAGING SYSTEMS

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Commission I, WG I/7

KEY WORDS: Digital; High resolution; Sensor systems; Satellite; Modelling; Design; Space; Technology

ABSTRACT:

High resolution digital cameras for airborne and spaceborne remote sensing are today well established in the market for digital data. Hi-Res here means either spatially or spectrally high-resolution systems. Spectral high-resolution systems have about 100 or more spectral channels with a bandwidth of a few nanometers in the visible spectral range (nnalog in the UV and IR). High spatial resolution systems on aircraft platforms have a GSD from a few centimeters and from space platforms of less than 0.5 meters. The image size (number of pixels) inperpendicular to flight direction is much larger than 20k pixel.
The design of high-resolution systems is always a consideration of many parameters. Technological parameter of the imaging system, e.g. diameter of the imaging system, mass and power, as well as storage and data transfer, have an direct impact on spacecraft size and design.

The performance of an imaging system is related to the following parameters:

- Signal to noise ration (SNR)
- Modulation transfer function (MTF) in different directions and at different places within the image

A balance of the modulation transfer function (MTF), and signal-to-noise ratio (SNR) is achieved by the system architecture to optimize the cost, complexity and risk with regard to requirements of end users.
Several parameter have influence on the system design and are defined by the customer.
Orbit and pointing. Orbit shape and altitude in relation on revisit times. A typical requirement is pointing by roll rotation, over an angle of at least $\pm 45^{\circ}$.
Camera concept. Pushbroom scanning or matrix camera is possible. Panchromatic band have a defined GSD_{PAN} (e.g. 0.5 m) and some multispectral bands in the visible and near infrared spectrum at resolutions of 4 x GSD_{PAN}.
Optics design. Main requirements concerning here MTF and distortions.
Dynamic range. At a minimum the detector output digitize a dynamic range of 14 bits.
MTF. The system level Modulation Transfer Function (MTF) at the Nyquist frequency shall be better than 12
Signal to Noise Ratio. SNR is better than 100.

This paper will give an overview of consequences for other design parameters (e.g. aperture and pixel size) and how to balance radiometric and reometric properties.

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