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Author: Mr. Gerard Otter
TNO, The Netherlands

ABSOLUTE RADIOMETRIC REFERENCE INSTRUMENT (ARRI)

Abstract

The cheapest method for an instrument to perform radiometric monitoring in orbit is to compare its radiometric response from a scene to the known radiance of that same scene. This is known as vicarious calibration. The known radiance of this scene comes mostly from other space instruments. The limiting factors of this vicarious calibration approach arise from differences in the acquisition time and illumination/viewing geometry between the two measurements. Earth scenes may change over time, which limits vicarious calibration to quasi stable scenes. The level of stability of these scenes limits the level of accuracy that can be achieved. Likewise, the bi-directional scattering distribution function (BSDF) of the observed scene is likely to cause differences in observed radiance if the illumination and/or viewing geometry changes. If the observation of the scene is at the same time then stability is no longer an issue, and if the observation is at the same geometry then BSDF effects will cancel and direct comparison is possible. This is rarely the case unless the instrument is on the same satellite. In this paper we present the design and measurement concept of such a small, on-board calibration instrument; the Absolute Radiometric Reference Instrument (ARRI). We believe this concept will revolutionise the approach to in-orbit absolute radiance calibration. The Absolute Radiometric Reference Instrument is designed to provide an absolute Earth reflectance averaged over the bright side of an orbit or several orbits. This averaged reflectance can be used to cross calibrate other (primary) instruments on the same satellite. ARRI will focus on providing only the radiometric reference and this limited functionality allows us to make a very small instrument in the order of 1U. The instrument is allowed to average spatially and/or spectrally in order to reach the required level of accuracy. Since radiometric changes will occur slowly, a daily measurement will be sufficient which allows considerable averaging over Earth scenes and orbits. ARRI itself will have its own radiometric calibration with a sun diffuser using a traditional mechanism or a passive system with additional metrology. The method implemented will depend on the primary instrument needs. The radiometric accuracy will be determined by the synchronisation of the main instrument(s) with the ARRI and the internal calibration of the instrument. The first aim is to deliver an absolute accuracy of 1% and a relative accuracy of 0.2%. The instrument concept operates over the full visible range.