

Thermal Modelling and Digital Servo Algorithm for the next generation of Differential Absolute Radiometer

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Abstract. The Differential absolute radiometer developed at the Royal Meteorological Institute of Belgium operates on SOHO as part of the VIRGO experiment. DIARAD produces a 3 minutes sampled TSI time series since 1996 with 100 ppm repeatability after correction of the in-flight aging. This characteristic limits the detectability of the long term Total Solar Irradiance variability to 0.13 W/m^2 . Any trend in the TSI signal below this level faces instrument's measurement limitations mainly due to the noise level of DIARAD's analogous servo system; if one assumes the stability of the reference voltages and the correct monitoring of the in-flight aging. In this paper we present a thermal model of the radiometric cavities using a finite difference approach and present the design of a new servo system. Adaptive servo system allows achieving noise levels as low as 20 ppm for DIARAD new generation, leading to a long term repeatability of about 0.03 W/m^2 . We first recall the DIARAD's measurement principle and establish the radiometric equation. We then focus on the so-called thermal efficiency parameter defined as the fraction of the total heat dissipated in the cavity that flows through the heat flux sensor at the bottom of the cavity related to the incident radiation. We finally compare experimental results to a finite difference model and present the design of digital servo algorithm.

References

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