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Title:

High Precision Sunphotometer using Wide Dynamic Range (WDR) Camera Tracking

Abstract:

The NASA Ames Sun-photometer-Satellite Group, DOE, PNNL Atmospheric Sciences and Global Change Division, and NASA Goddard's AERONET (AErosol RObotic NETwork) team recently collaborated on the development of a new airborne sunphotometry instrument that provides information on gases and aerosols extending far beyond what can be derived from discrete-channel direct-beam measurements, while preserving or enhancing many of the desirable AATS features (e.g., compactness, versatility, automation, reliability). The enhanced instrument combines the sun-tracking ability of the current 14-Channel NASA Ames AATS-14 with the sky-scanning ability of the ground-based AERONET Sun/sky photometers, while extending both AATS-14 and AERONET capabilities by providing full spectral information from the UV (350 nm) to the SWIR (1,700 nm). Strengths of this measurement approach include many more wavelengths (isolated from gas absorption features) that may be used to characterize aerosols and detailed (oversampled) measurements of the absorption features of specific gas constituents.

The Sky Scanning Sun Tracking Airborne Radiometer (3STAR) replicates the radiometer functionality of the AATS-14 instrument but incorporates modern COTS technologies for all instruments subsystems. A 19-channel radiometer bundle design is borrowed from a commercial water column radiance instrument manufactured by Biospherical Instruments of San Diego California (ref, Morrow and Hooker)) and developed using NASA funds under the Small Business Innovative Research (SBIR) program.

The 3STAR design also incorporates the latest in robotic motor technology embodied in Rotary actuators from Oriental motor Corp. having better than 15 arc seconds of positioning accuracy. Control system was designed, tested and simulated using a Hybrid-Dynamical modeling methodology. The design also replaces the classic quadrant detector tracking sensor with a wide dynamic range camera that provides a high precision solar position tracking signal as well as an image of the sky in the 45° field of view around the solar axis, which can be of great assistance in flagging data for cloud effects or other factors that might impact data quality.