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Data Compression in Astronomy

Janet C. Rountree

Science Applications International Corporation, 101 N. Wilmot Rd., Tucson, AZ, 85711

Abstract. The purpose of this BoF session was to bring the participants up to speed on the latest compression techniques that are being used or proposed for use in various astronomical applications. Downlink from spacecraft, transmission between ground-based servers and users, and archiving were all included. The format consisted of a number of short presentations, followed by questions and discussion.

Presentations

William Pence (NASA/GSFC) gave a brief presentation about the tiled image compression scheme that is supported by CFITSIO and IRAF and is currently used by the providers of several large astronomical data sets. Under this scheme the FITS image is divided into a rectangular grid of tiles, then each tile is compressed separately and stored as a variable-length array in a row of a FITS binary table. A choice of several different compression algorithms is available. Details of this compression scheme, which was developed by R. White, P. Greenfield, W. Pence, and D. Tody, are presented in the previous ADASS VIII (page 125) and ADASS IX (page 551) conference proceedings.

Michele Maris (INAF/Trieste) described the compression method used with the Low Frequency Instrument on board the ESA Planck mission, which aims to measure cosmological parameters by extracting them from the spatial power spectrum of Cosmic Microwave Background (CMB) fluctuations. The data flow generated on board is up to four times greater than the downlink bandwidth. Adaptive arithmetic compression followed by requantization was selected as the compression method (Maris et al. 2000, A&AS 147, 51). Although this distorts the power spectrum of the CMB fluctuations, it has been shown that, due to the large noise RMS and the repetitive nature of the observations, this small distortion can be predicted and removed.

Janet Rountree (SAIC) gave an overview of the JPEG 2000 standard for digital image compression. A "scan-based mode" of this algorithm has been implemented for use on board spacecraft. It buffers only a few image lines at a time before releasing the compressed data to the downlink. Once the data have been archived, they can be reordered for transmission to the user, without decompressing the file. The user can receive a thumbnail sketch, a low-quality version, a single wavelength, or a spatial subset of the image before deciding if he requires the entire file.