Efficient Transfer of Images over Networks

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Effective remote observing requires sending large images over long distances. The usual approach to the transfer problem is to require high bandwidth transmission links, which are expensive to install and operate. An alternative approach is to use existing low-bandwidth connections, such as phone lines or the Internet, in a highly efficient manner by compressing the images. The combined use of existing low-cost infrastructure and standard networking software means that remote observing can be made practical even for small observatories with limited network resources.

We have implemented such a scheme based on the H-transform compression method developed by White (1992) for astronomical images, which are often resistant to compression because they are noisy. The H-transform can be used for either lossy or lossless compression, and compression factors of at least 10 can be achieved with no noticeable losses in the astrometric or photometric properties of the compressed images. The H-transform allows us to organize the information in an image so that the "useful" information can be sent first, followed by the noise, which makes up the bulk of the transmission. The receiver can invert a partially received set of H-coefficients, creating an image that improves with time. The H-transform is particularly well-suited to this style of incremental reconstruction, because the spatially localized nature of the basis functions of the H-transform prevents the appearance of artifacts such as ringing around point sources and edges.

Our implementation uses the WIYN Telescope Control System's TCP-based communications protocol. We sent an 800x800 16-bit astronomical image over a 2400 baud connection, which would normally take about 71 minutes; after only 60 *seconds*, the partially received H-transform produced an image that did not differ appreciably from the original. This poster will present a quantification of the efficiencies, as well as examples of images reconstructed from partial data.