In future solar missions such as Solar Orbiter, telemetry limitations when confronted with scientific requirements impose to use efficient and high-quality data compression methods. In particular, the EUI instrument onboard Solar Orbiter consists of high resolution imagers (HRI) and one full Sun imager (FSI) that will monitor the chromosphere and low corona counterparts of large-scale solar eruptive events such as coronal mass ejections (CMEs) and will provide a crucial understanding of fine scale processes in the solar atmosphere.

The quality of the image compression system is a key element in the scientific success of any mission. In this poster, we present the constraint on the compression algorithm given by the Solar Orbiter mission. We then present the JlPEG2000 algorithm to be optimized. Finally, we focus on the definition of a compression quality.

Such study is essential to optimize a JPEG2000-like algorithm and its parameters. One important objective is to define a quality measure sensitive to the degradation of directional objects such as coronal loops.

**Quality Metrics of Compression**

In order to measure the level of quality of compression of an image, the most used metric is the mean squared error (MSE) which measures the intensity difference of compressed and original image. A derivative of the MSE is the peak signal-to-noise ratio (PSNR).

The classical approach is to adapt the MSE measure to specific applications is to use visual estimation of the quality by human observers: the error is then penalized depending on subjective quality. Here we propose to use a measure of structural similarity (SSIM) that compares local patterns of pixel intensities that have been normalized for intensity and contrast as proposed by Wang et al [1-3]. The SSIM quality metrics defines the level of distortion as a combination of the mean intensity distortion, the loss of correlation, and the contrast distortion. The component e measures the correlation coefficient between compressed and uncompresed data, and is equal to 1 (best value) if they are linearly related. The other relative distortion effects are measured by the comparison between mean intensity (µ), which is equal to 1 if the local means are equal, while the quantity measures the similarity between the local contrasts. We here give the mathematical definitions of the SSIM quality metrics.

\[ SSIM(x,y) = \frac{(2\mu_x\mu_y + C_1)(2\sigma_{xy} + C_2)}{\mu_x^2 + \mu_y^2 + C_1} \]

\[ Q = \frac{1}{2} \mu_x + \frac{1}{2} \mu_y - \frac{1}{2} \mu_c \]

\[ r = \frac{2\sigma_{xy}}{\sigma_x^2 + \sigma_y^2} \]

\[ s = \frac{2\sigma_c}{\sigma_c^2} \]

\[ m = \frac{\mu_c}{\mu_c} \]

\[ g = \frac{\sigma_c^2 + \sigma_c^2}{\sigma_c^2 + \sigma_c^2} \]

Results on TRACE 17.1 nm and VAULT Lyman-α images

Loop distortion measures

A coronal loop is fitted using B-spline. The profiles of the loop of the compressed and uncompressed images are compared in a graph representing the intensity of the pixels in the loop neighborhood, as a function of the normal distance of the pixel to the fitted spines and the arc length along the spine; their discrepancy between both the compressed and uncompressed loop is estimated using evaluated normalized values. This could be used as a possible definition of the g component of the SSIM.

Conclusions

- Combined with reccoding, JPEG2000 seems to offer promising results of high-quality compression.
- The quality metrics will be used to optimize the JPEG2000-like algorithm that will be tested during the EOCS project.
- In JPEG2000, the rate control is the process by which the code-stream is coded so that a target bit rate can be reached. The rate-control module performs the coding precision of each small group of pixels (the code-blocks). The strategy of truncation of the code blocks is to minimize the distortion while reaching the target bit-rate: for that, it is possible to define a quality metrics more efficient than the MSE.
- The SSIM seems to be a reliable quality metric in order to assess the efficiency of the compression algorithm. We will adapt it to the particularities of the EUI images of the solar atmosphere, e.g. by taking into account the distortion of directional objects. We hope it would help us to test JPEG2000 to EUI images of the solar atmosphere.

References

