METIS compression algorithms

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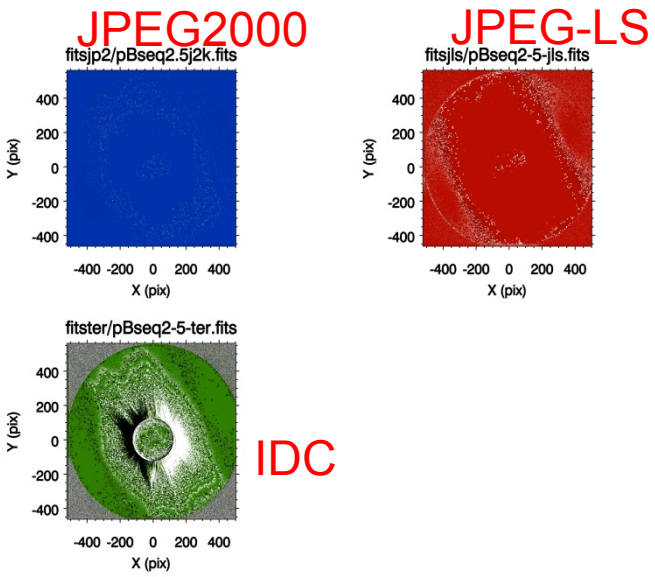
Preliminary work

- Main requirements
  - Low complexity
  - Ability to perform lossless + lossy compression (up to 10x compression including binning)
  - In lossy mode, ability to vary the maximum error over different regions (lossless and lossy at the same time)
- Preliminary work
  - Transforms vs. prediction
  - Use of an existing standard
    - CCSDS 122 "Image data compression"
    - CCSDS 123 "Lossless Multispectral and Hyperspectral image compression"



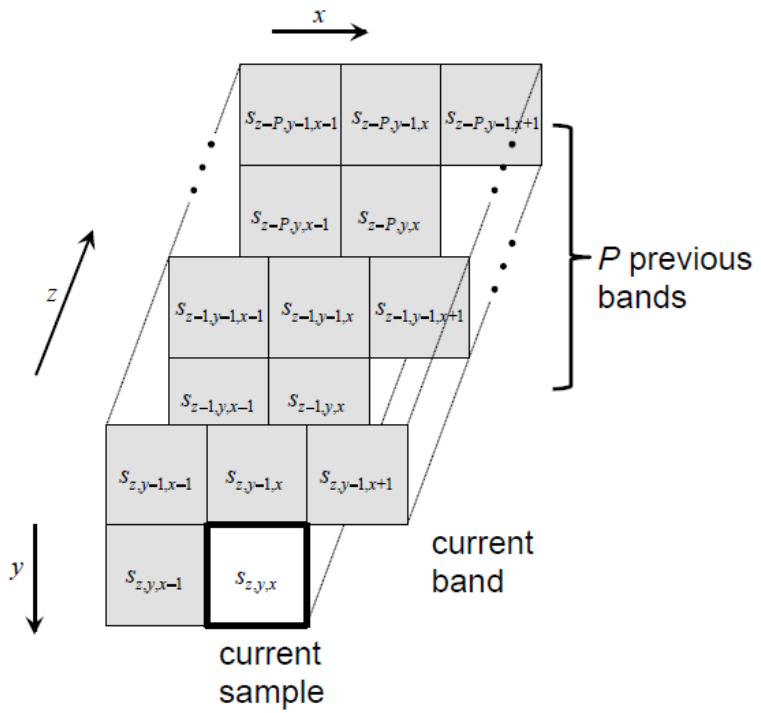
Algorithm design

- Predictive compression:

$$e[n] = x[n] - x_P[n]$$

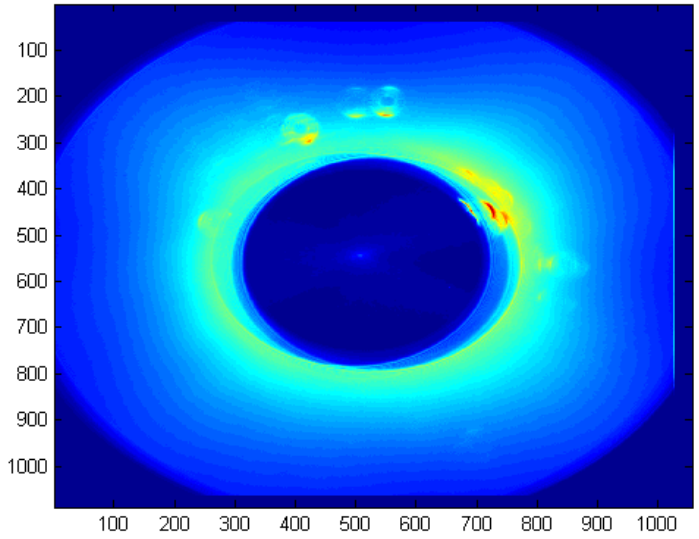
$$x[n] = e[n] + x_P[n]$$

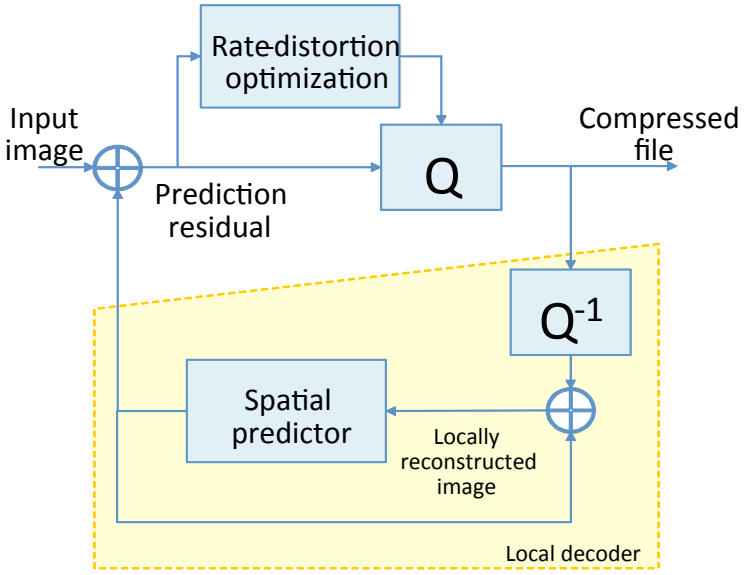
CCSDS 123 multispectral image compression



Algorithm concept

- Design based on CCSDS 123, with extensions
  - Added a quantization stage to achieve lossy compression
  - Multispectral → multitemporal
  - Binning + quantization: how to perform optimally?



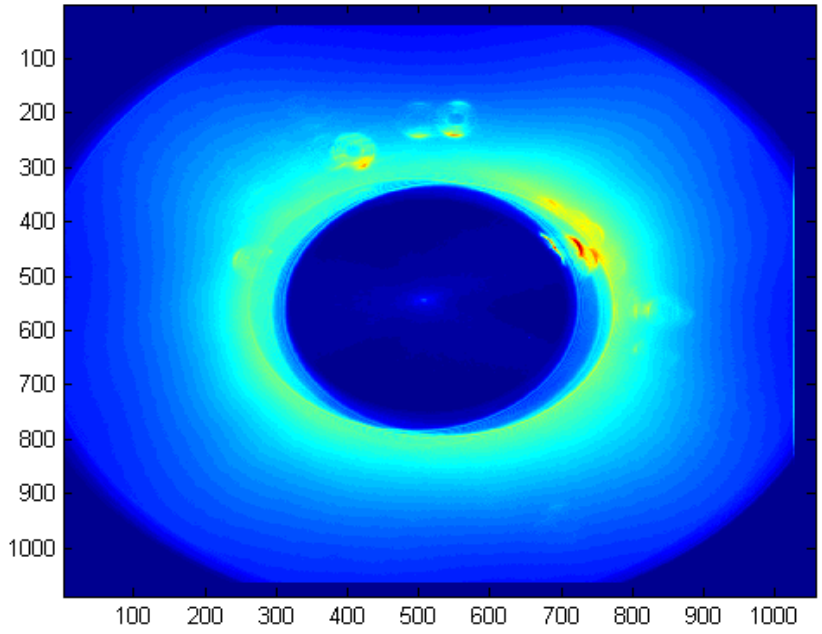


Test images

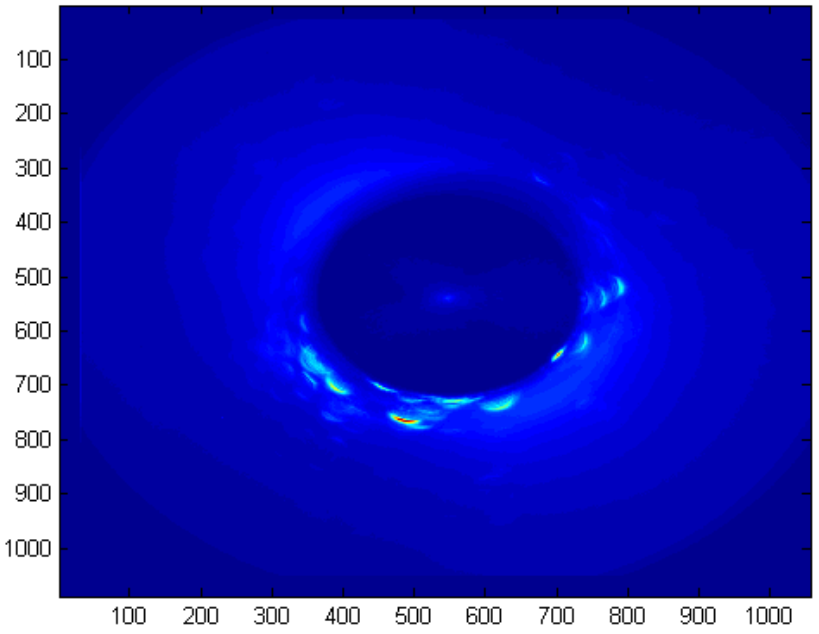
- STEREO-COR1 (Solar TErrestrial RElations Observatory), is a solar observation mission launched in 2006.
  - Two nearly identical spacecrafts (A and B) enable stereoscopic imaging of the Sun and solar phenomena. RAW images available (visible).
  - STEREO-A : 9 sequences of 3 images with polarization angles 0°, 120°,240°.
  - STEREO-B: 6 sequences of 3 images with polarization angles 0°, 120°,240°.

Test images

Stereo A @ 0°

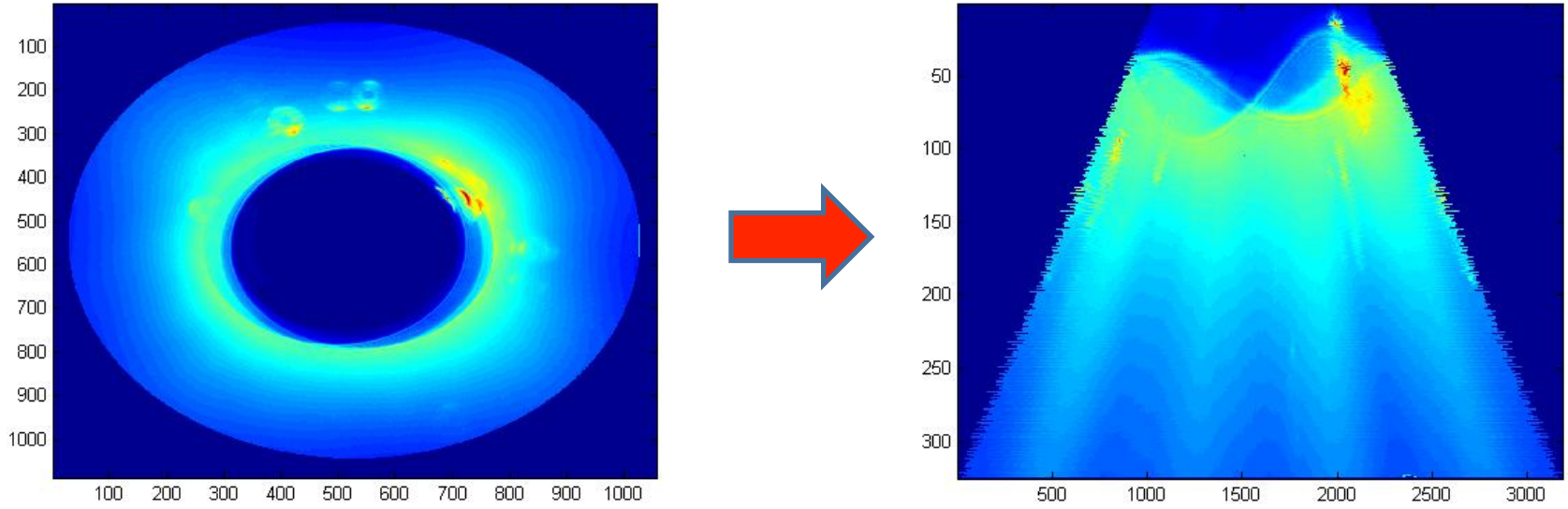


Stereo B @ 0°



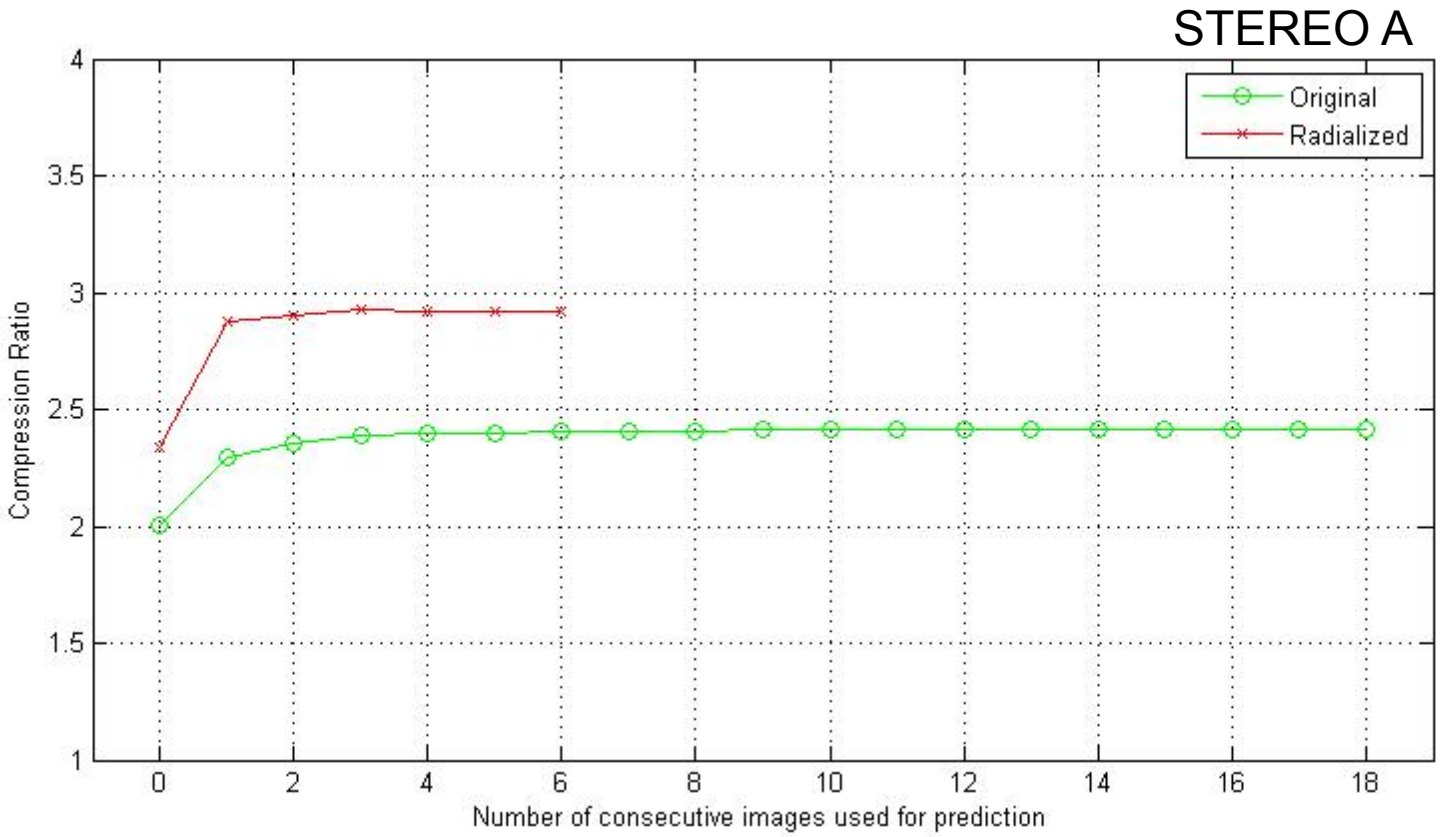
Radialization

- We propose to "radialize" the images, in order to make them amenable to "radial" quality allocation and "radial" binning
  - Simple precomputed permutation



Compression results

- Lossless, no binning



Compression results

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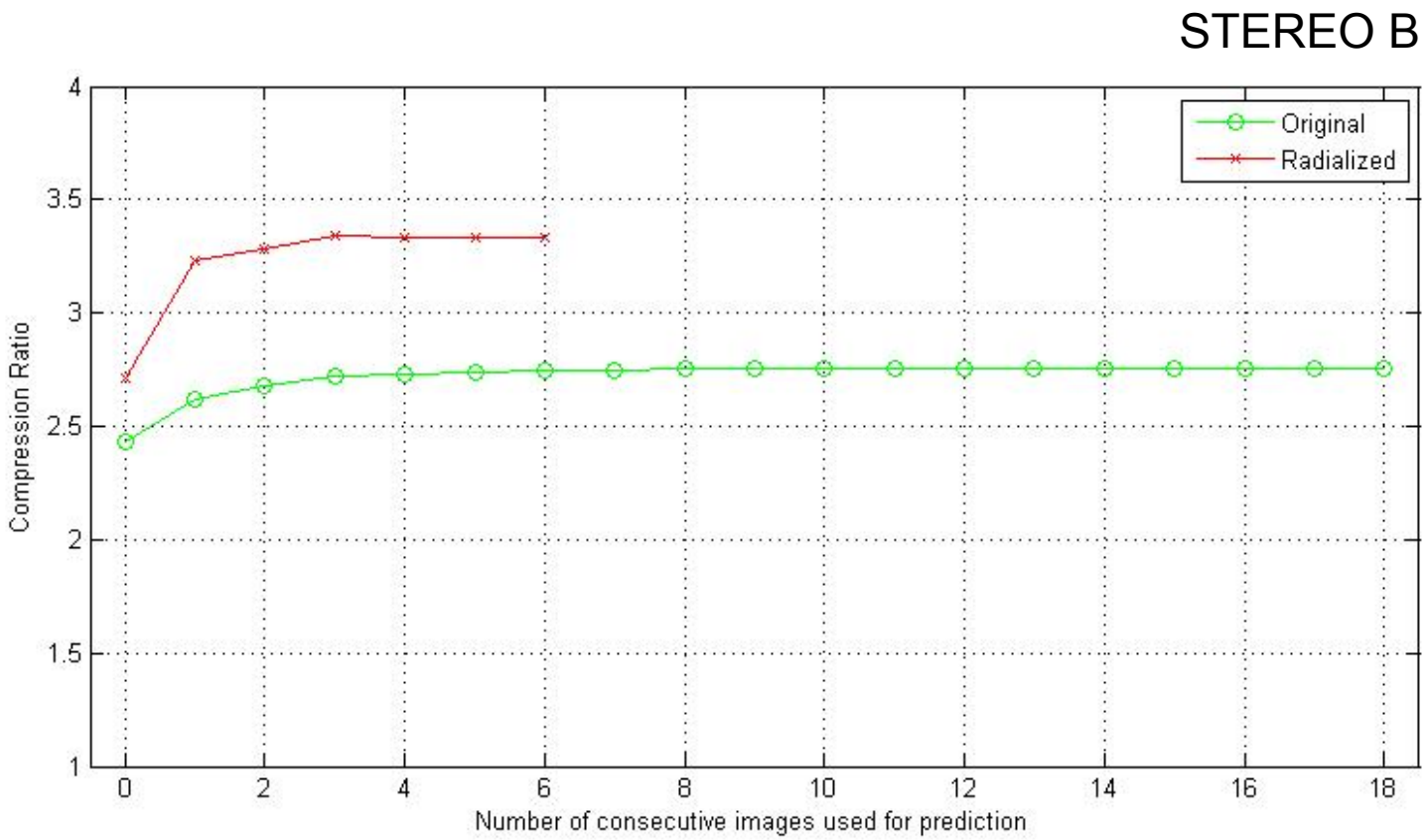

Conclusions

- Lossless compression (without binning) of a single radialized image can achieve CR about 2.5x
- Multitemporal compression using 2-3 previous images will increase CR to 3x
- 2x2 binning (sum of pixels) will likely increase CR to 12x
- Lossy compression can be used to increase CR even more, or to avoid binning

Open issues

- Open issues:
  - Handling of lateral regions of radialized image
  - Issues with STEREO data (even-valued pixels)
  - Complexity (depending on software vs. hardware architecture)