Information Loss in Diffraction-Limited Data Compression

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Introduction

- Microscopy has recently undergone a super-resolution revolution
- Most institutions are moving towards open data policies
- For TB-scale data sets, these requirements become cost-prohibitive;
- Practical archival of data files necessitates their compression
- Compression of diffraction-limited data may have consequences for analysis

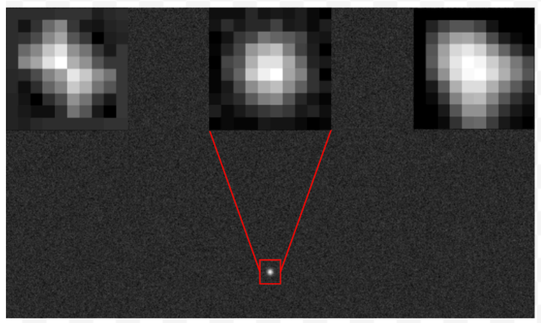

Figure 1: Uncompressed image (center). Compressed with H264 (left) and HEVC (right).

Methods

- Synthetic images of a small intensity peak were generated and compressed using 3 codecs: AV1, H264, and HEVC
- The fidelity of the compression was measured by comparing the peak centroid locations
- Successful compression occurred when the 95% CI of 1000 images captured the true center of the peak

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Data Collection

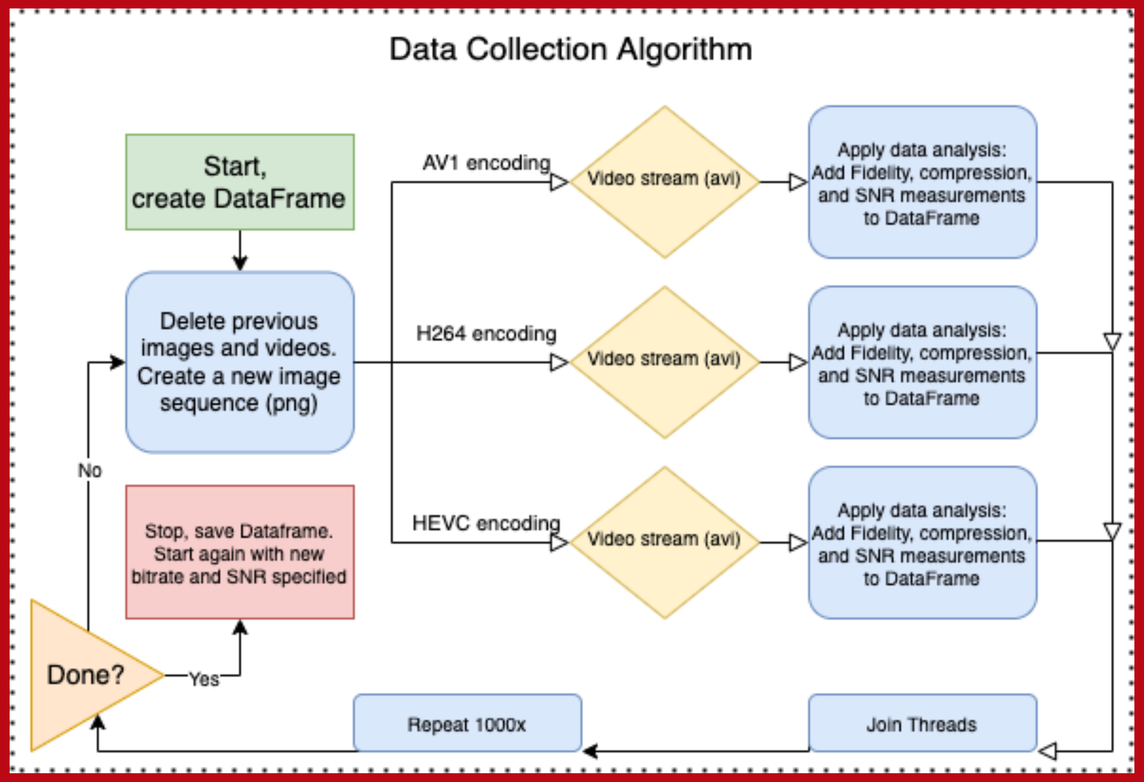

Figure 2: Algorithm flowchart. Process was implemented with ffmpeg-python libraries

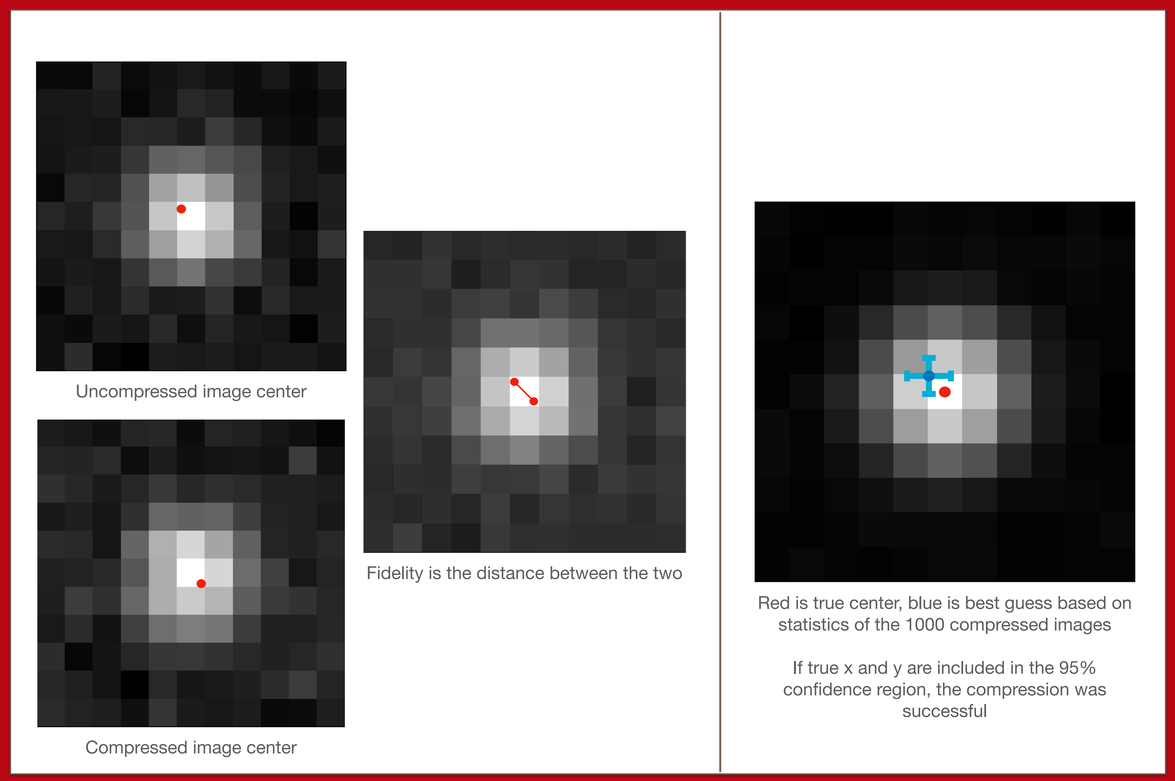

Figure 3: Illustration of measurement techniques for fidelity (left) and success (right)

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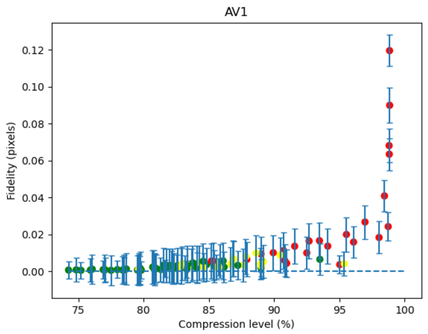
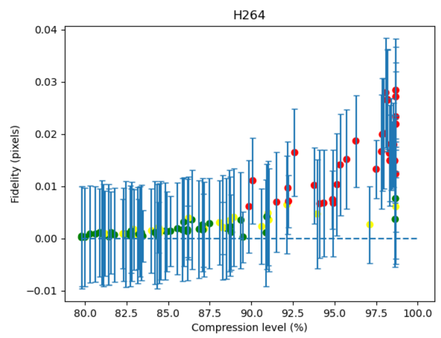
Results

- Below 80% compression, strong fidelity and success in all the tested codecs
- Fidelity diverges as compression approaches 100% (i.e. deletion of data)





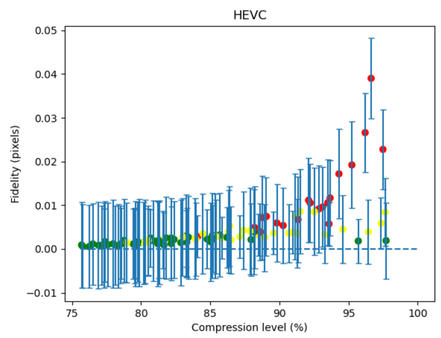


Figure 4: Fidelity vs. Compression level for the three tested codecs. Each data point is the average of 1000 images. Color indicates level of success

Conclusions

1. 80% compression is potentially feasible for single images
2. Pixel-locking effects may prove challenging to overcome in time-dependent measurements

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