

## 3D scanners: depth maps

Lossless, Phidelity: on par with JPEG XL at maximum effort ( $\sim 2\%$ ) while encoding 18 times faster; 2.5 times smaller than FFV1, 5 times smaller than the published PNGs.

### Data

TUM RGB-D (Technical University of Munich, CC BY 4.0), sequences fr3\_cabinet and fr3\_teddy (full turns around objects), structured-light Kinect, 640 × 480 depth in 16 bits; 2 × 300 consecutive frames, 369 MB raw.

### On PC — one core

| Format                              | Ratio        | Bits per pixel | Encoding (M px/s) | Decoding (M px/s) |
|-------------------------------------|--------------|----------------|-------------------|-------------------|
| <b>Phidelity compact</b>            | <b>24.92</b> | <b>0.64</b>    | <b>14.1</b>       | <b>15.2</b>       |
| JPEG XL e9                          | 24.43        | 0.66           | 0.8               | 21.1              |
| JPEG XL e7                          | 23.16        | 0.69           | 5.4               | 21.6              |
| <b>Phidelity light (format 1.5)</b> | <b>14.71</b> | <b>1.09</b>    | <b>72.8</b>       | <b>85.7</b>       |
| FFV1 (level 3, 4 slices)            | 10.06        | 1.59           | 103.3             | 79.9              |
| PNG 16 bits (Pillow, default)       | 8.31         | 1.93           | 7.1               | 173.0             |
| PNG as published (TUM)              | 4.73         | 3.39           | —                 | —                 |
| JPEG-LS                             | 4.69         | 3.41           | 97.7              | 103.6             |
| RVL (Microsoft, 2017)               | 3.40         | 4.70           | 372.2             | 412.8             |

#### Good to know

- Format 1.5: the light mode goes from  $\times 4.07$  to  $\times 14.71$  on these data, above FFV1 ( $\times 10.06$ ), at 73 M px/s.
- Format 1.6: with bounded error  $\pm k$ , “no measurement” pixels (0) stay exact with Phidelity, at no size cost; JPEG-LS NEAR alters millions of them on this set.

### Conditions

- PC: AMD Ryzen 7 8700F, a single core; every file decoded and compared with the original (zero error lossless, at most  $k$  in  $\pm k$ ).
- $\pm k$ : guaranteed maximum error of  $k$  on every sample. Phidelity and JPEG-LS (NEAR) hold it natively; for JPEG XL and the reference format, the image is first rounded to a  $2k + 1$  step, then coded losslessly.
- Codecs: libjxl 0.12 (efforts 3, 7 and 9), CharLS (JPEG-LS), OpenJPEG (JPEG 2000), FFV1 through ffmpeg, LERC, CCSDS 123.0-B-2 (encoder written for the benchmark, byte-identical to the NTNU verification model).
- Memory: peak private memory during the call only, measured on the largest item of the set.
- Embedded: instruction counts in emulation (QEMU), not board timings; cropped samples, sizes comparable with each other only. Compact and light through the 1.7 kit, fast through its core; in both cases with a caller-provided output buffer. Byte-identical streams on PC and ARM. Code on Cortex-M7: fast 73 KB, compact 92 KB, CharLS 205 KB, CCSDS 123 6 KB.