

Compression of Time Evolutionary Image Data through Predictive Deep Neural Networks

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Background:

- The next-generation detector (CITIUS) in the SPring-8 Center (RSC) generate about 100~400 PB
- To analyze and/or train an AI model with the data, data transfer from the sensors to a large-scale computer is necessary
- However, the transfer of large data becomes a performance bottleneck for this data pipeline

Approach:

- We have been developing and enhancing an AI-based data compression tool (TEZip)
- The AI model predicts or reconstruct target images and TEZip only store the delta values (**Fig.1**)
 - E.g.) PredNet: 1st image frame → [predict] → 2nd, 3rd, ... Nth image frame
 - B: Original image frames, P: Predicted image frames, D: Difference between B and P, C: Compressed image frames by a series of encoding
- Pre-processing (by AI Training): Train a NN to learn the pattern of the movement of the specimen (**Fig.1**)
- Data (De)compression (by AI Inference): Predict future images, compute delta and apply encoding/compressor (**Fig.1**)

Results (Fig.8, 10):

- TEZip gives higher compression ratio than major compression tools (e.g., X.265, SZ)
- Lossless mode: 9 to 15 / Lossy mode (w/ a few % of errors): 40 to 50

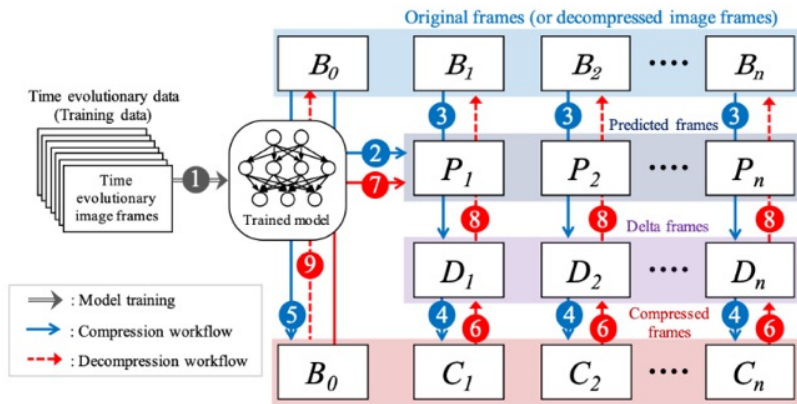


Fig 1. Workflows of TEZIP (de)compression

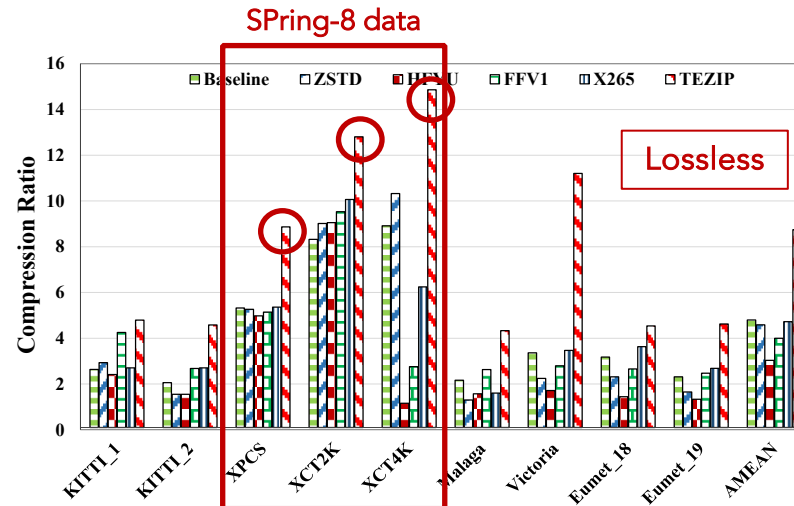


Fig. 8. Compression ratio with lossless compressors.

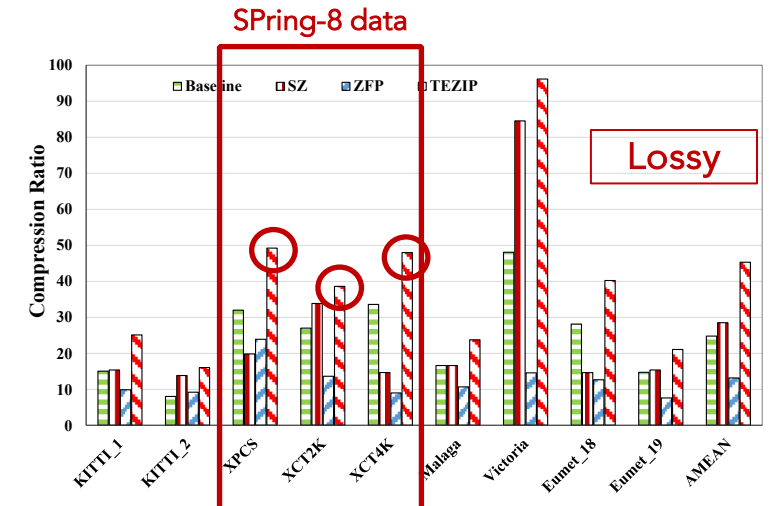


Fig. 10. Compression ratio with different lossy compressors