Freeing Space for NASA:
Incorporating a Lossless Compression Algorithm into NASA's FOSS System

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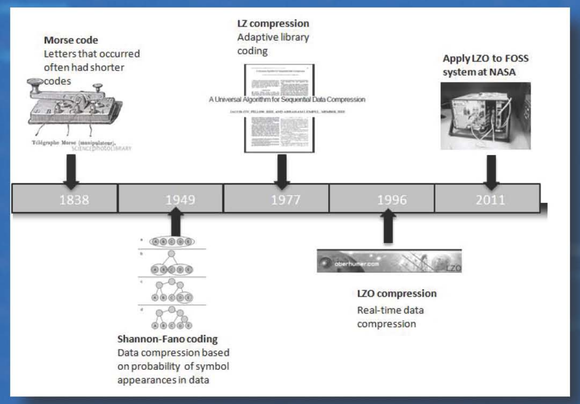
Background



Purpose

NASA's Fiber Optic Strain Sensing (FOSS) system, created to obtain a better view of strain on an object by possessing more sensors, can gather and store up to 1,536,000 bytes per second (1.46 megabytes per second). Since the FOSS system typically acquires hours – or even days – of data, the system can gather up to hundreds of gigabytes of data for a given test event. To free up memory space without compromising any data, NASA is modifying a Lempel-Ziv-Oberhumer (LZO) lossless data compression algorithm to compress data as it is being acquired.

Hypothesis

Data from the FOSS system consumes too much memory space and can be reduced using a Lempel-Ziv-Oberhumer lossless compression algorithm. Through implementation, data can be compressed to 60% of its original size at a rate of, at least, 4000 kilobytes per second.

References

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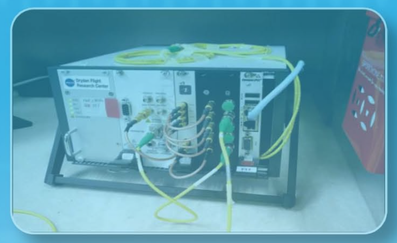
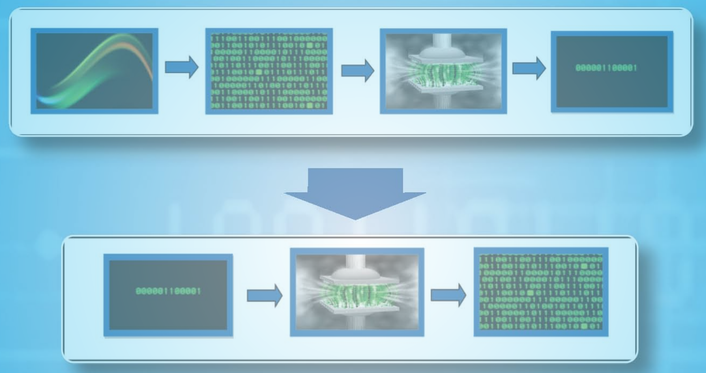
Lempel, A, Ziv, J.(1977). A Universal Algorithm for Sequential Data Compression. IEEE TRANSACTIONS ON INFORMATION THEORY, T-23,(3), 337-343.

Lim, H. (Feburary). Interactive Data Compression Tutor. Retrieved from http://www.eee.bham.ac.uk/WoolleySI/All7/ziv_1.htm

Methods and Materials





	Algorithm	Compression Rate (Kilobytes/second)	Decompression Rate (Kilobytes/second)	Amount Compressed (%)
Trial #1	LZO1x-1(15)	4999.81	15600.98	50.2
Trial #2	LZO1x-1(15)	4985.92	15730.84	49.2
Trial #3	LZO1x-1(15)	5006.49	15748.27	49.8
Trial #1	LZO1Y-1	4907.28	15684.29	50.1
Trial #2	LZO1Y-1	4963.18	15068.23	49.9
Trial #3	LZO1Y-1	4952.53	15112.03	50.1

```
/*
    Sample Program within which to incorporate the lossless data algorithm
Written in C programming language */

#include <lzo1x.h>
#include <portab.h>
#include <lzoconf.h>
#include <stdio.h>
#include <stdlib.h>

int main()
```

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Results

Results from oberhumer.com

Lossless Data Compression Test Using the Lempel-Ziv-Oberhumer Algorithm			
Algorithm	**Compression Rate (kilobytes/second)**	**Decompression Rate (kilobytes/second)**	**Amount Compressed (%)**
LZO1X-1(11)	4544.42	15879.04	47.4
LZO1X-1(12)	4411.15	15721.59	49.4
LZO1X-1	4991.76	15584.89	50.6
LZO1X-1(15)	5077.5	15744.56	50.9
LZO1Y-1	4952.52	15638.82	50.2
LZO1A-1	4937.83	14410.35	49.3
LZO1B-1	4565.53	15438.34	50.4
LZO1C-1	4883.08	15570.91	49.6
LZO1F-1	4755.97	16074.12	49.2

Conclusion

Based on previous studies of various versions of LZO data compression algorithms, expected results are that the data from the FOSS system will compress to at least 60% of its original size at a rate of 4,000 kilobytes per second.

Due to the extra data storage capacity created by the compression algorithm, the FOSS system can be in use for longer periods of time, making it more appealing for many structures, like long-flight aircraft, wind turbines, bridges, medical instruments used in lengthy testing.