

Computer Speed and Dilational Stress Analysis

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Calculation time becomes an issue with dilational stress analysis because of the large number of images involved. This note presents actual measured times on two machines and projects what is possible on a better, yet affordable, computer. Times were measured on the movie of diluted milk used in “*Milk as an Example of Dynamic Interfacial Tension and Dilational Stress Measurements*” which is available in pdf format on the FTA website. This movie has 1000 full-format images and has 310,512K bytes, or roughly 310 meg. The computational time for longer or shorter movies will be proportional to the number of images in them.

Timing Benchmarks

Some operations are limited by disk speed, some by the capacity (size) of the RAM, and some by CPU speed. The following benchmarks illustrate these differences.

File | Open Movie: This loads the entire movie. When you have a RAM larger, say by a factor of $\times 2$, than the movie, then this is simply a test of disk speed. However, when the RAM is too small to hold the entire movie, some portion of it must be written back to the Windows swap file, so the test becomes an issue of how much must be written back. This can be seen clearly in the data table below.

File | Close Movie: Closing the movie involves recompressing it and is a test of both the CPU speed, which handles the compression, and the disk.

Clear All: Clearing the movie involves reading every image record and removing any data or graphics. The time required is strongly affected by whether the movie is already in RAM or has to be read from disk.

IF Tension Analysis, full Laplace-Young integration: This is CPU intensive, and the CPU time normally swamps any disk access time. Analyze all 1000 images in test movie for IFT.

IF Tension Analysis, quick mode: This is also CPU intensive, but being faster is increasingly affected by any disk accesses. The IFT analysis uses a polynomial fit to the profile rather than integrating the equation pixel by pixel. The surface area calculation is identical to that in the full integration mode.

Dilational Stress Analysis: This is quicker than the Laplace-Young integration, so is affected both by CPU speed and disk access. The 1000 image movie was divided into 20 sub-intervals, as discussed in the paper.

Test Computers

The slow machine tested was a several year old Dell OptiPlex GX100 with 256M RAM, 800MHz CPU, and a 20G hard drive. The fast machine tested was a new Dell OptiPlex GX270 with 512M RAM, 2.4GHz CPU, and a 40G hard drive. The fast machine, without monitor, has a US Internet price of less than \$1,500. Performance for a faster machine, which has a similar Internet price of less than \$2,000, is projected based on the performance of the other two actual machines and the nature of the benchmarks. This machine would have a 3.2GHz CPU and 1G RAM. (Prices in other parts of the world vary with customs, taxes, local regulatory requirements, etc.)

Note that the size of the movie, 310M, means that it will not fit in the 256M RAM of the slow GX100. This clearly affects then disk-intensive operations because portions of the movie must be swapped. All tests were run with Build 171 of Fta32 Video.

Test Results

Benchmark	GX100 with 800MHZ CPU, 256M RAM	GX270 with 2.4GHz CPU, 512M RAM	Projected GX270 with 3.2GHZ CPU, 1G RAM
Open movie	65s	10s	7s
Close movie	130s	85s	60s
Clear movie	92s	17s	12s
Laplace-Young IFT	900s	316s	225s
Quick mode IFT	180s	62s	47s
Dilational Stress	66s	7s	5s
Est. L-Y Live Rate	1 image/s	3 images/s	4 images/s

Discussion

There are several methods to speed up analysis, without buying a faster machine:

1. Use half-size format, but keep full Laplace-Young integration. This is a low-cost way of speeding all operations by $\times 2$ to $\times 4$ because the images and files are four times smaller. The loss of precision is very slight. Many workers make this trade-off.
2. Analyze images Live while acquiring. This requires a sufficiently fast CPU, but avoids the time IFT analysis time after acquisition. The last row in the table is the estimated Laplace-Young analysis rate in Live mode assuming full size images.
3. Analyze images Live and use only the DataLog file. Use File | Import to make an imageless movie. This movie is small and loads and unloads quickly. The penalty is that you do not get to look at the images.

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