

EFFICIENT USE OF THE GRAPHICS CARD FOR MATHEMATICAL COMPUTATIONS *

Vítězslav Vít VLČEK

University of West Bohemia in Pilsen
Department of Mathematics
vsoft@kma.zcu.cz

1. Introduction

Recently the new graphics cards were introduced which have the high performance processor. This processor is called graphics processing unit (GPU) and it can process a lot of graphics data at a time. The performance of the GPU can be more than common CPU (central processor unit) in some cases. This is the reason why I try to use the graphics card for mathematical computation especially for vector or matrix addition.

2. Computation Experiments

I would like to show the test task where I would like to illustrate that the GPU computation is faster than the CPU computation in this section. I chose the test task $\mathbf{C} = \mathbf{A} + \mathbf{B}$ (the addition of two big matrices). I created the purely CPU program and the program for GPU. The resulting speed is shown in the following table.

N	GPU-time	CPU-time	Speedup
1	375/5625	62/2765	0.5
2	375/6843	140/2937	0.4
10	375/6953	718/3453	0.5
100	406/7671	7157/9875	1.3
1000	8187/15609	73406/76109	4.9 (8.2)*
10000	84531/92265	718515/7212186	7.8

Table: Comparison of the GPU-CPU computing

The size of the matrices was 1024×4096 . The column **N** means the number of repeated addition. The **GPU-time** and **CPU-time** contain two values. The first of them is the time of addition in milliseconds and the second value is the total running time of the program in milliseconds. The column **Speedup** is the speedup

*This work was supported by grant No. 1354/2004/G6 of the FRVS of the Czech Republic.

ratio=CPU total time/GPU total time. The value with * means speedup ratio of the matrix entry multiplication – if we replace + with * ($\mathbf{C} = \mathbf{A} * \mathbf{B}$ in the Matlab sense).

I used CPU Pentium 4 2.8GHz and Radeon 9800.

3. Conclusion

We can see in the comparison table that the GPU computing is not always efficient especially if we have a low count of the data operations or small data. But if we process a lot of data then we can expect certain speedup. The further problem is to limit significantly program complications and necessity of the graphics framework.

The reasons why to use the graphics card for mathematical computation are the price of graphics card which is significantly lower than the cost of an equivalent CPU, the further advantage is the extra memory on graphics card.

I would like to implement the matrix-matrix, matrix-vector multiplication as I expect some speedup here, too.

References

- [1] Microsoft: *The MSDN Library*. Microsoft, 2001.
- [2] Luna, F.: *Introduction to 3D Game Programming with DirectX 9.0*. Wordware Publishing, ISBN 1556229135, 2003.