Parallel Programming Exercise 10 – 4

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(If you and your team member contribute equally, you can use (co-first author), after each name.)

1 Problem and Proposed Approach

(Brief your problem, and give your idea or concept of how you design your program.)

The problem involves a cube with edge length s=2 from which a cylindrical hole of diameter d=0.3 is drilled. The cylinder's axis is aligned with the diagonal of the cube that passes through its opposite corners. The task is to write a program that calculates, with five digits of precision, the volume of the remaining portion of the cube after the cylindrical hole is removed.

To calculate the remaining volume of the cube after drilling the cylindrical hole, follow these steps:

(1) Initial Cube Volume: Vcube=2 ** 3

(2) Cylinder Geometry: The cylindrical hole is aligned along the space diagonal of the cube, x=y=z. And the diameter of the cylinder is d=0.3, which means its radius is r = d / 2 = 0.15.

(3) Effective Cylinder Volume: Calculate the space diagonal of the cube using the formula Diagonal =s * (3 ** 0.5), and the cylinder volume is given by Vcylinder =π* r ** 2 * Diagonal.

(4) Remaining Volume: Subtract the volume of the cylinder from the cube Vremaining = Vcube − Vcylinder.

2 Theoretical Analysis Model

(Try to give the time complexity of the algorithm, and analyze your program with iso-efficiency metrics)

Cube Volume Calculation is a single arithmetic operation: O(1).

Space Diagonal Calculation computeing the square root is an O(1) operation for scalar values.

Cylinder Volume Calculation computing π* r ** 2 * Diagonal involves two multiplications: O(1).

Matrix size: N×N×N

Block size per process: N×N×N / P .

⇨ T(N,1) = O(N^3)

- ⇨ T(N,P) = O(P * (N * N * log(P))
- ⇨ N^3 >= C * P * N * N *log(P)
- ⇨ iso-efficiency metrics**:** M(C * P * log(P)) / P = C^3 * P**2 * log^3 (P)

i.e Bad scalable algorithm.

3 Performance Benchmark

(Give your idea or concept of how you design your program.)

4 Conclusion and Discussion

(Discuss the following issues of your program

1. What is the speedup respect to the number of processors used?
2. How can you improve your program further more?
3. How does the communication and cache affect the performance of your program?
4. How does the Karp-Flatt metrics and Iso-efficiency metrics reveal?

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Appendix(optional):

(If something else you want to append in this file, like picture of life game)