IDCT: A PERFORMANCE COMPARISON ON OPENCL AND OPENMP

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DISCRETE COSINE TRANSFORM

- DCT/IDCT
  - Time Domain -> Frequency Domain
- Faster Approaches:
  - O(N^2) vs. O(N logN)
OPENCL

- Portable
- Standard Vector Processing
- Parallel Programming

```c
kernel void square(global float* input, global float* output) {
    int id = get_global_id(0);
    output[id] = input[id] * input[id];
}
```
OPENMP

- Portable
- User-friendly
- Shared-memory multiprocessor programming

```cpp
#include <iostream>
#include <omp.h>

using namespace std;

int main() {
    int id;

    #pragma omp parallel private(id)
    {
        id = omp_get_thread_num();
        #pragma omp critical
        cout << "Hello from thread " << id << "!" << endl;
    }
}
IMPLEMENTATION

- IDCT & IFCT:
  - Simple
  - OpenCL
  - OpenMP
TESTING

- Speed
- Accuracy

<table>
<thead>
<tr>
<th>CPU</th>
<th>GPU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor Name: Intel Core i5</td>
<td>Model: Intel Iris 5100</td>
</tr>
<tr>
<td>Core Speed: 2.6 GHz, up to 83.2 GFLOPS</td>
<td>Core Speed: 1.3GHz, up to 832 GFLOPS</td>
</tr>
<tr>
<td>Peak theoretical bandwidth: 25.6 GB/s</td>
<td>Peak theoretical bandwidth: 25.6 GB/s</td>
</tr>
<tr>
<td>Total Number of Cores: 4</td>
<td>Pipelines/Execution Units: 40</td>
</tr>
<tr>
<td>L2 Cache (per Core): 256 KB</td>
<td></td>
</tr>
<tr>
<td>L3 Cache: 3 MB</td>
<td></td>
</tr>
</tbody>
</table>
RESULTS

![Graphs showing results for different values of n]
## RESULTS

<table>
<thead>
<tr>
<th>Approach</th>
<th>Calculated Speed (GFLOPS)</th>
<th>Theoretical Limit (GFLOPS)</th>
<th>% of theoretical hardware limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple IDCT</td>
<td>1.95</td>
<td>83.2</td>
<td>2.3%</td>
</tr>
<tr>
<td>OpenMP</td>
<td>4.55</td>
<td>83.2</td>
<td>5.5%</td>
</tr>
<tr>
<td>OpenCL DCT</td>
<td>2.82</td>
<td>832</td>
<td>0.3%</td>
</tr>
<tr>
<td>Simple IFCT</td>
<td>6.83</td>
<td>83.2</td>
<td>8.2%</td>
</tr>
<tr>
<td>OpenMP IFCT</td>
<td>11.7</td>
<td>83.2</td>
<td>14.1%</td>
</tr>
<tr>
<td>OpenCL IFCT</td>
<td>20.48</td>
<td>832</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th></th>
<th>IDCT</th>
<th>IFCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>1.37789e-5</td>
<td>0.515388</td>
</tr>
<tr>
<td>OpenMP</td>
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<td>0.515388</td>
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<tr>
<td>OpenCL</td>
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FURTHER RESEARCH

Bottlenecks:
- Thread scheduling
- Memory access patterns
- Cache line performance