GPGPU Assignment #3

1 Acceleration Methods implemented

Both hierarchical method and SOR method are implemented.

1.1 Implementation

The cloning process is modified as

Algorithm 1 Accelerated Poisson Image Cloning

function PoissonImageCloning(background, target, mask)
  result = DownSample(result, $2^{\text{N\_HIER}-1}$)
  for $i = \text{N\_HIER} - 1 \to 0$ **do**
    subTarget = DownSample(target, 2^{-i})
    subMask = DownSample(mask, 2^{-i})
    result = DownSample(result, 2^{-i})
    fixed = CalculateFixed(subBackground, subTarget, subMask)
    for $j = 1 \to \text{N\_ITERS}$ **do**
      $w = \frac{1 \cdot j + W \cdot (N\_ITERS - j)}{N\_ITERS}$
      result = PoissonImageCloningIteration(fixed, subMask, result, w)
    end for
    result = UpSample(result, 2^i)
  end for
  return SimpleClone(background, result, mask)
end function

Here result from previous lower resolution is preserved as initial value of next iterations. Also, at each level of resolution, a w is calculated dynamically as the weight of SOR.

1.2 Analysis

1.2.1 SOR

As shown in figure 2, when $W = 2.10$, after 400 iterations, the result is kind of acceptable, thought the center place is still a little white and the edge blur a little bit. But if we increase $W = 2.12$, after 400 iterations, edge of the target blur severely. Therefore, SOR can only gives moderate acceleration for a proper W.

(a) 200 Iterations

(b) 20000 Iterations

Figure 1: Original Algorithm

(a) 400 Iterations for $W = 2.10$

(b) 400 Iterations for $W = 2.12$

Figure 2: SOR Acceleration

1.2.2 Hierarchical

(a) 40 Iterations for 5 Levels

(b) 80 Iterations for 5 Levels

Figure 3: Hierarchical Acceleration

As show in figure 3, after 5 levels of scale, namely accumulate results from 1/16, 1/8, 1/4, 1/2, 1 scales, 40 iterations for each level, totally 200 iterations, the result is even better than that of SOR acceleration. And if 80 iteration are done for each level, the result is as good as that from original algorithm. As far as number of iteration is concern, 5 times speedup is achieved.

1.2.3 Hierarchical and SOR

Figure 4: 60 Iterations for 5 Levels with $W = 1.12$

With 60 iterations for 5 levels with $W = 1.12$, it converges to acceptable result with totally 300 iterations., which is even faster than use hierarchical acceleration solely. However, it seems to blur more apparently than that of using hierarchical method only.