Supplementary Materials for Smoothed Local Histogram Filters

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1 Parameters

For all the examples in the paper, the spatial weighting function W is a two-dimensional isotropic Gaussian with standard deviation σ_W, and the histogram smoothing kernel K is a one-dimensional Gaussian with standard deviation σ_K. The following parameters were used in creating the figures.

Figure	Parameters
1(b)	$m = 15$
1(c)	$m = 15$
1(d)	$\sigma_K = .021$, $\sigma_W = 7.1$
4(b)	$\sigma_K = .042$, $\sigma_W = 7.1$
4(c)	$\sigma_K = .042$, $\sigma_W = 7.1$
6(b)	$\sigma_K = .014$, $\sigma_W = 2.8$, 5%/95% close/open
8(a)	$\sigma_K = .042$, $\sigma_W = 10.6$
9(b)	$\sigma_K = .042$, $\sigma_W = 10.6$
10(b)	$\sigma_K = .18$, $\sigma_W = 21.2$
11(b), 12	$\sigma_K = (.07, .007, .0035)$, $\sigma_W = 7.1$

2 Algorithms

What follows is pseudocode for all the algorithms in the paper. The pseudocode is presented in a simple form for exposition. For maximum memory efficiency, the loops of all the algorithms can be rearranged so that the outermost loop is over the index i and the inner loop is over the pixel indices p. This will make the memory footprint independent of m.

Algorithm 1 Percentile filter: $t = .5$ gives a median filter, smaller t values perform a dilation, and larger t values perform erosion.

```
Compute R_i(p)) for all p, i.
for i = 1 to m − 1 do
  target ← R_1(p) + t(R_m(p) − R_1(p))
  for i = 1 to b − 1 do
    if R_i(p) ≤ target and R_{i+1}(p) ≥ target then
      out(p) ← s_i + (s_{i+1} − s_i)(target − R_i(p))/(R_{i+1}(p) − R_i(p))
    end if
  end for
end for
```

Algorithm 2 Dominant mode filter.

```
Compute R_i(p), D_i(p) for all p, i.
for all p ∈ I do
  curPeak ← 0
  bestPeak ← 0
  bestIntegral ← 0
  leftIntegral ← R_1(p)
  for i = 1 to m − 1 do
    if D_i(p) ≤ 0 and D_{i+1}(p) > 0 then
      // Valley
      bucketDistance ← D_i(p)/(D_i(p) − D_{i+1}(p))
      rightIntegral ← R_i(p) + (R_{i+1}(p) − R_i(p)) · bucketDistance
      integral ← rightIntegral − leftIntegral
      if integral ≥ bestIntegral then
        bestIntegral ← integral
        bestPeak ← curPeak
      end if
      leftIntegral ← rightIntegral
    else if D_i(p) ≥ 0 and D_{i+1}(p) < 0 then
      // Peak
      bucketDistance ← D_i(p)/(D_i(p) − D_{i+1}(p))
      curPeak ← s_i + (s_{i+1} − s_i) · bucketDistance
    end if
  end for
  lastIntegral ← R_m(p) − leftIntegral
  if lastIntegral ≥ bestIntegral then
    if curPeak = 0 then
      // Histogram monotonically increases
      bestPeak ← s_m
    else
      // Only one peak
      bestPeak ← curPeak
    end if
  end if
  out(p) ← bestPeak
end for
```

Algorithm 3 Local mode filter

Compute $D_i(\mathbf{p})$ for all $\mathbf{p}, i$.
for all $\mathbf{p} \in I$ **do**
  $out(\mathbf{p}) \leftarrow 0$
  $dist \leftarrow \infty$
  for $i = 1$ to $m - 1$ **do**
    if $D_i(\mathbf{p}) \geq 0$ and $D_{i+1}(\mathbf{p}) < 0$ **then**
      // Peak
      $bucketDistance \leftarrow D_i(\mathbf{p})/(D_i(\mathbf{p}) - D_{i+1}(\mathbf{p}))$
      $curPeak \leftarrow s_i + (s_{i+1} - s_i) \cdot bucketDistance$
      $curDist \leftarrow |I(\mathbf{p}) - curPeak|$
      if $curDist < dist$ **then**
        $dist \leftarrow curDist$
        $out(\mathbf{p}) \leftarrow curPeak$
      end if
    end if
  end for
  if $D_1(\mathbf{p}) < 0$ and $I(\mathbf{p}) < dist$ **then**
    // Closer peak at leftmost bucket
    $dist \leftarrow I(\mathbf{p})$
    $out(\mathbf{p}) \leftarrow s_1$
  end if
  if $D_1(\mathbf{p}) > 0$ and $|I(\mathbf{p}) - s_m| < dist$ **then**
    // Closer peak at rightmost bucket
    $out(\mathbf{p}) \leftarrow s_m$
  end if
end for

Algorithm 4 Diffusion.

// We use $\alpha = \sqrt{2}$ and $\eta = .2$
$\sigma \leftarrow \sigma_{min}$
$D_0 \leftarrow S$ // S is the original base layer
$i \leftarrow 1$
while $\sigma \leq \sigma_{max}$ **do**
  $B_i \leftarrow D_{i-1} * G(\sigma)$
  $E_u \leftarrow (D_{i-1} - I)^2 * G(\eta\sigma)$
  $E_b \leftarrow (B_i - I)^2 * G(\eta\sigma)$
  $R \leftarrow E_u / E_b$
  for all $\mathbf{p} \in I$ **do**
    if $R(\mathbf{p}) < .5$ **then**
      $D_i(\mathbf{p}) \leftarrow B_i(\mathbf{p})$
    else if $R(\mathbf{p}) \in [.1, 1)$ **then**
      $D_i(\mathbf{p}) \leftarrow 2(R(\mathbf{p}) - \frac{1}{2})(D_{i-1}(\mathbf{p}) - B_i(\mathbf{p})) + B_i(\mathbf{p})$
    else
      $D_i(\mathbf{p}) \leftarrow D_{i-1}(\mathbf{p})$
    end if
  end for
  $i \leftarrow i + 1$
  $\sigma \leftarrow \alpha\sigma$
end while
$D \leftarrow D_{i-1}$
Output D // Selectively diffused base layer