Gaussian and Laplacian pyramids

Here is a demonstration of how to compute the well-known Burt-Adelson image pyramid [P. Burt and E. H. Adelson, “The Laplacian Pyramid as a Compact Image Code,” *IEEE Transactions on Communication* 31 (1983) 532-540]. Note that by using *Mathematica*’s powerful functional programming constructs, the Gaussian and Laplacian pyramids are computed with one-line programs.

```
img = ExampleData[{"TestImage", "Elaine"}]
```

This defines a commonly used generating kernel.

```
ker = Outer[Times, {0.05, 0.25, 0.4, 0.25, 0.05}, {0.05, 0.25, 0.4, 0.25, 0.05}, 1]
```

```
{{0.0025, 0.0125, 0.02, 0.0125, 0.0025},
 {0.0125, 0.0625, 0.1, 0.0625, 0.0125}, {0.02, 0.1, 0.16, 0.1, 0.02},
 {0.0125, 0.0625, 0.1, 0.0625, 0.0125}, {0.0025, 0.0125, 0.02, 0.0125, 0.0025}}
```

This constructs the Gaussian pyramid by repeatedly convolving an image with the generating kernel and decimating the result. A pure function is used to define the operation at each step of the iteration inside `NestList`.

```
Dimensions[ImageData[img]]
```

```
{512, 512}
```

```
gaussPyramid = NestList[GaussianFilter[#1, 5] &, img, 5]
```

```
laplacianPyramid = #[[1]] - #[[2]] & /@ Partition[gaussPyramid, 2, 1];
ImageAdjust /@ laplacianPyramid
```

As expected, the images have dimensions that decrease by a factor of four at each level of the pyramid.

```
ImageDimensions /@ gaussPyramid
ImageDimensions /@ laplacianPyramid
```

```
{{512, 512}, {512, 512}, {512, 512}, {512, 512}, {512, 512}, {512, 512}}
```

```
{{512, 512}, {512, 512}, {512, 512}, {512, 512}, {512, 512}}
```

This shows the images in a graphics array.

```
recImg = Fold[ImageAdd[#1, #2] &, Last[gaussPyramid], laplacianPyramid]
```

```
Quartiles@Flatten@ImageData[gaussPyramid[[1]] - recImg]
```

```
{0., 0., 0.}
```

Some transfer

```
vgImg =  ;
ImageDimensions[vgImg]
```

```
{210, 159}
```

```
vgImg = ImageResize[vgImg, ImageDimensions[img]];
vgImgGaussPyramid = NestList[GaussianFilter[#, 5] &, vgImg, 5];
vgImgLaplacianPyramid = #[[1]] - #[[2]] & /@ Partition[vgImgGaussPyramid, 2, 1];
ImageAdjust /@ vgImgLaplacianPyramid
```

Reconstruct with injection of pyramid level.

```
k = 0;
recImg = Fold[(k++;
    If[k == 2, ImageAdjust@Blend[{ImageAdd[#1, #2], vgImgGaussPyramid[[k]]}, 0.3],
     ImageAdd[#1, #2]]) &, Last[gaussPyramid], laplacianPyramid]
```

```
Times @@ ImageDimensions[vgImg]
```

```
262 144
```

```
feRes = FeatureExtract[{vgImg}, "PixelVector"];
```

```
Dimensions[feRes]
```

```
{1, 196 608}
```

```
FeatureExtract[{vgImg}, "IndicatorVector"]
```