A complete guide to using CSS filters with SVGs

June 22, 2022 · 14 min read

Filters are extremely popular in photography. You can find them on nearly every photo editing app or website, and some cameras have inbuilt filter options so you don't have to edit the photos later.

CSS has several filters that help improve the visual aspects of a website. You can apply them directly to a web element using the `filter` property, as well as to the area behind the element with the `backdrop-filter` property.

With these filters, you can blur an image, adjust contrast and saturation, change the hue, reduce opacity, and more!

In this post, we're specifically going to learn about a unique and powerful set of tools: SVG filters. But before we proceed, let's have a little introduction to SVGs.

What are SVGs?

SVGs, or Scalable Vector Graphics, are an XML-based vector image format for displaying two-dimensional graphics. XML is another fancy acronym that stands for Extensible Markup Language. XML is used to store and transmit data, and define your tags.

Back to SVGs. An SVG doubles as both an image and document format. Regular image formats like JPEG and PNG are made up of pixels that generally lose quality when they're zoomed in.

What makes SVGs different is that they maintain their quality no matter how much you zoom. This is possible because they're made up of mathematical formulas.

Let's have a look at what's under the hood of an SVG.

SVG image in a code editor. Here's a screenshot of what you

kes up a complex shape. We can control the color, size, and other
e image within the lines of code. Let's create a simpler shape, a

```
<body>
  <svg width="400" height="400">
    <circle cx="200" cy="200" r="100" fill="#553c9a">
  </svg>
</body>
```

And we have a purple circle!

We can turn this circle into a ring by adding a `stroke` value. A stroke is the border, and we can set the `fill` color to `transparent` .

```
<body>
  <svg width="400" height="400">
    <circle cx="200" cy="200" r="100" fill="transparent"
    stroke="#553c9a" stroke-width="20px">
  </svg>
</body>
```

The result is this:

Complex images can be created by combining different SVGs. SVGs are used for icons, logos, or as background images. They can also be animated!

Using CSS filters with SVGs

CSS filters are mostly limited to images and are fairly easy to use. SVG filters, on the other hand, can be applied to images (both SVGs and other formats), y other HTML element. CSS filters are actually a subset of SVG

rk with the `<filter>` element and a set of functions called filter ese functions are child elements that create effects.

element will be referenced by the CSS `filter` property through

Filter primitives

To get started, create an `svg` element with a `filter` element nested inside it. Then, add the primitives before the image (or whatever element you want the filter applied to).

There are 17 filter primitives, and they are:

1. `feGaussianBlur`
2. `feDropShadow`
3. `feMorphology`
4. `feTurbulence`
5. `feDisplacementMap`
6. `feColorMatrix`
7. `feConvolveMatrix`
8. `feComponentTransfer`
9. `feOffset`
10. `feMerge`
11. `feFlood`
12. `feComposite`
13. `feImage`
14. `feBlend`
15. `feDiffuseLighting`
16. `feSpecularLighting`
17. `feTile`

“fe” stands for filter effect. From the names, we can get an idea of what effects e. Let’s look at a basic SVG filter syntax:


```
d="">
r Primitives go in here-->
```

Each SVG primitive has its own unique set of attributes used to create the effects. Some of these filter primitives work fine on their own, but some have to be combined with other primitives.

There's a lot to cover, so let's get started.

feGaussianBlur

SVGs are based on mathematical formulas, so it's only right to get things going with a Gaussian blur filter. This filter is named after the late mathematician Carl Friedrich Gauss and applies a mathematical function to blur the image.

First, you'll need an image. Here's one from freepik.com:

Next, we'll create the SVG syntax in the HTML file:

```
<svg>
  <filter id="blur">
    <feGaussianBlur stdDeviation="5" in="SourceGraphic" result="BLUR">
</feGaussianBlur>
  </filter>
    <image
       xlink:href="2833.jpg" filter="url(#blur)"></image>
</svg>
```

Now, we'll have the SVG filter primitive, `feGaussianBlur`, within the `filter` e are some attributes inside the primitive that'll have an effect oduced.

ute is `stdDeviation`, which regulates the amount of blur.

r input, that defines where the filter will be applied. In this case, eGraphic, which is our image. The `SourceGraphic` can also be

The final attribute in this example is `result`. We use it to name the filter. This is useful as a reference for `in` when working with multiple filters.

Here's the resulting image with the filter applied:

As mentioned earlier, SVG filters can be applied externally using the `filter` property and a `url` pointing to an `id`:

```
<svg>
    <filter id="blur">
      <feGaussianBlur stdDeviation="5"></feGaussianBlur>
    </filter>
</svg>
```

Finally, apply it with the `filter` CSS property:

```
img{
  width: 1000px;
  height: auto;
  filter: url(#blur);
}
```

feDropShadow

This filter is pretty straightforward and adds a drop shadow behind an element.

syntax:

```
="blur">
hadow in="SourceGraphic" dx="10" dy="10"></feDropShadow>
```

The `dx` and `dy` attributes define the shadow's position along the x and y axis, respectively. The result is a really dark shadow behind the image:

feMorphology

Morphology is the study of form, shape, and structure. The `feMorphology` primitive is used to change, or morph, the form of elements.

It works with the `operator` attribute that accepts any one of two values, `dilate` or `erode`, and a `radius` that defines the amount of dilation or erosion. For `dilate`, the pixels of the `SourceGraphic` are spread outwards. `erode` does the opposite.

Let's compare both. First up is `dilate`:

```
<svg>
  <filter id="blur">
   <feMorphology in="SourceGraphic" operator="dilate" radius="5">
   </feMorphology>
  </filter>
</svg>
```

The result:

Now let's see `erode`:


```
="blur">
logy in="SourceGraphic" operator="erode" radius="5">
ology>
```

Where did all the stars go?🤔

From these results, we can see that `dilate` produces a more vibrant image compared to the darkened and subdued image from `erode`. The brightness is due to the image's pixels expanding and vice versa.

feTurbulence

The only real explanation this filter primitive's effect is right there in its name: turbulence. It uses two attributes: `baseFrequency` and `numOctaves`.

```
<feTurbulence in="SourceGRaphic" baseFrequency="0.01 0.02"
              numOctaves="1" result="NOISE">
</feTurbulence>
```

The result is a noise effect on the image:

Let's explain the attributes.

The `baseFrequency` controls the amount of distortion, or noise, in the x and y directions. A high `baseFrequency` value reduces the size of the distortion pattern. It can contain two values, and if one value is used, it covers both the x and y axis.

`numOctaves` is also a noise function and controls the number of octaves in the filter effect. Using a `baseFrequency` of `"0.01 0.02"`, we get the following:

s up to you to decide the number of octaves and amount of
y with the values and see what you come up with. Keep in mind
t accept negative values.

acementMap

A displacement map is an image used to change the content of another element. The texture of one element can be applied to another.

For this SVG filter primitive, we'll need two inputs: `in` and `in2`. One will hold the original graphic and the other will be the image serving as the displacement map.

```
<svg>
 <filter id="turbulence">
   <feTurbulence type="turbulence" baseFrequency="0.01 0.02"
numOctaves="1" result="NOISE"></feTurbulence>
   <feDisplacementMap in="SourceGraphic" in2="NOISE" scale="50">
   </feDisplacementMap>
 </filter>
</svg>
```

Now for the result. The image follows the distortion pattern created by the `feTurbulence` filter:

We can go a step further by adding some wavy animation to complete the watery look:

```
<svg>
  <filter id="wavy">
  <feTurbulence id="turbulence" type="turbulence" numOctaves="1"
  result="NOISE"></feTurbulence>
   <feDisplacementMap in="SourceGraphic" in2="NOISE" scale="50">
   </feDisplacementMap>
   <animate xlink:href="#turbulence" attributeName="baseFrequency"
   dur="60s" keyTimes="0;0.5;1"
   values="0.02 0.02;0.02 0.04;0.01 0.02" repeatCount="indefinite">
```


e first filter primitive now has an `id`. This is what we're

animating.

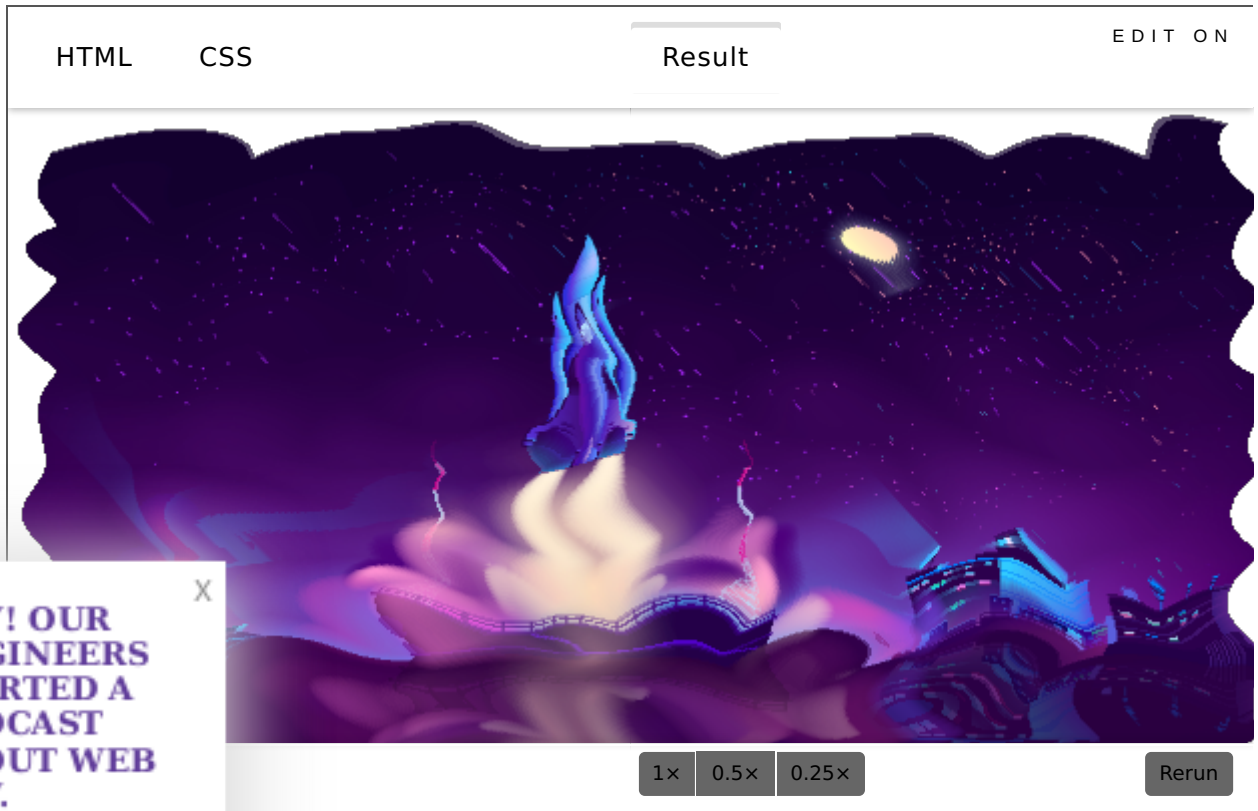
Next, we'll use the `<animate>` element to define the animation. This element will contain `xlink:href`, pointing to the filter that'll be animated. After that is `attributeName`, and the primitive attribute we're animating is the `baseFrequency`.

Next, we set the duration with `dur` and the `keyTimes`. These are essentially `@keyframes`.

`values` contain the new `baseFrequency` values for the stop points set up with `keyTimes`.

Finally, we have `repeatCount` set to `indefinite` so the effect runs in a loop.

And this is the result:



se the regular `animation` and `transition` CSS properties or
pt for animation.

feColorMatrix

This SVG filter is used to modify the hue and saturation of an element. It works with a `type` attribute and four possible values: `matrix`, `saturate`, `hueRotate`, and `luminaceToAlpha`.

For `matrix`, the filter effect is applied using an RGBA color matrix, or grid, for its `value`.

```
<svg>
<filter>
  <feColorMatrix in="SourceGraphic" type="matrix"
                  values="1 0 0 0 0
                          0 1 0 0 0
                          0 0 1 0 0
                          0 0 0 1 0">
</filter>
</svg>
```

The syntax above will not change the color of the image. Let's look at each color channel.

Play with the values and see what hues, shades, and tints you can come up with!

Next, we have `saturate`. This uses `values` between 0 and 1 to control the amount of black and white in the image.


```
="saturate">
orMatrix in="SourceGraphic" type="saturate" values="0.5"/>
>
```

Next up is `hueRotate`. This attribute rotates the colors of the image around the color wheel by a specific angle. Let's start by showing you the color wheel:

Now let's use the attribute:

```
<feColorMatrix in="SourceGraphic" type="hueRotate" values="60"/>
```

The browser detects every color in the image and rotates each one by 60 degrees along the color wheel. This will be the resulting image:

The final `type` is `luminaceToAlpha`. This basically turns the image into a translucent negative by removing the alpha channel.

The `matrix` can achieve the same effects as the others if given the right values for the grid.

feConvolveMatrix

From one matrix to the next! This filter primitive adds a convolution effect, or kernel, to an image. It's used for blurring, edge detection, sharpening, embossing, and beveling using a combination of pixels.

We can demonstrate a subtle glitch effect using some random values in the grid:

```
r id="convolve">
onvolveMatrix kernelMatrix
-4 1
0 -8
0 -4" />
>
```

The result:

Let's compare with the original to see the effects clearly:

`feComponentTransfer`

This primitive is similar to `feColorMatrix`, but, in place of a grid, each color channel (RGBA) is a separate function. And just like with the matrix, we can adjust the contrast of the image by manipulating the color intensity across those channels.

This is what it looks like:

And here's how it works using the values given in this example:

In the red channel, for instance, the color intensity ranges from 0 to 1. We've gone with four values, so 1 is divided by 4. Now we have four equal ranges of red: 0–0.25, 0.25–0.5, 0.5–0.75, and 0.75–1.

Any red value between 0–0.25 gets assigned the first value in the `tableValues` and so on. The same principle is used for as many as 10 values.

There are various functions that can be used with this filter primitive, and the first one we're going to look at is `discrete`. This reduces the amount of color in an image.

```
<svg>
      <filter id="discrete">
        <feComponentTransfer>
          <feFuncR type="discrete" tableValues="0 0.5 0 1"/>
          <feFuncG type="discrete" tableValues="0 0.5 0 1"/>
          <feFuncB type="discrete" tableValues="0 0.5 0 1"/>
          <feFuncA type="discrete" tableValues="0 0.5 0 1"/>
      </feComponentTransfer>
    </filter>
</svg>
```

The result:

The next `type` is `table`, which makes more subtle changes to the image's contrast. So, using the same `tableValues` as above...

```
<svg>
   <filter id="convolve">
      <feComponentTransfer>
          <feFuncR type="table" tableValues="0 0.5 0 1" />
          <feFuncG type="table" tableValues="0 0.5 0 1" />
          <feFuncB type="table" tableValues="0 0.5 0 1" />
          <feFuncA type="table" tableValues="0 0.5 0 1" />
      </feComponentTransfer>
   </filter>
</svg>
```

...we get this:

a duotone effect using this primitive. Duo means two, so we're
r values for each channel in `tableValues`.

olors, let's go with `#A91C93` and `#8EE3FF`. Now, we need the
ues — `#A91C93` is equivalent to `(169,28,147)` and `#8EE3FF` is
`(255,142,227)`.

Next, we need to divide the values in the red, green, and blue channels by 255 to get a value in the 0–1 range. This goes into `tableValues`.

```
<svg>
    <filter id="duotone">
       <feComponentTransfer>
          <feFuncR type="table" tableValues="0.662745098 1" />
          <feFuncG type="table" tableValues="0.109803922 0.556862745"
/>
          <feFuncB type="table" tableValues="0.576470588 0.890196078"
/>
       </feComponentTransfer>
    </filter>
</svg>
```

And we get this:

There's a third way to control the contrast of the image, and that's the `type`, `gamma`. This comes with three other attributes: `exponent`, `amplitude`, and `offset`.

Increasing the `exponent` makes darkened areas of the image even darker. It's the opposite with `amplitude`, brightening the already bright areas of the image.

`offset` adds a white tint to the image and its values are between 0 and 1.

```
<svg>
  <filter id="amplify">
    <feComponentTransfer>
       <feFuncR type="gamma" exponent="1.9" amplitude="1.9" offset="0"
/>
       <feFuncG type="gamma" exponent="1.9" amplitude="1.9" offset="0"
/>
       <feFuncB type="gamma" exponent="1.9" amplitude="1.9" offset="0"
/>
    </feComponentTransfer>
   </filter>
</svg>
```

Let's compare with the original image:

Try out other values to find more ways to spice up an element. There are so many possibilities at your finger tips with this SVG filter primitive!

feOffset

This primitive is quite simple. We're offsetting the image along the x and y directions, similar to what we did with the drop shadow.

```
<svg>
    <filter id="convolve">
      <feOffset in="SourceGraphic" dx="10" dy="10"></feOffset>
    </filter>
```


r lets us layer two or more elements. Each layer is a `feMergeNode` in `feMerge` primitive.

Now is the perfect time to introduce the `SourceAlpha`, a black copy of the `SourceGraphic`. So, using our image, the `SourceAlpha` is a black rectangle with the same dimensions as the image. We can use this to create a better drop shadow.

We'll start by offsetting the `SourceAlpha`:

```
<svg>
    <filter id="drop-shadow">
      <feOffset in="SourceAlpha" dx="10" dy="10"></feOffset>
    </filter>
</svg>
```

Next, we'll apply a blur and reduce the opacity using `feColorMatrix`:

```
<svg>
    <filter id="drop-shadow">
      <feOffset in="SourceAlpha" dx="10" dy="10"></feOffset>
      <feGaussianBlur stdDeviation="10" result="BLUR">
</feGaussianBlur>
      <feColorMatrix
          type="matrix"
          in="BLUR"
          result="DROPSHADOW"
          values="1 0 0 0 0
                  0 1 0 0 0
                  0 0 1 0 0
                  0 0 0 0.5 0"></feColorMatrix>
>
```


we have a blurry translucent rectangle:

er our image on top of this shadow using `feMerge`. The first will be the top layer and the others will follow in that order.

```
<feMerge>
    <feMergeNode in="FINALSHADOW"></feMergeNode>
    <feMergeNode in="SourceGraphic"></feMergeNode>
</feMerge>
```

Now, we have a better drop shadow by combining four SVG filters!

feFlood

With this filter primitive, we're simply flooding the filter area with color.

```
<svg>
      <filter id="convolve">
        <feflood flood-color="#00c2cb" flood-opacity="0.1" />
      </filter>
</svg>
```

The result:

feComposite

This filter combines an image with its background. We'll switch to text to demonstrate the effect of this filter primitive.

We're also going to work with two other SVG filters, `feFlood` and , to create some knockout text.

text:

SVG syntax:

```
<body>
  <svg>
    <filter id="knockout">
      <feMorphology operator="dilate" radius="2" in="sourceGraphic"
      result="DILATE" />
      <feFlood flood-color="#301934" flood-opacity="0.5"
result="FLOOD" />
        <feComposite operator="out" in="FLOOD" in2="DILATE" />
      </filter>
  </svg>
    <h1>HELLO! I'M A KNOCKOUT...</h1>
</body>
```

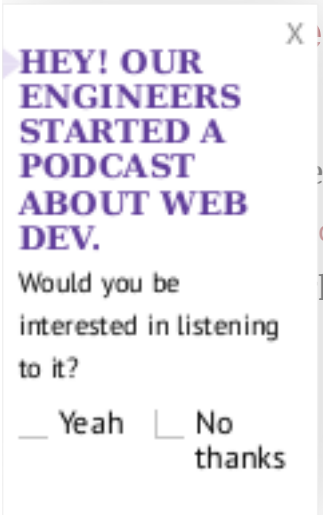
This is the result:

First, we used `feMorphology` with the `operator` as `dilate` to expand the text. Next, we flooded the text area with the color. And finally, we used `feComposite` to blend the text with the white background.

We used `out` as the value for the composite `operator`. Can you guess what happens when we use `in`?

Let's see:

It does the opposite! This time, the flood color stays within the letters of the text.



fills up the the filter area with an image. This is exactly what we `ood`. We're sticking with the text example, so let's see how this ks.

```
<feImage xlink:href="2833.jpg" x="0" y="0"
        width="100%" height="100%"
        preserveAspectRatio="none" result="IMAGE">
</feImage>
```

Right now, this is the result:

Now, we can use `feComposite` to add this image to the text.

```
<svg>
  <filter id="knockout">
    <feImage xlink:href="2833.jpg" x="0" y="0"
       width="100%" height="100%"
       preserveAspectRatio="none" result="IMAGE"></feImage>
    <feComposite operator="in" in="IMAGE" in2="SourceGraphic" />
  </filter>
</svg>
```

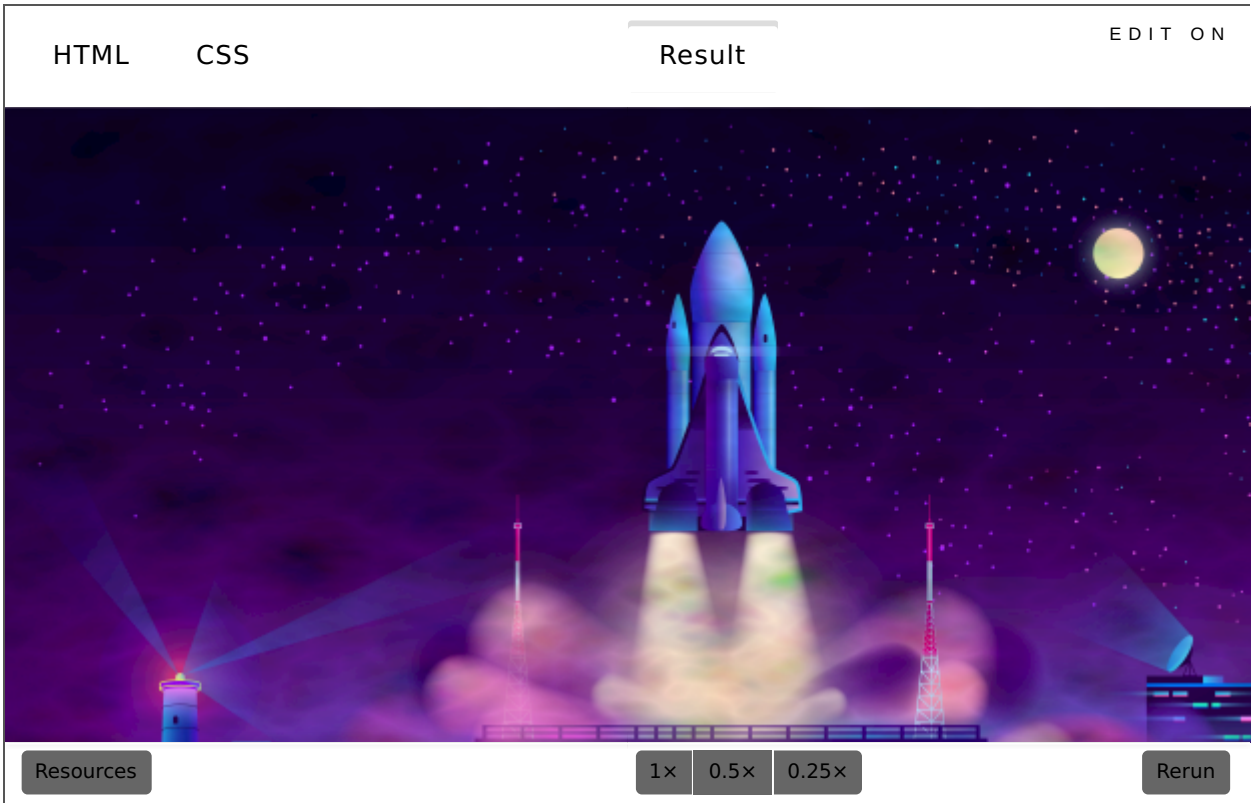
feBlend

Like the name suggests, this primitive blends the image with its background. To demonstrate this, we'll create a noise effect with `feTurbulence` and combine it with the image.

```
<svg>
  <filter id="blend">
    ulence in="SourceGraphic" type="turbulence"
    quency="0.01 0.02" numOctaves="1" result="NOISE">
    bulence>
     in="SourceGraphic" in2="NOISE" mode="multiply"
    D">     </feBlend>
```


cloudy image:

Let's look at an animated demo:



`feDiffuseLighting`

Diffuse lighting is light coming from a large, outside source. It uses the alpha channel of the image as a bump map. Bump mapping is a graphical method of adding texture to an image.

There are three light sources that work with this primitive: `feDistantLight`, `fePointLight`, and `feSpotLight`.

efines a light source that's coming from a distance.

```
<svg>
  <filter id="knockout">
     <feDiffuseLighting in="SourceGraphic" lighting-color="#00c2cb"
     diffuseConstant="2">
      <feDistantLight azimuth="100" elevation="15" />
     </feDiffuseLighting>
     <feComposite in="SourceGraphic" operator="arithmetic" k1="1"
k2="0"
          k3="0" k4="0" />
  </filter>
</svg>
```

From this snippet, the light source is blue. `diffuseConstant` defines the light's diffusion reflection constant, and that's how the light reflects off the surface. Lower values will dim the light.

For the `feDistantLight` attributes, `azimuth` is the clockwise direction of the light on the xy plane and `elevation` is the angle direction on the z axis.

This is the resulting effect using the code above:

Next up, `fePointLight` . We're essentially pointing the light on a particular spot in the image. Looking at our image, the moon seems to be the best spot to shine light on.

To get this, we're moving the light along the x, y, and z axis.

```
<svg>
<filter id="point">
  <feDiffuseLighting in="SourceGraphic" lighting-color="#00c2cb"
diffuseConstant="2">
     <fePointLight x="580" y="100" z="40"/>
  </feDiffuseLighting>
  <feComposite in="SourceGraphic" operator="arithmetic" k1="1" k2="0"
          k3="0" k4="0" />
</filter>
</svg>
```

Now we have a nice blue moon in the starry night sky:

Finally, for this SVG filter, we have `feSpotLight`. It's right there in the name, there's an invisible spotlight pointing a beam at the image. As for us, we can control the position, angle, and intensity.

```
<svg>
<filter id="point">
 <feDiffuseLighting in="SourceGraphic" lighting-color="#00c2cb"
 diffuseConstant="5">
    <feSpotLight x="680" y="20" z="30"
              limitingConeAngle="60"
              pointsAtX="100" pointsAtY="100"
              pointsAtZ="0" />
        </feDiffuseLighting>
  <feComposite in="SourceGraphic" operator="arithmetic" k1="1" k2="0"
          k3="0" k4="0" />
</filter>
```


`ConeAngle` controls how wide the spotlight will be. `pointsAtX`, nd `pointsAtZ` control the direction the spotlight is pointing.

feSpecularLighting

Specular light is used for highlighting. This filter primitive uses the same light sources as `feDiffuseLighting`.

```
<svg>
<filter id="point">
<feSpecularLighting specularExponent="5" lighting-color="#00c2cb"
          surfaceScale="1" in="SourceGraphic" specularConstant="1.5">
          <fePointLight x="570" y="100" z="200" />
        </feSpecularLighting>
  <feComposite in="SourceGraphic" operator="arithmetic" k1="1" k2="0"
          k3="0" k4="0" />
</filter>
</svg>
```

Let's look at the attributes. `specularExponent` controls the brightness of the highlight and `surfaceScale` is the height of the image's surface. `specularConstant` does the same thing as `diffuseConstant` and brightens or dims the color of the light.

The result:

We used `fePointLight`, but try it out with others and see what you can come up with!

feTile

ed at the end, the final SVG filter that is `feTile`. This filter
tes a repeating pattern on an element, just like tiles on the floor.

```
<svg>
  <filter id="tiles">
     <feTile in="SourceGraphic" x="50" y="50" width="50" height="50"
/>
      <feTile />
  </filter>
</svg>
```

In this snippet, we're selecting the part of the image on the x and y axis that will be on displayed on each tile. All we have to do is set the `width` and `height` of the tiles.

And voila!

There we have it, all 17 SVG filter primitives. Who needs Photoshop when you can edit on the go? You can combine many primitives to get more complex effects.

Browser support

SVG filters have good support across all modern browsers. Here's a screenshot

Leave a Reply

Enter your comment here...

Oscar Jite-Orimiono Follow

I'm a self taught frontend web developer. I build websites so everyone finds a home online. The digital space is massive, full of endless possibilities, let's explore it together!

#css