

**Claim Chart for U.S. Pat. No. 9123124**

<b>Limitation</b>	<b>Notes</b>
<p>1. An image processing apparatus configured to perform image processing on an image including image data with a negative value, the image processing apparatus comprising:</p>	
<p>a transformation unit configured to perform a nonlinear transformation processing on the image including image data with a negative value to transform the image including image data with a negative value into an image that does not include image data with a negative value;</p>	
<p>an image processing unit configured to perform predetermined image processing on the image that does not include image data with a negative value; and</p>	
<p>an inverse transformation unit configured to perform an inverse transformation processing of the nonlinear transformation processing on the image, having been subjected to the image processing, which does not include image data with a negative value to inversely transform the image, having been subjected to the image processing, which does not include image data with a negative value into an image, having been subjected to the image processing, which includes image data with a negative value.</p>	
<p>2. The image processing apparatus according to claim 1, wherein the transformation unit is configured to set a predetermined value of the image data as a boundary and perform the nonlinear transformation processing using first and second functions different from each other in a case where the image data is smaller than the predetermined value and a case where the image data is equal to or greater than the predetermined value, and</p>	

## Claim Chart for U.S. Pat. No. 9123124

<p>wherein output values of the first and second functions are continuous at the boundary.</p>	
<p>3. The image processing apparatus according to claim 2, wherein the predetermined value of the image data is 0, and wherein the transformation unit is configured to perform the nonlinear transformation processing using the first and second functions different from each other in a case where the image data has a negative value and a case where the image data does not have a negative value.</p>	
<p>4. The image processing apparatus according to claim 3, wherein the first function is a function in which a tilt of a change in the output value decreases as the image data having a negative value decreases in a direction of negative infinity.</p>	
<p>5. The image processing apparatus according to claim 3, wherein the second function is a function that transforms the image data not having a negative value into a logarithm.</p>	
<p>6. The image processing apparatus according to claim 3, wherein when a value of image data of the image including the image data with a negative value is set to <math>x</math> and an offset value added to the <math>x</math> is set to <math>offset</math>, the first function is <math>(-x)^{0.5} - \text{Log}_{10}(offset)</math> and the second function is <math>-\text{Log}_{10}(x + offset)</math>.</p>	
<p>7. The image processing apparatus according to claim 1, wherein the image processing unit is configured to perform gradation conversion, as the image processing, on the image that does not include image data with a negative value.</p>	
<p>8. The image processing apparatus according to claim 1, wherein the image processing unit is configured to perform the image processing using a lookup table.</p>	

Claim Chart for U.S. Pat. No. 9123124

<p>9. The image processing apparatus according to claim 8, wherein the lookup table, which is created from an existing lookup table in which an output value corresponding to an input value is defined, is created by performing logarithmic transformation of the input value and the output value, linearly interpolating at equal intervals between a minimum value and a maximum value of the input value, having been subjected to the logarithmic transformation so as to be allocated to integer values which are in a predetermined range, and linearly interpolating at equal intervals between two logarithmically transformed output values corresponding to the logarithmically transformed input values before and after the input values allocated at equal intervals to obtain output values corresponding to the input values allocated at equal intervals.</p>	
<p>10. The image processing apparatus according to claim 1, wherein the image processing unit is configured to perform the image processing using a computing equation.</p>	
<p>11. The image processing apparatus according to claim 1, wherein the image processing apparatus is configured to perform image processing on an image that is defined in a scene-referred image color space.</p>	
<p>12. An image processing method of performing image processing on an image including image data with a negative value, the image processing method comprising steps of:</p>	
<p>performing a nonlinear transformation processing on the image including image data with a negative value to transform the image including image data with a negative value into an image that does not include image data with a negative value;</p>	

**Claim Chart for U.S. Pat. No. 9123124**

<p>performing predetermined image processing on the image that does not include image data with a negative value; and</p>	
<p>performing an inverse transformation processing of the nonlinear transformation processing on the image, having been subjected to the image processing, which does not include image data with a negative value to inversely transform the image, having been subjected to the image processing, which does not include image data with a negative value into an image, having been subjected to the image processing, which includes image data with a negative value.</p>	
<p>13. The image processing method according to claim 12, wherein the image processing is performed using a lookup table.</p>	
<p>14. The image processing method according to claim 13, wherein the lookup table, which is created from an existing lookup table in which an output value corresponding to an input value is defined, is created by performing logarithmic transformation of the input value and the output value, linearly interpolating at equal intervals between a minimum value and a maximum value of the input value, having been subjected to the logarithmic transformation so as to be allocated to integer values which are in a predetermined range, and linearly interpolating at equal intervals between two logarithmically transformed output values corresponding to the logarithmically transformed input values before and after the input values allocated at equal intervals to obtain output values corresponding to the input values allocated at equal intervals.</p>	
<p>15. The image processing method according to claim 12, wherein the image processing is performed using a computing equation.</p>	

**Claim Chart for U.S. Pat. No. 9123124**

16. A non-transitory computer-readable recording medium having recorded thereon a program for causing a computer to execute the steps of the image processing method according to claim 12.	
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