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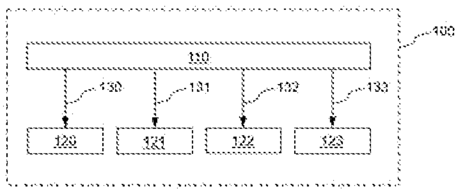
(54) **LIGHT DEVICE**

(57) According to the invention, a light device (100) configured for radiating mimicked black-body radiation; wherein black-body radiation has a locus curve in the CIE 1931 x,y space depending on a body temperature of a radiating black-body; wherein the mimicked black-body radiation mimics black-body radiation for a body temperature range; and wherein the light device comprises: at least three LEDs each having distinct radiation patterns together forming the mimicked black-body radiation, wherein the at least three radiation patterns define a convex polygon surrounding a locus curve section of the locus curve defined by the body temperature range; a controller (110) configured for: receiving an input associable with a set body temperature; translating the input to a LED setting for each of the at least three LEDs; and setting the at least three LEDs according to the LED settings; and wherein the convex polygon snugly fits around the locus curve section.



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Dit octrooi is verleend ongeacht het bijgevoegde resultaat van het onderzoek naar de stand van de techniek en schriftelijke opinie. Het octrooischrift komt overeen met de oorspronkelijk ingediende stukken.

LIGHT DEVICE

FIELD OF THE INVENTION

The invention relates to a light device having at least three LEDs. The invention relates more specifically to mimicking black-body radiation with the at least three LEDs. The invention further relates to a method for producing the light device, and a method for producing sets of LEDs. The invention further relates to a data processing system and a computer-readable storage medium.

BACKGROUND OF THE INVENTION

Conventional light, such as light bulbs, can be switched on and off. When on, these light bulbs radiate a particular light. Advancements in technology have provided LEDs in the colours red, green, yellow, blue. Combinations of these primary colour LEDs are used for providing a combined radiated spectrum. The combined radiated spectrum is typically some sort of white light. The colour of the combined radiated spectrum may be changed by adjusting the power to one or more of these LEDs. A disadvantage of these combinations of these primary colour LEDs is that the light radiate spectrum is not very stable, the radiated spectrum is typically some white colour, and the efficiency in producing some white colour may be improved.

SUMMARY OF THE INVENTION

An object of the invention is to overcome one or more of the disadvantages mentioned above.

According to a first aspect of the invention, a light device configured for radiating mimicked black-body radiation; wherein black-body radiation has a locus curve in the CIE 1931 x,y space depending on a body temperature of a radiating black-body; wherein the mimicked black-body radiation mimics black-body radiation for a body temperature range; and wherein the light device comprises: at least three LEDs each having distinct radiation patterns together forming the mimicked black-body radiation, wherein the at least three radiation patterns define a convex polygon surrounding a locus curve section of the locus curve defined by the body temperature range; a controller (110) configured for: receiving an input associable with a set body temperature; translating the input to a LED setting for each of the at least three LEDs; and setting the at least three LEDs according to the LED settings; and wherein the convex polygon snugly fits around the locus curve section.

Many applications require close control over the radiated light. Stability over time is of concern in many applications. Furthermore, while changing the radiated light, one or more other measurable parameters of the radiated light should preferably remain as stable as possible. In an embodiment, the LED may be a nano-dot.

Multiple LEDs may together mimic white light or light close to white light. Typically, the combination of LEDs attempts to mimic or comes close to the radiation pattern of a black-body at a particular body temperature. A shift in body temperature causes a change in the black-body radiation. It is an insight of the inventor that the locus or combined maximum of the radiation pattern of the at least three LEDs is the dominant or most important parameter. Furthermore, it is an insight of the inventor that the locus or combined maximum of the radiation pattern is dominant or most important parameter for the perception of the human, specifically the human eye and/or skin.

The controller is arranged for translating or converting a body temperature to a setting for each individual LED such that the combination of LEDs mimic the radiation pattern, more specifically the locus of a radiation pattern, of a black-body. The controller typically also receives an intensity setting. The intensity setting may be taken into account when performing the translation. The intensity setting together with the body temperature may determine the LED settings. In detail, the body temperature may determine the relation between LED settings, while the intensity setting may determine the total of the LED settings or the average of the LED settings.

The locus curve in the CIE 1931 x,y space for black-body radiation is known. The locus curve defines the locus of the black-body radiation for a body temperature from 0 Kelvin to infinity. Typically, not the complete range of locus curve is of interest or present in the product. Only a section of the locus curve is typically of interest.

The at least three LEDs each have a distinct radiation pattern. The radiation pattern may be a combination of wavelengths radiated by the LED. The radiation pattern may be seen as represented, condensed or summarized in one specific point in the CIE 1931 x,y space. Alternatively, the radiation pattern may be seen as represented, condensed or summarized in a specific, typically small area in the CIE 1931 x,y space. The small area may have different shapes, such as a circle or oval. Furthermore, the small area typically has a gradual or blurred edge. Typically, the locus of the radiation pattern of the LED in the CIE 1931 x,y space may be taken as representing the LED radiation pattern. The LED radiation pattern may alternatively be expressed in an x,y graph with on the horizontal axis the wavelength in e.g. nanometres, and on the vertical axis the intensity in e.g. Candela. The radiation patterns of the at least three are combined in the light device. The radiation patterns of the at least three are radiated together by the light device for forming a combined radiation pattern. The combined radiation pattern may be combined by averaging the three locus points of the radiation patterns for example in the CIE 1931 x,y space. This averaging may be a weighted averaging or other more advanced methods for combining these radiation patterns. The light device is configured such that the locus or combined maximum of the combined radiation pattern mimics the locus of the radiation pattern of a black-body at a particular body temperature. Alternatively, the light device is configured such that the combined radiation pattern mimics the radiation pattern of a black-body at a particular body temperature.

The radiation patterns of the at least three LEDs form a convex polygon. A convex polygon comprises a convex set. In a convex polygon, all interior angles are less than or equal to 180 degrees, while in a strictly convex polygon all interior angles are strictly less than 180 degrees. In a specific embodiment, the radiation patterns of the at least three LEDs define a strictly convex polygon. As the radiation patterns of the at least three LEDs are typically

Instead of the current selection of LEDs, it is an insight of the inventor to select LEDs with a radiation pattern close to the locus curve section. Selecting LEDs with a radiation pattern close to the curve section increases efficiency as the radiation patterns of the LEDs are closer to the selected or set point on the locus curve section. The selected or set point is determined by the body temperature. Arranging the radiation patterns of the at least three LEDs close to the locus curve section causes the combined maximum or locus of the combined radiation patterns to mimic the black-body radiation more perfectly. Furthermore, arranging the radiation patterns of the at least three LEDs close to the locus curve section causes the combined maximum or locus of the combined radiation patterns to change less when the LED settings are changed. Thus, arranging the radiation patterns of the at least three LEDs close to the locus curve section improves stability of the combined radiation pattern in the CIE 1931 x,y space.

According to another aspect of the invention a method for producing a light device configured for radiating mimicked black-body radiation; wherein black-body radiation has a locus curve in the CIE 1931 x,y space depending on a body temperature of a radiating black-body; wherein the mimicked black-body radiation mimics black-body radiation for a body temperature range; and wherein the method comprises the steps of: providing a controller; providing at least three groups of LEDs each group having distinct radiation patterns together forming the mimicked black-body radiation; selecting one LED from each of the at least three groups of LEDs; determining the position in the CIE 1931 x,y space of the selected LEDs based on its radiation pattern; and if the selected LEDs defining a convex polygon surrounding, preferably snugly fitting around, a locus curve section of the locus curve defined by the body temperature range, forming the light device based on the selected LEDs and the controller. The method provides the same advantages as mentioned for the light device.

According to another aspect of the invention a method for producing sets of LEDs for a light device configured for radiating mimicked black-body radiation; wherein black-body radiation has a locus curve in the CIE 1931 x,y space depending on a body temperature of a radiating black-body; wherein the mimicked black-body radiation mimics black-body radiation for a body temperature range; and wherein the method comprises the steps of: providing at least three groups of LEDs; determining a spread in and an average of radiation patterns of LEDs of each of the group of LEDs; verifying if the average and the spread of the radiation patterns for each of the groups of LEDs defining a worst case convex polygon surrounds a locus curve section of the locus curve defined by the body temperature range; if the verification is negative, adjusting at least one of the average and the spread of the radiation patterns of the at least one of the at least three groups of LEDs; and if the verification is positive, selecting a LED from each of the three groups for forming a set of LEDs for a light device for together forming the mimicked black-body radiation. The method provides the same advantages as mentioned for the light device.

According to another aspect of the invention a data processing system comprising means for carrying out the steps of any of the embodiments of the methods or the steps of the controller of any of the embodiments of the light device. The data processing system provides the same advantages as mentioned for the light device.

According to another aspect of the invention a computer-readable storage medium comprising instructions which, when executed by a computer, cause the computer to carry out the steps of any of the embodiments of the methods or the steps of the controller of any of the embodiments of the light device. The computer-readable storage medium provides the same advantages as mentioned for the light device.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

In an embodiment of the light device, the distance between the convex polygon and the locus curve section in the CIE 1931 x,y space is at least 0.01, preferably 0.03, more preferably 0.04, most preferably 0.05. Production may cause variations. Furthermore, the radiation pattern of a LED may vary over its lifetime, such as its economic and/or technical lifetime. Snugly fitting should be interpreted as providing enough distance between the convex polygon and the locus curve section for advantageously anticipating one or more of the mentioned variations.

In an embodiment of the light device, the distance between the convex polygon and the locus curve section in the CIE 1931 x,y space is at most 0.15, preferably 0.12, more preferably 0.10, most preferably 0.08. Production may cause variations. Furthermore, the radiation pattern of a LED may vary over its lifetime, such as its economic and/or technical lifetime. While these variations may influence snugly fitting, on the other hand arranging the radiation patterns close, such as snugly, to the locus curve section provides the advantages of improved stability. Another advantage of the invention in general may be that if the radiation patterns of the LEDs are close to the locus curve section, the LEDs mimic the black-body radiation more efficiently. The efficiency is found in that the LEDs mimic the black-body radiation more closely thereby less of the radiated spectrum from one of the LEDs is to be ignored or filtered out or compensated for by the other LEDs. Snugly fitting should be interpreted as providing only enough distance between the convex polygon and the locus curve section for advantageously anticipating one or more of the mentioned variations while still providing the advantages as defined for this invention.

In an embodiment of the light device, the locus is a Planckian locus or black body locus hereby advantageously detailing the locus. In an embodiment of the light device, at least one of the LED settings is a voltage and/or a current driving the associated LED. Alternatively, at least one of the LED settings is associated or associable with a voltage and/or a current driving the associated LED. In an embodiment of the light device, the locus curve section is advantageously in the visible light spectrum, preferably ranges from yellow to blue, more preferably ranges from yellow-white to white, most preferably substantially white. In an embodiment of the light device, the locus curve section advantageously represents a body temperature in the range of 2,000K to ∞, preferably 2,500K to 100,000K, more preferably 3,000K to 20,000K, more preferably 4,000K to 10,000K, most preferably 4,500K to 9,000K.

In an embodiment of the light device, each of the radiation patterns of the at least three LEDs has a predictable shift in the CIE 1931 x,y space over its operational lifetime; and the convex polygon snugly fits around the locus curve section during the operational lifetime. This embodiment provides a balance between on one side arranging the convex polygon close to the locus curve section for stability and/or efficiency, while on the other side the variation of the radiated spectrum can be accommodated. In a further embodiment of the light device, the predictable shift is predicted based on a trained neural network. The variation in production of the radiated patterns or spectra as well as the variation of the radiated patterns or spectra over its lifetime, or even in combination, are typically highly non-linear, non-symmetric, depending on environmental conditions, such as environmental temperature, humidity, rain or exposure to sunlight, or combinations. Predicting the change of radiated spectrum is therefore advantageously predicted by a trained neural network. The neural network may be trained with samples from production of the different LEDs. The trained neural network may be provided with samples from production of the different LEDs for providing a more accurate prediction. The trained neural network may be provided with measurements from light devices in the field for providing a prediction for that light device. In a further preferred embodiment of the light device, the trained neural network is trained with data from testing a sample set of LEDs; and the sample set of LEDs statistically represents at least one of the at least three LEDs defining the convex polygon. In a further preferred embodiment, testing simulates typical operational use. In a further preferred embodiment, three sample sets of LEDs statistically represents the at least three LEDs, respectively.

In an embodiment of the light device, the light device comprises at least four LEDs, preferably five LEDs, more preferably six LEDs, all having distinct radiation patterns forming the convex polygon for more snugly fitting around the locus curve section. With more distinct radiation patterns the black-body radiation may be mimicked more precise. Furthermore, with more distinct radiation patterns the convex polygon may even more snugly fit around the locus curve section.

In an embodiment of the light device the convex polygon is formed such that if one of the LEDs fails or the radiation pattern of one of the LEDs shifts too much, and this radiation pattern is removed from the convex polygon thereby forming a reduced convex polygon, then this reduced convex polygon snugly fits around a reduced locus curve section; wherein the reduced locus curve section is substantially equal to the locus curve section. This increases dependability during operation and/or lifetime of the light device for failure of one of the LEDs.

In an embodiment of the light device the convex polygon is formed such that if a predefined or specific one of the LEDs fails or the radiation pattern of a predefined or specific one of the LEDs shifts too much, and this LED is removed from the convex polygon thereby forming a reduced convex polygon, then this reduced convex polygon still snugly fits around the locus curve radiation. A Led with a specific and/or distinct radiation pattern may statistically fail more often compared to others. This increases dependability during operation and/or lifetime of the light device for failure of a predefined or specific one of the LEDs.

In an embodiment the light device comprises a support LED having a radiation pattern distinct from the radiation patterns forming the convex polygon; wherein the support LED has a radiation pattern within the convex polygon; and wherein the controller is also configured for: translating the input to a support LED setting; and setting the support LED according to the support LED setting for contributing to the mimicked black-body radiation. The radiation pattern of the support LED is typically arranged on or close to the locus curve section. The support LED enhances efficiency of the light device mimicking black-body radiation. The support LED enhances how well the light device mimics the black-body radiation. The support LED causes other LEDs forming the convex polygon to radiate less thereby increasing their operational lifetime.

In an embodiment of the method for producing a light device, the step of determining comprises the step of determining the position in the CIE 1931 x,y space of the selected LEDs over its operational lifetime; the condition for the forming step is extended with the selected LEDs defining a convex polygon surrounding, preferably snugly fitting around, a locus curve section of the locus curve defined by the body temperature range over its lifetime. This embodiment provides a balance between on one side arranging the convex polygon close to the locus curve section for stability and/or efficiency, while on the other side the variation of the radiated spectrum can be accommodated. In a further embodiment of the method, the predictable shift is predicted based on a trained neural network. The variation in production of the radiated patterns or spectra as well as the variation of the radiated patterns or spectra over its lifetime, or even in combination, are typically highly non-linear, non-symmetric, depending on environmental conditions, such as environmental temperature, humidity, rain or exposure to sunlight, or combinations. Predicting the change of radiated spectrum is therefore advantageously predicted by a trained neural network. The neural network may be trained with samples from production of the different LEDs. The trained neural network may be provided with samples from production of the different LEDs for providing a more accurate prediction. The trained neural network may be provided with measurements from light devices, preferably formed according to the method, in the field for providing a prediction for that light device. In a further preferred embodiment of the method, the trained neural network is trained with data from testing a sample set of LEDs; and the sample set of LEDs statistically represents at least one of the at least three LEDs defining the convex polygon. In a further preferred embodiment, testing simulates typical operational use. In a further preferred embodiment, three sample sets of LEDs statistically represents the at least three LEDs, respectively. In a further embodiment, the method for producing a light device comprises the step of providing a trained neural network for predicting the shift of the radiation pattern over its lifetime; and the step of determining the position over its lifetime is based on the results from the trained neural network.

In a further embodiment, the method for producing a light device comprises the steps of: sampling a set of LEDs statistically representing at least one of the at least three groups of LEDs; testing a sample set of LEDs for generating test data representing change of radiation pattern preferably testing simulates typical operational use; and training the neural network with the test data. This advantageously provides a trained neural network based on representative data.

In an embodiment, the method comprises the steps of: providing a controller; and forming the light device based on the selected LEDs and the controller. This advantageously provides a tested and/or for the operational and/or technical lifetime statistically guaranteed light device of which the convex polygon snugly fits around the locus curve section.

In an embodiment, the method comprises the step of adjusting comprises the steps of: selecting LEDs from the at least three groups of LEDs for forming a new group of LEDs; wherein selecting is based on the determined spread in and the determined average of the radiation patterns; and wherein in the verifying step the new group of LEDs is used. This advantageously provides a tested and/or for the operational and/or technical lifetime statistically guaranteed light device of which the convex polygon snugly fits around the locus curve section.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be apparent from and elucidated further with reference to the embodiments described by way of example in the following description and with reference to the accompanying drawings, in which:

Figure 1 schematically shows a CIE 1931 x,y space with the locus curve; Figure 2 schematically shows the black-body radiation locus curve;

Figure 3 schematically shows the black-body radiation locus curve with a first convex polygon;

Figure 4 schematically shows the black-body radiation locus curve with a second convex polygon;

Figure 5 schematically shows the black-body radiation locus curve with a third convex polygon;

Figure 6 schematically shows a light device;

Figure 7 schematically shows a method for producing a light device;

Figure 8 schematically shows a method for producing sets of LEDs for a light device; and

Figure 9 schematically shows an embodiment of a computer program product, computer readable medium and/or non-transitory computer readable storage medium according to the invention.

The figures are purely diagrammatic and not drawn to scale. In the figures, elements which correspond to elements already described may have the same reference numerals.

LIST OF REFERENCE NUMERALS

10	CIE 1931 x,y space
20	locus curve
100	light device
110	controller
120, 121, 122, 123	LED
130, 131, 132, 133	LED setting
141, 142, 143, 144, 145	locus radiation patterns
150, 150’, 150”	convex polygon
151, 152, 153, 154, 155	sides convex polygon
160	support LED
161, 162	sides reduced convex polygon
200	method for producing light device
210	providing controller
220	providing at least three groups of LEDs
230	selecting one LED from each group
240	determining position
250	forming light device
300	method for producing sets of LEDs
310	providing at least three groups of LEDs
320	determining spread and average
330	verifying spread and average
340	adjusting spread and average
350	selecting LED from each of three groups
1000	computer program product

1010	computer readable medium
1020	computer readable code

DETAILED DESCRIPTION OF THE FIGURES

The following figures may detail different embodiments. Embodiments can be combined to reach an enhanced or improved technical effect. These combined embodiments may be mentioned explicitly throughout the text, may be hint upon in the text or may be implicit.

Figure 1 schematically shows a CIE 1931 x,y space 10. The CIE 1931 x,y space is a colour space. The edges of the colour space are defined by a flat side and an edge extending as a lobe from this flat side. The left bottom corner has a blue colour. The right bottom has a red colour. The top of the lobe has a green colour. The area between these extremes comprises colour gradients for gradually changing colour when traversing the colour space. On the edge of the lobe the wavelength of the particular colour at that point on the edge of the lobe is indicated. The source for this CIE 1931 x,y space is the Wikipedia page for the Planckian locus. Furthermore, the information from the Wikipedia page for the Planckian locus is hereby incorporated by reference.

Figure 1 further comprises the locus curve 20 for black-body radiation. The actual locus of the black-body radiation shifts over this curve depending on the body temperature. Several body temperatures are indicated ranging from 1500 to ∞ or infinity.

Figure 2 schematically shows the black-body radiation locus curve 20 from Figure 1 without the CIE 1931 x,y space. Although the body temperatures are shown, these temperatures are removed for clarity reasons in the Figures 3-5.

Figure 3 schematically shows the black-body radiation locus curve 20 with a first convex polygon 150. The first convex polygon is a triangle. The first convex polygon comprises a first vertex 141, a second vertex 142, and a third vertex 143. The first vertex represents the locus of the radiation pattern of a first LED. The second vertex represents the locus of the radiation pattern of the second LED. The third vertex represents the locus of the radiation pattern of the third LED. The vertex may be a point in the CIE 1931 x,y space. Alternatively, the vertex may be an area, preferably a small area in the CIE 1931 x,y space. The first convex polygon further comprises a first side 151 arranged between the first and second vertices, a second side 152 arranged between the second and third vertices, and a third side 153 arranged between the third and first vertices. The part of the locus curve covered by the area of the convex polygon is labelled locus curve section.

Each of the LEDs radiates a distinct radiation pattern represented as a vertex of the convex polygon in the CIE 1931 x,y space. Depending on the LED setting of a particular LED, this particular LED may radiate more or less compared to the other LEDs of the light device. The convex polygon defines a control area. Depending on the different LED settings for the LEDs the combined radiation pattern of the LEDs, preferably the locus of the combined radiation pattern of the LED, may be represented as a point or small area in the CIE 1931 x,y space, which point or small area is arranged on the control area. Typically, the more a LED is powered the more dominant its radiation pattern is in the combined radiation pattern, the more the combined radiation pattern is close to the radiation pattern of this LED in the CIE 1931 x,y space.

Figure 4 schematically shows the black-body radiation locus curve with a second convex polygon. The same numbers as mentioned in Figure 3 have the same meaning in Figure 4. The second convex polygon is a quadrilateral which is convex. The second convex polygon further comprises a fourth vertex 144. The fourth vertex represents the locus of the radiation pattern of a fourth LED. Different from Figure 3, the third side is arranged between the third vertex and the fourth vertex. The second convex polygon further comprises a fourth side 154 arranged between the fourth and first vertices.

Figure 5 schematically shows the black-body radiation locus curve with a third convex polygon. The same numbers as mentioned in Figures 3 and 4 have the same meaning in Figure 5. The third convex polygon is a pentagon which is convex. The third convex polygon further comprises a fifth vertex 145. The fifth vertex represents the locus of the radiation pattern of a fifth LED. Different from Figure 4, the fourth side is arranged between the fourth vertex and the fifth vertex. The third convex polygon further comprises a fifth side 155 arranged between the fifth and first vertices.

Figure 5 further shows a support LED 160. The support LED may be used to support the combined radiation pattern such that when the support LED radiates, the combined radiated pattern, preferably the locus of the combined radiated pattern, is closer to the locus of the support LED in the CIE 1931 x,y space. The support radiation pattern, preferably the locus of the support radiation pattern, is arranged on the area of the convex polygon.

An effect may be that the third LED in this case may radiate less for moving the combined radiated pattern, preferably the locus of the combined radiated pattern, closer to the locus of the third LED in the CIE 1931 x,y space, especially when the combined radiated pattern is far away from the third vertex. Another effect may be that the combined radiated pattern, preferably the locus of the combined radiated pattern, in the CIE 1931 x,y space may be controlled with higher accuracy and/or stability.

Furthermore, when the third LED fails, the convex polygon is reduced to the reduced convex polygon comprising a first side 151, a first alternative side 161, a second alternative side 162, a fourth side 154, and a fifth side 155. The reduced polygon still allows to cover a considerable part of the locus curve, labelled reduced locus curve section. Although the reduced locus curve section is smaller compared to the locus curve section, the reduced locus curve section still allows the light device to radiate light with a locus in the CIE 1931 x,y space covered by the reduced convex polygon. The effect is that the support LED increases the reliability of the light device. A further effect is that the combined radiation pattern can be controlled with higher accuracy.

Figure 6 schematically shows a light device 100. The light device comprises a controller 110, and at least three LEDs 120, 121, 122, 123. The controller controls the LEDs by communicating a LED setting 130, 131, 132, 133 to the respective LEDs.

The controller is configured for receiving an input associable with a set body temperature; translating the input to a LED setting for each of the at least three LEDs; and setting the at least three LEDs according to the LED settings.

Figure 7 schematically shows a method 200 for producing a light device. The method comprises the step of providing 210 a controller. The method further comprises the step of providing 220 at least three groups of LEDs each having distinct radiation patterns together forming the mimicked black-body radiation. The method further comprises the step of selecting 230 one LED from each of the at least three groups of LEDs. The method further comprises the step of determining 240 the position in the CIE 1931 x,y space of the selected LEDs based on its radiation pattern. The method further comprises the step of if the selected LEDs defining a convex polygon surrounding, preferably snugly fitting around, a locus curve section of the locus curve defined by the body temperature range, forming 250 the light device based on the selected LEDs and the controller.

Figure 8 schematically shows a method 300 for producing sets of LEDs for a light device. The method comprises the step of providing 310 at least three groups of LEDs. The method further comprises the step of determining 320 a spread in and an average of radiation patterns of LEDs of each of the group of LEDs. The method further comprises the step of verifying 330 if the average and the spread of the radiation patterns for each of the groups of LEDs defining a worst-case convex polygon surrounds a locus curve section of the locus curve defined by the body temperature range. The method further comprises the step of if the verification is negative, adjusting 340 at least one of the average and the spread of the radiation patterns of the at least one of the at least three groups of LEDs. The method further comprises the step of if the verification is positive, selecting 350 a LED from each of the three groups for forming a set of LEDs for a light device.

Figure 9 schematically shows an embodiment of a computer program product 1000, computer readable medium 1010 and/or non-transitory computer readable storage medium according to the invention comprising computer readable code 1020.

It will also be clear that the above description and drawings are included to illustrate some embodiments of the invention, and not to limit the scope of protection. Starting from this disclosure, many more embodiments will be evident to a skilled person without departing from the scope of the invention as set forth in the appended claims. These embodiments are within the scope of protection and the essence of this invention and are obvious combinations of prior art techniques and the disclosure of this patent. Devices functionally forming separate devices may be integrated in a single physical device.

The term “substantially” herein, such as in “substantially all emission” or in “substantially consists”, will be understood by the person skilled in the art. The term “substantially” may also include embodiments with “entirely”, “completely”, “all”, etc. Hence, in embodiments the adjective substantially may also be removed. Where applicable, the term “substantially” may also relate to 90% or higher, such as 95% or higher, especially 99% or higher, even more especially 99.5% or higher, including 100%. The term “comprise” also includes embodiments wherein the term “comprises” means “consists of”.

The term "functionally" will be understood by, and be clear to, a person skilled in the art. The term “substantially” as well as “functionally” may also include embodiments with “entirely”, “completely”, “all”, etc. Hence, in embodiments the adjective functionally may also be removed. When used, for instance in “functionally parallel”, a skilled person will understand that the adjective “functionally” includes the term substantially as explained above. Functionally in particular is to be understood to include a configuration of features that allows these features to function as if the adjective “functionally” was not present. The term “functionally” is intended to cover variations in the feature to which it refers, and which variations are such that in the functional use of the feature, possibly in combination with other features it relates to in the invention, that combination of features is able to operate or function. For instance, if an antenna is functionally coupled or functionally connected to a communication device, received electromagnetic signals that are receives by the antenna can be used by the communication device. The word “functionally” as for instance used in “functionally parallel” is used to cover exactly parallel, but also the embodiments that are covered by the word “substantially” explained above. For instance, “functionally parallel” relates to embodiments that in operation function as if the parts are for instance parallel. This covers embodiments for which it is clear to a skilled person that it operates within its intended field of use as if it were parallel.

Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein. Thus, these terms are not necessarily intended to indicate temporal or other prioritization of such elements.

The devices or apparatus herein are amongst others described during operation. As will be clear to the person skilled in the art, the invention is not limited to methods of operation or devices in operation.

It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "to comprise" and “to include”, and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. Also, the use of introductory phrases such as “at least one” and “one or more” in the claims should not be construed to imply that the introduction of another claim element by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim element to inventions containing only one such element, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an." The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

The invention may be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. In the device or apparatus claims enumerating several means, several of these means may be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

The invention further applies to an apparatus or device comprising one or more of the characterising features described in the description and/or shown in the attached drawings. The invention further pertains to a method or process comprising one or more of the characterising features described in the description and/or shown in the attached drawings.

It will be appreciated that the invention also applies to computer programs, particularly computer programs on or in a carrier, adapted to put the invention into practice. The program may be in the form of a source code, a code intermediate source and an object code such as in a partially compiled form, or in any other form suitable for use in the implementation of the method according to the invention. It will also be appreciated that such a program may have many different architectural designs. For example, a program code implementing the functionality of the method or system according to the invention may be sub-divided into one or more sub-routines. Many different ways of distributing the functionality among these sub-routines will be apparent to the skilled person. The sub-routines may be stored together in one executable file to form a self-contained program. Such an executable file may comprise computer-executable instructions, for example, processor instructions and/or interpreter instructions (e.g. Java interpreter instructions). Alternatively, one or more or all of the sub-routines may be stored in at least one external library file and linked with a main program either statically or dynamically, e.g. at run-time. The main program contains at least one call to at least one of the sub-routines. The sub-routines may also comprise function calls to each other. An embodiment relating to a computer program product comprises computer-executable instructions corresponding to each processing stage of at least one of the methods set forth herein. These instructions may be sub-divided into sub-routines and/or stored in one or more files that may be linked statically or dynamically. Another embodiment relating to a computer program product comprises computer-executable instructions corresponding to each means of at least one of the systems and/or products set forth herein. These instructions may be sub-divided into sub-routines and/or stored in one or more files that may be linked statically or dynamically.

The carrier of a computer program may be any entity or device capable of carrying the program. For example, the carrier may include a data storage, such as a ROM, for example, a CD ROM or a semiconductor ROM, or a magnetic recording medium, for example, a hard disk. Furthermore, the carrier may be a transmissible carrier such as an electric or optical signal, which may be conveyed via electric or optical cable or by radio or other means. When the program is embodied in such a signal, the carrier may be constituted by such a cable or other device or means. Alternatively, the carrier may be an integrated circuit in which the program is embedded, the integrated circuit being adapted to perform, or used in the performance of, the relevant method.

The various aspects discussed in this patent can be combined in order to provide additional advantages. The mere fact that certain measures are recited in mutually different claims does not indicate that a combination of these measures cannot be used to advantage. Furthermore, some of the features can form the basis for one or more divisional applications.

EMBODIMENTS:

1. Light device (100) configured for radiating mimicked black-body radiation;

wherein black-body radiation has a locus curve in the CIE 1931 x,y space depending on a body temperature of a radiating black-body;

wherein the mimicked black-body radiation mimics black-body radiation for a body temperature range; and

wherein the light device comprises:

- at least three LEDs each having distinct radiation patterns together forming the mimicked black-body radiation, wherein the at least three radiation patterns define a convex polygon surrounding a locus curve section of the locus curve defined by the body temperature range;

- a controller (110) configured for:

receiving an input associable with a set body temperature;

translating the input to a LED setting for each of the at least three LEDs; and

setting the at least three LEDs according to the LED settings; and

wherein the convex polygon snugly fits around the locus curve section.

2. Light device according to the preceding embodiment, wherein the distance between the convex polygon and the locus curve section in the CIE 1931 x,y space is at least 0.01, preferably 0.03, more preferably 0.04, most preferably 0.05.

3. Light device according to the preceding embodiment, wherein the distance between the convex polygon and the locus curve section in the CIE 1931 x,y space is at most 0.15, preferably 0.12, more preferably 0.10, most preferably 0.08.

4. Light device according to any of the preceding embodiments, wherein the locus is a Planckian locus or black body locus.

5. Light device according to any of the preceding embodiments, wherein at least one of the LED settings is a voltage and/or a current driving the associated LED.

6. Light device according to any of the preceding embodiments, wherein the locus curve section is in the visible light spectrum, preferably ranges from yellow to blue, more preferably ranges from yellow-white to white, most preferably substantially white.

7. Light device according to any of the preceding embodiments, wherein the locus curve section represents a body temperature in the range of 2,000K to ∞, preferably 2,500K to 100,000K, more preferably 3,000K to 20,000K, more preferably 4,000K to 10,000K, most preferably 4,500K to 9,000K.

8. Light device according to any of the preceding embodiments,

wherein each of the radiation patterns of the at least three LEDs has a predictable shift in the CIE 1931 x,y space over its operational lifetime; and

wherein the convex polygon snugly fits around the locus curve section during the operational lifetime.

9. Light device according to the preceding embodiments, wherein the predictable shift is predicted based on a trained neural network.

10. Light device according to the preceding embodiment,

wherein the trained neural network is trained with data from testing a sample set of LEDs;

wherein the sample set of LEDs statistically represents at least one of the at least three LEDs defining the convex polygon;

wherein preferably testing simulates typical operational use; and

wherein preferably three sample sets of LEDs statistically represents the at least three LEDs, respectively.

11. Light device according to any of the preceding embodiments, wherein the light device comprises at least four LEDs, preferably five LEDs, more preferably six LEDs, all having distinct radiation patterns forming the convex polygon for more snugly fitting around the locus curve section.

12. Light device according to any of the preceding embodiments, wherein the convex polygon is formed such that if one of the LEDs fails or the radiation pattern of one of the LEDs shifts, and this radiation pattern is removed from the convex polygon thereby forming a reduced convex polygon, then this reduced convex polygon snugly fits around a reduced locus curve section; wherein the reduced locus curve section is substantially equal to the locus curve section.

13. Light device according to any of the preceding embodiments, wherein the convex polygon is formed such that if a predefined or specific one of the LEDs fails or the radiation pattern of a predefined or specific one of the LEDs shifts too much, and this LED is removed from the convex polygon thereby forming a reduced convex polygon, then this reduced convex polygon still snugly fits around the locus curve radiation.

14. Light device according to any of the preceding embodiments,

comprising a support LED having a radiation pattern distinct from the radiation patterns forming the convex polygon;

wherein the support LED has a radiation pattern within the convex polygon; and

wherein the controller is also configured for:

translating the input to a support LED setting; and

setting the support LED according to the support LED setting for contributing to the mimicked black-body radiation.

15. Method for producing a light device configured for radiating mimicked black-body radiation;

wherein black-body radiation has a locus curve in the CIE 1931 x,y space depending on a body temperature of a radiating black-body;

wherein the mimicked black-body radiation mimics black-body radiation for a body temperature range; and

wherein the method comprises the steps of:

- providing a controller;

- providing at least three groups of LEDs each group having distinct radiation patterns together forming the mimicked black-body radiation;

- selecting one LED from each of the at least three groups of LEDs;

- determining the position in the CIE 1931 x,y space of the selected LEDs based on its radiation pattern; and

- if the selected LEDs defining a convex polygon surrounding, preferably snugly fitting around, a locus curve section of the locus curve defined by the body temperature range, forming the light device based on the selected LEDs and the controller.

16. Method for producing a light device according to the preceding embodiment,

wherein the step of determining comprises the step of determining the position in the CIE 1931 x,y space of the selected LEDs over its operational lifetime;

wherein the condition for the forming step is extended with the selected LEDs defining a convex polygon surrounding, preferably snugly fitting around, a locus curve section of the locus curve defined by the body temperature range over its lifetime.

17. Method for producing a light device according to the preceding embodiment, comprising the step of providing a trained neural network for predicting the shift of the radiation pattern over its lifetime; and

wherein the step of determining the position over its lifetime is based on the results from the trained neural network.

18. Method for producing a light device according to the preceding embodiment, comprising the steps of:

- sampling a set of LEDs statistically representing at least one of the at least three groups of LEDs;

- testing a sample set of LEDs for generating test data representing change of radiation pattern preferably testing simulates typical operational use; and

- training the neural network with the test data.

19. Method for producing sets of LEDs for a light device configured for radiating mimicked black-body radiation;

wherein black-body radiation has a locus curve in the CIE 1931 x,y space depending on a body temperature of a radiating black-body;

wherein the mimicked black-body radiation mimics black-body radiation for a body temperature range; and

wherein the method comprises the steps of:

- providing at least three groups of LEDs;

- determining a spread in and an average of radiation patterns of LEDs of each of the group of LEDs;

- verifying if the average and the spread of the radiation patterns for each of the groups of LEDs defining a worst case convex polygon surrounds a locus curve section of the locus curve defined by the body temperature range;

- if the verification is negative, adjusting at least one of the average and the spread of the radiation patterns of the at least one of the at least three groups of LEDs; and

- if the verification is positive, selecting a LED from each of the three groups for forming a set of LEDs for a light device for together forming the mimicked black-body radiation.

20. Method according to the preceding embodiment comprising the steps of:
- providing a controller; and
- forming the light device based on the selected LEDs and the controller.

21. Method according to any of the preceding embodiments 19-20, wherein the step of adjusting comprises the steps of:

- selecting LEDs from the at least three groups of LEDs for forming a new group of LEDs;

wherein selecting is based on the determined spread in and the determined average of the radiation patterns; and

wherein in the verifying step the new group of LEDs is used.

22. Data processing system comprising means for carrying out the steps of any of the embodiments 15-21 or the steps of the controller of any of the embodiments 1-20.

23. Computer-readable storage medium comprising instructions which, when executed by a computer, cause the computer to carry out the steps of any of the embodiments 15-21 or the steps of the controller of any of the embodiments 1-20.

CONCLUSIES

1. Lichtinrichting (100) geconfigureerd voor het uitstralen van nagebootste zwartlichaamstraling;

waarbij zwartlichaamstraling een locuskromme heeft in de CIE 1931 x,y-ruimte afhankelijk van een lichaamstemperatuur van een uitstralend zwart-lichaam;

waarbij de nagebootste zwartlichaamstraling zwartlichaamstraling nabootst voor een lichaamstemperatuurbereik; en

waarbij de lichtinrichting omvat:

- ten minste drie LED's die elk verschillende stralingspatronen hebben die samen de nagebootste zwartlichaamstraling vormen, waarbij de ten minste drie stralingspatronen een convexe veelhoek definiëren die een locuskrommegedeelte van de locuskromme gedefinieerd door het lichaamstemperatuurbereik omgeeft;

- een besturingseenheid (110) geconfigureerd voor:

het ontvangen van een invoer die geassocieerd is met een ingestelde lichaamstemperatuur;

het vertalen van de invoer naar een LED-instelling voor elk van de ten minste drie LED's; en

het instellen van de ten minste drie LED's volgens de LED-instellingen; en

waarbij de convexe veelhoek nauwsluitend rond het locuskrommegedeelte past.

2. Lichtinrichting volgens de voorgaande conclusie, waarbij de afstand tussen de convexe polygoon en het locuskrommegedeelte in de CIE 1931 x,y-ruimte ten minste 0,01, bij voorkeur 0,03, bij verdere voorkeur 0,04, bij hoogste voorkeur 0,05 is.

3. Lichtinrichting volgens de voorgaande conclusie, waarbij de afstand tussen de convexe polygoon en het locuskrommegedeelte in de CIE 1931 x,y-ruimte ten hoogste 0,15, bij voorkeur 0,12, bij verdere voorkeur 0,10, bij hoogste voorkeur 0,08 is.

4. Lichtinrichting volgens een van de voorgaande conclusies, waarbij de locus een Planck-locus of zwartlichaamlocus is.

5. Lichtinrichting volgens een van de voorgaande conclusies, waarbij ten minste één van de LED-instellingen een spanning en/of een stroom is die de bijbehorende LED aandrijft.

6. Lichtinrichting volgens een van de voorgaande conclusies, waarbij het locuskrommegedeelte zich in het zichtbare lichtspectrum bevindt, bij voorkeur varieert van geel tot blauw, bij verdere voorkeur varieert van geel-wit tot wit, bij hoogste voorkeur in hoofdzaak wit.

7. Lichtinrichting volgens een van de voorgaande conclusies, waarbij het locuskrommegedeelte een lichaamstemperatuur in het bereik van 2.000 K tot ∞, bij voorkeur 2.500 K tot 100.000 K, bij verdere voorkeur 3.000 K tot 20.000 K, bij verdere voorkeur 4.000 K tot 10.000K, bij hoogste voorkeur 4.500K tot 9.000K.

8. Lichtinrichting volgens een van de voorgaande conclusies,

waarbij elk van de stralingspatronen van de ten minste drie LED's een voorspelbare verschuiving heeft in de CIE 1931 x,y-ruimte gedurende zijn operationele levensduur; en

waarbij de convexe veelhoek tijdens de operationele levensduur nauwsluitend rond de locuskrommegedeelte past.

9. Lichtinrichting volgens de voorgaande conclusie, waarbij de voorspelbare verschuiving wordt voorspeld op basis van een getraind neuraal netwerk.

10. Lichtinrichting volgens de voorgaande conclusie,

waarbij het getrainde neurale netwerk is getraind met gegevens van het testen van een bemonsteringsverzameling van LED's;

waarbij de bemonsteringsverzameling van LED's statistisch ten minste één van de ten minste drie LED's vertegenwoordigt die de convexe veelhoek definiëren;

waarbij testen bij voorkeur typisch operationeel gebruik simuleert; en

waarbij bij voorkeur drie bemonsteringsverzamelingen van LED's statistisch respectievelijk de ten minste drie LED's vertegenwoordigen.

11. Lichtinrichting volgens een van de voorgaande conclusies, waarbij de lichtinrichting ten minste vier LED's omvat, bij voorkeur vijf LED's, bij verdere voorkeur zes LED's, die allemaal verschillende stralingspatronen hebben die de convexe veelhoek vormen om nauwsluitend rond het locuskrommegedeelte te passen.

12. Lichtinrichting volgens een van de voorgaande conclusies, waarbij de convexe veelhoek zodanig is gevormd dat indien een van de LED's uitvalt of het stralingspatroon van een van de LED's verschuift, en dit stralingspatroon wordt verwijderd uit de convexe veelhoek waardoor een gereduceerde convexe veelhoek wordt gevormd, dan past deze gereduceerde convexe

veelhoek nauwsluitend rond een gereduceerde locuskrommegedeelte; waarbij de gereduceerde locuskrommegedeelte in hoofdzaak gelijk is aan de locuskrommegedeelte.

13. Lichtinrichting volgens een der voorgaande conclusies, waarbij de convexe veelhoek zodanig is gevormd dat indien een vooraf bepaalde of specifiek één van de LED's uitvalt of het stralingspatroon van een vooraf gedefinieerde of specifieke één van de LED's te veel verschuift, en deze LED wordt verwijderd uit de convexe veelhoek waardoor een gereduceerde convexe veelhoek wordt gevormd, dan past deze gereduceerde convexe veelhoek nauwsluitend rond een gereduceerde locuskrommegedeelte; waarbij de gereduceerde locuskrommegedeelte in hoofdzaak gelijk is aan de locuskrommegedeelte

14. Lichtinrichting volgens een van de voorgaande conclusies,

omvattende een steun-LED met een stralingspatroon dat verschilt van de stralingspatronen die de convexe veelhoek vormen;

waarbij de steun-LED een stralingspatroon heeft binnen de convexe veelhoek; en

waarbij de besturingseenheid ook is geconfigureerd voor:

het vertalen van de invoer naar een ondersteunende LED-instelling; en

het instellen van de ondersteunings-LED volgens de ondersteunings-LED-instelling om bij te dragen aan de nagebootste black-body-straling.

15. Werkwijze voor het produceren van een lichtapparaat dat is geconfigureerd voor het uitstralen van nagebootste zwartlichaamstraling;

waarbij zwartlichaamstraling een locuskromme heeft in de CIE 1931 x,y-ruimte afhankelijk van een lichaamstemperatuur van een uitstralend zwart-lichaam;

waarbij de nagebootste zwartlichaamstraling zwartlichaamstraling nabootst voor een lichaamstemperatuurbereik; en

waarbij de werkwijze de stappen omvat van:

- het verschaffen van een besturingseenheid;

- het verschaffen van ten minste drie groepen LED's, waarbij elke groep verschillende stralingspatronen heeft die samen de nagebootste zwartlichaamstraling vormen;

- het selecteren van één LED uit elk van de ten minste drie groepen LED's;

- het bepalen van de positie in de CIE 1931 x,y-ruimte van de geselecteerde LED's op basis van hun stralingspatroon; en

- als de geselecteerde LED's een convexe veelhoek definiëren die, bij voorkeur nauwsluitend rond, een locuskrommegedeelte van de locuskromme gedefinieerd door het lichaamstemperatuurbereik omringen, de lichtinrichting vormen op basis van de geselecteerde LED's en de besturingseenheid.

16. Werkwijze voor het vervaardigen van een lichtinrichting volgens de voorgaande conclusie,

waarbij de stap van het bepalen de stap omvat van het bepalen van de positie in de CIE 1931 x,y-ruimte van de geselecteerde LED's gedurende de operationele levensduur ervan;

waarbij de voorwaarde voor de vormingsstap wordt uitgebreid met dat de geselecteerde LED's die een convexe veelhoek definiëren die, bij voorkeur nauwsluitend rond, een locuskrommegedeelte van de locuskromme gedefinieerd door het lichaamstemperatuurbereik gedurende zijn levensduur omgeven.

17. Werkwijze voor het vervaardigen van een lichtinrichting volgens de voorgaande conclusie, omvattende de stap van het verschaffen van een getraind neuraal netwerk voor het voorspellen van de verschuiving van het stralingspatroon gedurende zijn levensduur; en

waarbij de stap van het bepalen van de positie gedurende zijn levensduur is gebaseerd op de resultaten van het getrainde neurale netwerk.

18. Werkwijze voor het vervaardigen van een lichtinrichting volgens de voorgaande conclusie, omvattende de stappen van:

- het bemonsteren van een verzameling LED's die statistisch ten minste één van de ten minste drie groepen LED's vertegenwoordigen;

- het testen van een bemonsteringsverzameling van LED's voor het genereren van testgegevens die een verandering van het stralingspatroon vertegenwoordigen, bij voorkeur simuleert het testen typisch operationeel gebruik; en

- het trainen van het neurale netwerk met de testgegevens.

19. Methode voor het produceren van sets LED's voor een lichtapparaat dat is geconfigureerd voor het uitstralen van nagebootste zwartlichaamstraling;

waarbij zwartlichaamstraling een locuskromme heeft in de CIE 1931 x,y-ruimte afhankelijk van een lichaamstemperatuur van een uitstralend zwart-lichaam;

waarbij de nagebootste zwartlichaamstraling zwartlichaamstraling nabootst voor een lichaamstemperatuurbereik; en

waarbij de werkwijze de stappen omvat van:

- het verschaffen van minimaal drie groepen LED's;

- het bepalen van een spreiding in en een gemiddelde van stralingspatronen van LED's van elk van de groep LED's;

- het verifiëren of het gemiddelde en de spreiding van de stralingspatronen voor elk van de groepen LED's die een convexe veelhoek in het slechtste geval definiëren, een locuskrommegedeelte omringt van de locuskromme gedefinieerd door het lichaamstemperatuurbereik;
- indien de verificatie negatief is, het aanpassen van ten minste één van het gemiddelde en de spreiding van de stralingspatronen van ten minste één van de ten minste drie groepen LED's; en
- als de verificatie positief is, het selecteren van een LED uit elk van de drie groepen voor het vormen van een verzameling LED's voor het vormen van een lichtinrichting voor het samen vormen van de nagebootste zwartlichaamstraling te vormen.

20. Werkwijze volgens de voorgaande conclusie, omvattende de stappen van:
- het verschaffen van een besturingseenheid; en
- het vormen van de lichtinrichting op basis van de geselecteerde LED's en de besturingseenheid.

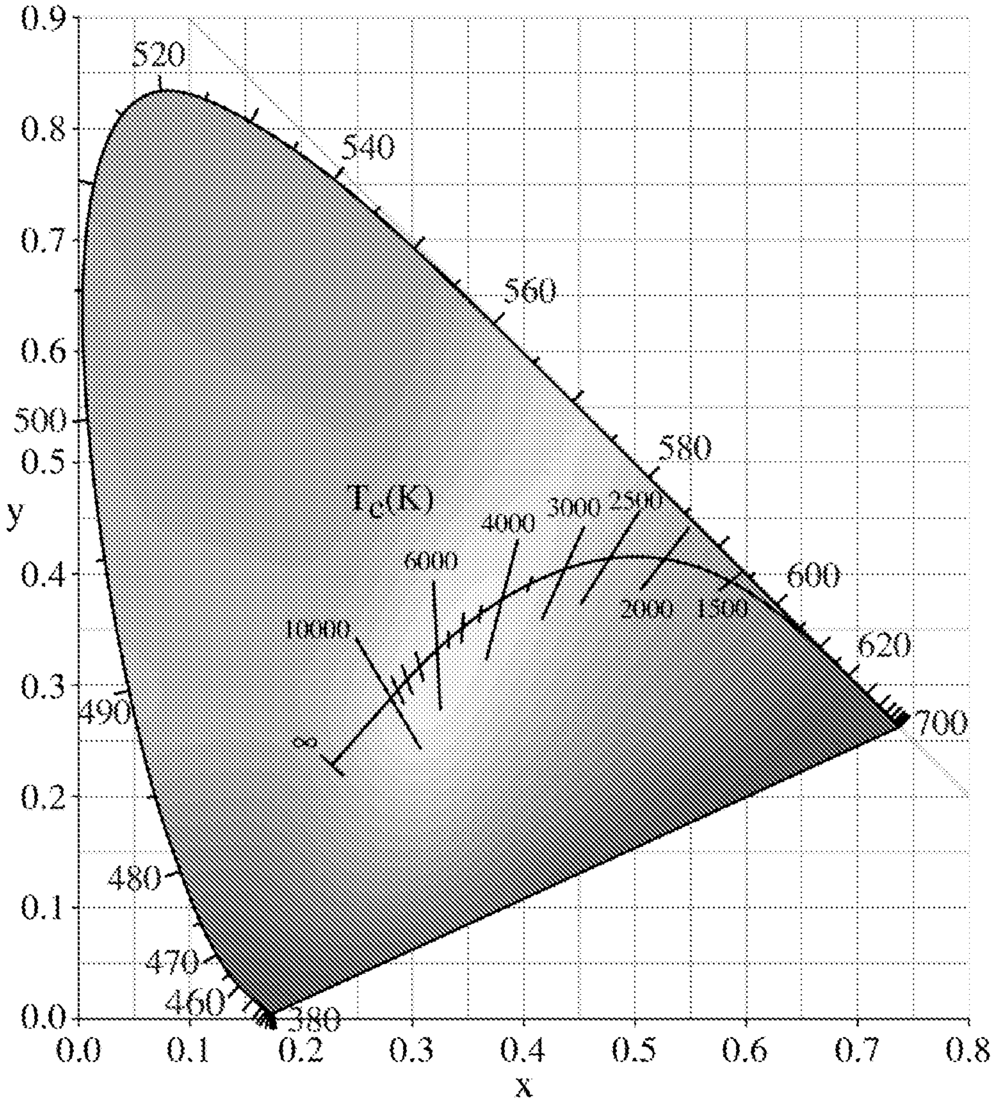
21. Werkwijze volgens een der voorgaande conclusies 19-20, waarbij de stap van het aanpassen de stappen omvat van:
- het selecteren van LED's uit de ten minste drie groepen LED's voor het vormen van een nieuwe groep LED's;

waarbij het selecteren is gebaseerd op de bepaalde spreiding in en het bepaalde gemiddelde van de stralingspatronen; en

waarbij in de verificatiestap de nieuwe groep LED's wordt gebruikt.

22. Gegevensverwerkingssysteem omvattende middelen voor het uitvoeren van de stappen van een van de conclusies 15-21 of de stappen van de besturingseenheid van een van de conclusies 1-20.

23. Computerleesbaar opslagmedium omvattende instructies die, wanneer uitgevoerd door een computer, ervoor zorgen dat de computer de stappen van één van de conclusies 15-21 of de stappen van de besturingseenheid van één van de conclusies 1-20 uitvoert.



https://en.wikipedia.org/wiki/Planckian_locus

Fig. 1

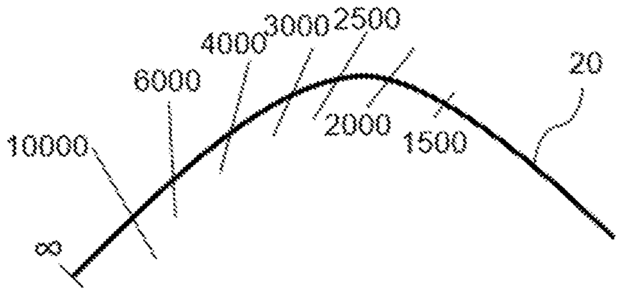


Fig. 2

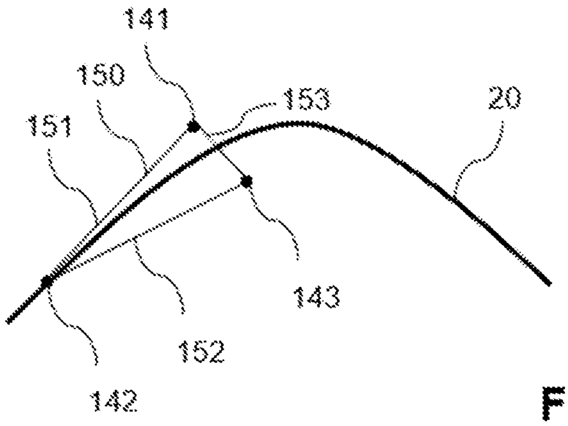


Fig. 3

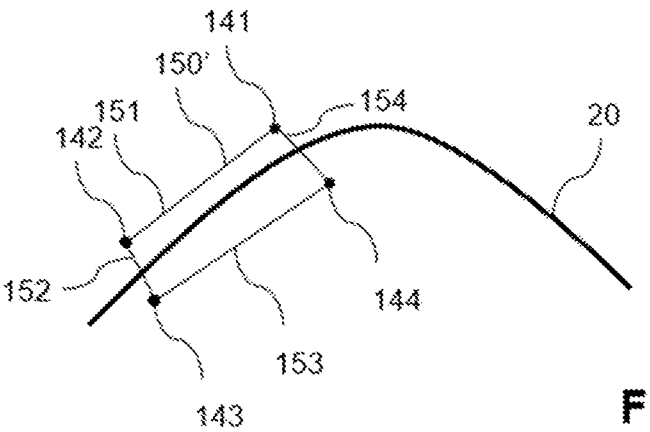


Fig. 4

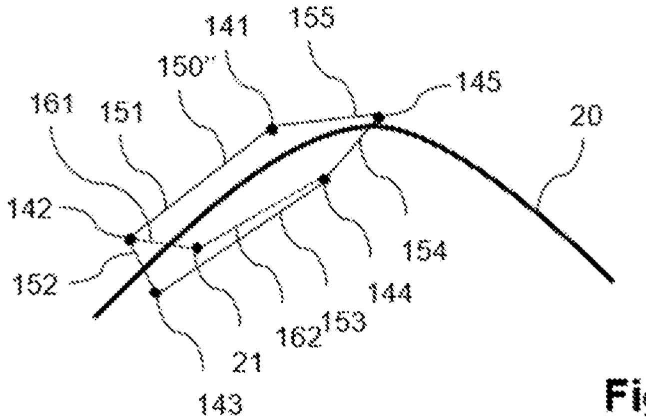

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Fig. 5

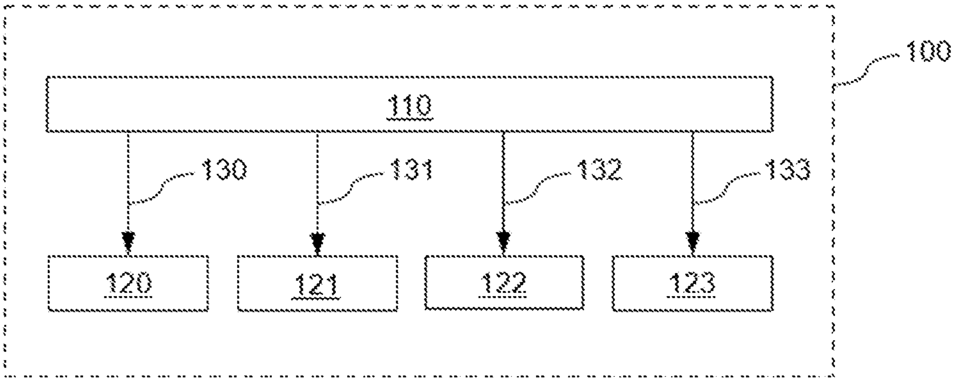
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Fig. 6

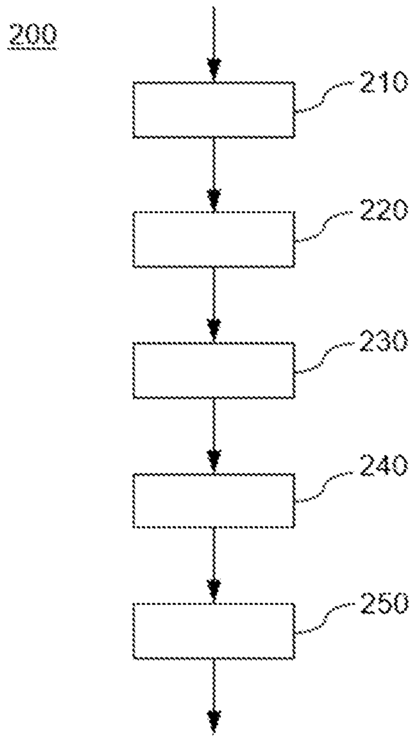

Fig. 7

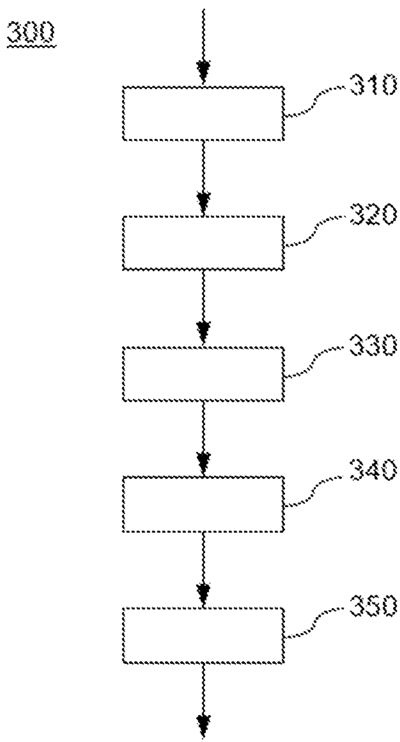

Fig. 8

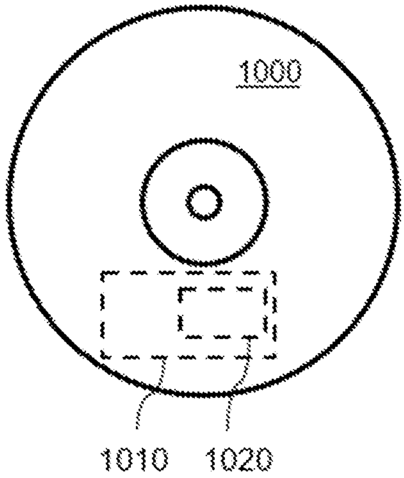

Fig. 9

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	**KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE**
Nederlands aanvraag nr. **2029552**	Indieningsdatum **29-10-2021**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **We - Did - It - Again B.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **29-01-2022**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN80560**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)
Volgens de internationale classificatie (IPC) **Zie onderzoeksrapport**

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK	
	Onderzochte minimumdocumentatie
Classificatiesysteem	Classificatiesymbolen
IPC	**Zie onderzoeksrapport**
Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen	

III.		**GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV.		**GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

Form PCT/ISA 201 A (11/2000)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2029552

A. CLASSIFICATIE VAN HET ONDERWERP
INV. H05B45/20
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
H05B F21K H01L A61B F21S F21V

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)

EPO-Internal, WPI Data, INSPEC, COMPENDEX, FSTA, IBM-TDB

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X Y	US 8 928 249 B2 (ABL IP HOLDING LLC [US]) 6 januari 2015 (2015-01-06) * kolom 1, regels 24-35; figuren 1-12 * * kolom 2, regel 28 - kolom 5, regel 47 * * kolom 7, regel 20 - kolom 29, regel 11 * * in het bijzonder, kol. 1, regels 24-35; van kol. 2, regel 54 tot kol. 3, regel 4; kol. 3, regels 41-45; van col. 3, regel 62 tot kol. 4, regel 5; kol. 7, regels 20-43, 62-67; van kol. 9, regel 6 tot kol. 10, regel 11; van kol. 11, lijn 67 tot kol. 12, regel 2; kol. 13, regels 11-20, 55-59; van kol. 16, regel 46 tot kol. 19, regel 12; van kol. 28, regel 5 tot kol. 29, regel 11; Fig. 1, 2A-2B, 3, 4A-4C, 6-8, 9A-9C, 12A-12D * ----- -/--	1-7, 11-13, 15,19-23 8-10,14, 16-18

[X] Verdere documenten worden vermeld in het vervolg van vak C.

[X] Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
31 mei 2022	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Brosa, Anna-Maria

1

Formulier PCT/ISA/201 (tweede blad) (Januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2029552

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	US 9 133 990 B2 (DICON FIBEROPTICS INC [US]; DICON FIBEROPTICS INC [US]) 15 september 2015 (2015-09-15)	1-7,11, 15,20, 22,23
Y	* kolom 1, regels 10-16; figuren 1-13 * * kolom 3, regels 14-43 *	8-10,14, 16-18
A	* kolom 4, regel 42 - kolom 16, regel 19 * * in het bijzonder, kol. 9, regels 53-55; van kol. 10, regel 3 tot kol. 12, regel 22; van kol. 15, regel 12 tot kol. 16, regel 19; Fig. 8, 9A-9B, 13A-13B * -----	12,13, 19,21
X	US 2015/289327 A1 (CAMPBELL GREGORY [US] ET AL) 8 oktober 2015 (2015-10-08)	1-7,11, 15,20, 22,23
Y	* bladzijde 1, alinea 2; figuren 1-21 * * bladzijde 1, alinea 6 - bladzijde 2, alinea 22 *	8-10,14, 16-18
A	* bladzijde 2, alinea 50 - bladzijde 8, alinea 117 * * in het bijzonder de alinea's [0051], [0073], [0115]-[0117]; Figuren 20, 21A-21C * -----	12,13, 19,21
Y	WO 2005/009085 A1 (TIR SYSTEMS LTD [CA]; ASHDOWN IAN [CA]) 27 januari 2005 (2005-01-27) * in het bijzonder bladzijde 4, regels 16-18; bladzijde 6, regels 5-34; bladzijde 8, regels 12-25; bladzijde 10, regels 19-22; bladzijde 11, regels 17-21; van bladzijde 12, regel 2 tot bladzijde 13, regel 21; figuren 3-5; het gehele document * -----	8-10, 16-18
Y	EP 1 462 711 A1 (OKUMURA YUKIYASU [JP]) 29 september 2004 (2004-09-29) * bladzijde 2, alinea 1 * * bladzijde 2, alinea 5 - bladzijde 3, alinea 8 * * bladzijde 3, alinea 10 - bladzijde 8, alinea 50 * * in het bijzonder de alinea's [0005], [0014], [0016]; Figuren 1, 4 * -----	14

1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek

NL 2029552

In het rapport genoemd octrooigeschrift		Datum van publicatie	Overeenkomend(e) geschrift(en)			Datum van publicatie
US 8928249	B2	06-01-2015	GEEN			
US 9133990	B2	15-09-2015	US	2014210368	A1	31-07-2014
			US	2016007419	A1	07-01-2016
US 2015289327	A1	08-10-2015	CA	2943851	A1	08-10-2015
			US	2015289327	A1	08-10-2015
			US	2015289333	A1	08-10-2015
			US	2015289334	A1	08-10-2015
			US	2015289335	A1	08-10-2015
			WO	2015153147	A1	08-10-2015
WO 2005009085	A1	27-01-2005	CA	2533209	A1	27-01-2005
			CN	1857034	A	01-11-2006
			EP	1649730	A1	26-04-2006
			JP	5197957	B2	15-05-2013
			JP	2006528419	A	14-12-2006
			US	2005062446	A1	24-03-2005
			US	2008224024	A1	18-09-2008
			WO	2005009085	A1	27-01-2005
EP 1462711	A1	29-09-2004	CN	1575394	A	02-02-2005
			EP	1462711	A1	29-09-2004
			JP	4146797	B2	10-09-2008
			JP	4774076	B2	14-09-2011
			JP	2008258169	A	23-10-2008
			JP	WO2003019072	A1	16-12-2004
			US	2004264193	A1	30-12-2004
			WO	03019072	A1	06-03-2003

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN80560	29.10.2021		NL2029552

International Patent Classification (IPC) INV. H05B45/20
Applicant We - Did - It - Again B.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I — Basis of the opinion
- ☐ Box No. II — Priority
- ☐ Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV — Lack of unity of invention
- ☒ Box No. V — Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI — Certain documents cited
- ☒ Box No. VII — Certain defects in the application
- ☒ Box No. VIII — Certain observations on the application

	Examiner Brosa, Anna-Maria

WRITTEN OPINION

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	2, 3, 8-10, 12-14, 16-18, 21
	No:	Claims	1, 4-7, 11, 15, 19, 20, 22, 23
Inventive step	Yes:	Claims	
	No:	Claims	1-23
Industrial applicability	Yes:	Claims	1-23
	No:	Claims	

2. Citations and explanations

   see separate sheet

WRITTEN OPINION

Box No. VII Certain defects in the application

see separate sheet

Box No. VIII Certain observations on the application

see separate sheet

<u>Re Item V</u>

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 8 928 249 B2 (ABL IP HOLDING LLC [US]) 6 januari 2015 (2015-01-06)

D2 US 9 133 990 B2 (DICON FIBEROPTICS INC [US]; DICON FIBEROPTICS INC [US]) 15 september 2015 (2015-09-15)

D3 US 2015/289327 A1 (CAMPBELL GREGORY [US] ET AL) 8 oktober 2015 (2015-10-08)

D4 WO 2005/009085 A1 (TIR SYSTEMS LTD [CA]; ASHDOWN IAN [CA]) 27 januari 2005 (2005-01-27)

D5 EP 1 462 711 A1 (OKUMURA YUKIYASU [JP]) 29 september 2004 (2004-09-29)

2 Insofar as the subject-matter of claims **1, 15** and **19** can be understood (see objections under section **VIII** below), the present application does not meet the criteria of patentability because the subject-matter of claims **1, 15** and **19** is not new.

2.1 The document **D1** discloses (the references between parentheses applying to this document) a lichtinrichting geconfigureerd voor het uitstralen van nagebootste zwartlichaamstraling (see the whole document, especially col. 1, lines 24-35; from col. 2, line 28 to col. 5, line 47; from col. 7, line 20 to col. 29, line 11; Figs. 1-12, in particular, col. 1, lines 24-35; from col. 2, line 54 to col. 3, line 4; col. 3, lines 41-45; from col. 3, line 62 to col. 4, line 5; col. 7, lines 20-43, 62-67; from col. 9, line 6 to col. 10, line 11; from col. 11, line 67 to col. 12, line 2; col. 13, lines 11-20, 55-59; from col. 16, line 46 to col. 19, line 12; from col. 28, line 5 to col. 29, line 11; Figs. 1, 2A-2B, 3, 4A-4C, 6-8, 9A-9C, 12A-12D);

waarbij zwartlichaamstraling een locuskromme heeft in de CIE 1931 x,y-ruimte afhankelijk van een lichaamstemperatuur van een uitstralend zwart-lichaam (col. 16, lines 46-51; Fig. 9A);

waarbij de nagebootste zwartlichaamstraling zwartlichaamstraling nabootst voor een lichaamstemperatuurbereik (Figs. 2A, 9B); en

waarbij de lichtinrichting omvat:

- ten minste drie LED's die elk verschillende stralingspatronen hebben die samen de nagebootste zwartlichaamstraling vormen (col. 9, lines 6-24; Fig. 1: Green LED 18, Blue LED 19, warm White LED 15a, Red LED 15b, phosphor converted Amber LED 15), waarbij de ten minste drie stralingspatronen een convexe veelhoek definiëren die een locuskrommegedeelte van de locuskromme gedefinieerd door het lichaamstemperatuurbereik omgeeft (Figs. 2A, 9B);
- een besturingseenheid (Fig. 1: Microcontroller 22 and LED drivers 21a, 21b, 21c) geconfigureerd voor:
  - het ontvangen van een invoer die geassocieerd is met een ingestelde lichaamstemperatuur (Fig. 1: User Input);
  - het vertalen van de invoer naar een LED-instelling voor elk van de ten minste drie LED's (Fig. 1: conversion of the User Input by the Microcontroller 22 into suitable driving outputs for LED drivers 21a-21c); en
  - het instellen van de ten minste drie LED's volgens de LED-instellingen (Fig. 1: providing the respective LED settings to the LEDs through the LED drivers 21a-21c); en

waarbij de convexe veelhoek nauwsluitend rond het locuskrommegedeelte past (from col. 17, line 62 o col. 18, line 16; Figs. 2A, 9B).

Consequently, claim **1** is not allowable for lack of novelty of its subject-matter.

2.2 Since claim **15** appears to form the corresponding independent method claim, the same objection applies *mutatis mutandis*.

2.3 The same objection applies when considering each of the documents **D2** and **D3**. In particular,

2.3.1 The document **D2** discloses (the references between parentheses applying to this document) a lichtinrichting geconfigureerd voor het uitstralen van nagebootste zwartlichaamstraling (see the whole document, especially col. 1, lines 10-16; col. 3, lines 14-43; from col. 4, line 42 to col. 16, line 19; Figs. 1-13, in particular, col. 9, lines 53-55; from col. 10, line 3 to col. 12, line 22; from col. 15, line 12 to col. 16, line 19; Figs. 8, 9A-9B, 13A-13B);

waarbij zwartlichaamstraling een locuskromme heeft in de CIE 1931 x,y-ruimte afhankelijk van een lichaamstemperatuur van een uitstralend zwart-lichaam (Fig. 9B);

waarbij de nagebootste zwartlichaamstraling zwartlichaamstraling nabootst voor een lichaamstemperatuurbereik (col. 3, lines 28-33); en waarbij de lichtinrichting omvat:

- ten minste drie LED's die elk verschillende stralingspatronen hebben die samen de nagebootste zwartlichaamstraling vormen (col. 11, lines 8-57; from col. 15, line 66 to col. 16, line 8; Figs. 13A-13B), waarbij de ten minste drie stralingspatronen een convexe veelhoek definiëren die een locuskrommegedeelte van de locuskromme gedefinieerd door het lichaamstemperatuurbereik omgeeft (col. 11, lines 21-39);
- een besturingseenheid (Fig. 13B: microcontroller) geconfigureerd voor:
  - het ontvangen van een invoer die geassocieerd is met een ingestelde lichaamstemperatuur (Fig. 13B: inputs provided to the microcontroller);
  - het vertalen van de invoer naar een LED-instelling voor elk van de ten minste drie LED's (Fig. 13B: conversion of the user input by the microcontroller into suitable driving outputs for LED driver circuits 1-4); en
  - het instellen van de ten minste drie LED's volgens de LED-instellingen (Fig. 1: providing the respective LED settings to the LEDs through the LED driver circuits 1-4); en

  waarbij de convexe veelhoek nauwsluitend rond het locuskrommegedeelte past (col. 11, lines 33-39).

2.3.2 The document **D3** discloses (the references between parentheses applying to this document) a lichtinrichting geconfigureerd voor het uitstralen van nagebootste zwartlichaamstraling (see the whole document, especially page 1, par. [0002]; from page 1, par. [0006] to page 2, par. [0022]; from page 2, par. [0050] to page 8, par. [0117]; Figs. 1-21, in particular, pars. [0051], [0073], [0115]-[0117]; Figs. 20, 21A-21C);

waarbij zwartlichaamstraling een locuskromme heeft in de CIE 1931 x,y-ruimte afhankelijk van een lichaamstemperatuur van een uitstralend zwart-lichaam (Fig. 12);

waarbij de nagebootste zwartlichaamstraling zwartlichaamstraling nabootst voor een lichaamstemperatuurbereik (Figs. 21A-21C); en

waarbij de lichtinrichting omvat:

- ten minste drie LED's die elk verschillende stralingspatronen hebben die samen de nagebootste zwartlichaamstraling vormen (par. [0113]; Fig. 20), waarbij de ten minste drie stralingspatronen een convexe veelhoek definiëren die een locuskrommegedeelte van de locuskromme gedefinieerd door het lichaamstemperatuurbereik omgeeft (Figs. 21A-21B);

- een besturingseenheid (Fig. 3: ASIC 330) geconfigureerd voor:
  - het ontvangen van een invoer die geassocieerd is met een ingestelde lichaamstemperatuur (par. [0117]);
  - het vertalen van de invoer naar een LED-instelling voor elk van de ten minste drie LED's (par. [0117]); en
  - het instellen van de ten minste drie LED's volgens de LED-instellingen (par. [0117])); en

waarbij de convexe veelhoek nauwsluitend rond het locuskrommegedeelte past (par. [0116])).

2.4 The document **D1** discloses (the references between parentheses applying to this document) a methode voor het produceren van sets LED's voor een lichtapparaat dat is geconfigureerd voor het uitstralen van nagebootste zwartlichaamstraling (see the whole document, especially col. 1, lines 24-35; from col. 2, line 28 to col. 5, line 47; from col. 7, line 20 to col. 29, line 11; Figs. 1-12, in particular, col. 1, lines 24-35; from col. 2, line 54 to col. 3, line 4; col. 3, lines 41-45; from col. 3, line 62 to col. 4, line 5; col. 7, lines 20-43, 62-67; from col. 9, line 6 to col. 10, line 11; from col. 11, line 67 to col. 12, line 2; col. 13, lines 11-20, 55-59; from col. 16, line 46 to col. 19, line 12; from col. 28, line 5 to col. 29, line 11; Figs. 1, 2A-2B, 3, 4A-4C, 6-8, 9A-9C, 12A-12D);

waarbij zwartlichaamstraling een locuskromme heeft in de CIE 1931 x,y-ruimte afhankelijk van een lichaamstemperatuur van een uitstralend zwart-lichaam (col. 16, lines 46-51; Fig. 9A);

waarbij de nagebootste zwartlichaamstraling zwartlichaamstraling nabootst voor een lichaamstemperatuurbereik (Figs. 2A, 9B); en

waarbij de werkwijze de stappen omvat van:

- het verschaffen van minimaal drie groepen LED's (col. 11, lines 8-57; from col. 15, line 66 to col. 16, line 8; Figs. 13A-13B);
- het bepalen van een spreiding in en een gemiddelde van stralingspatronen van LED's van elk van de groep LED's (col. 15, lines 3-19);

- het verifiëren of het gemiddelde en de spreiding van de stralingspatronen voor elk van de groepen LED's die een convexe veelhoek in het slechtste geval definiëren, een locuskrommegedeelte omringt van de locuskromme gedefinieerd door het lichaamstemperatuurbereik (from col. 9, line 25 to col. 10, line 11; from col. 17, line 40 to col. 18, line 16);
  - indien de verificatie negatief is, het aanpassen van ten minste één van het gemiddelde en de spreiding van de stralingspatronen van ten minste één van de ten minste drie groepen LED's (from col. 17, line 62 to col. 18, line 16); en
  - als de verificatie positief is, het selecteren van een LED uit elk van de drie groepen voor het vormen van een verzameling LED's voor het vormen van een lichtinrichting voor het samen vormen van de nagebootste zwartlichaamstraling te vormen (col. 10, lines 1-11; Fig. 2a).

Consequently, claim **19** is not allowable for lack of novelty of its subject-matter.

3 Dependent claims **2-14, 16-18** and **20-23** do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of patentability in respect of novelty and/or inventive step, the reasons being as following:

- the additional features defined in claims **2, 3** are possible design implementations. It is clear that these dimensions could be arrived at by routine trial and error or by application of normal design procedures. Hence, the skilled person would select said dimensions depending on the design circumstances and/or constraints, thereby arriving at the subject-matter of these claims without an inventive step;
- the additional features defined in claim **4** are disclosed or hinted at in each of **D1** (col. 9, lines 66-67; Figs. 2A, 9A-9B), **D2** () and **D3** ();
- the additional features defined in claim **5** are disclosed or hinted at in each of **D1** (col. 21, lines 31-40; col. 12, lines 4-34; Figs. 4A-4C), **D2** () and **D3** ();
- the additional features defined in claims **6, 7** are disclosed or hinted at in each of **D1** (Figs. 2A, 9B), **D2** () and **D3** ();
- the additional features defined in claims **8-10** and **16-18** are disclosed or hinted at in each of the following combinations **D1** (see the passages cited in section **V.2.1** above)- **D4** (see the whole document, esp. page 4, lines 16-18; page 6, lines 5-34; page 8, lines 12-25; page 10, lines 19-22; page 11, lines 17-21; from page 12, line 2 to page 13, line 21; Figs. 3-5),

D2 (see the passages cited in section **V.2.3.1** above)- **D4** (see the whole document, esp. page 4, lines 16-18; page 6, lines 5-34; page 8, lines 12-25; page 10, lines 19-22; page 11, lines 17-21; from page 12, line 2 to page 13, line 21; Figs. 3-5) and **D3** (see the passages cited in section **V. 2.3.2** above)- **D4** (see the whole document, esp. page 4, lines 16-18; page 6, lines 5-34; page 8, lines 12-25; page 10, lines 19-22; page 11, lines 17-21; from page 12, line 2 to page 13, line 21; Figs. 3-5);

- the additional features defined in claim **11** are disclosed or hinted at in **D1** (Figs. 2A, 9B);
- the additional features defined in claims **12, 13, 21** are disclosed or hinted at in **D1** (from col. 9, line 25 to col. 10, line 11; from col. 17, line 40 to col. 18, line 16);
- the additional features defined in claim **14** are disclosed or hinted at in each of the following combinations **D1** (see the passages cited in section **V.2.1** above)- **D5** (see the whole document, esp. pars. [0005], [0014], [0016]; Figs. 1, 4), **D2** (see the passages cited in section **V.2.3.1** above)- **D5** (ee the whole document, esp. pars. [0005], [0014], [0016]; Figs. 1, 4) and **D3** (see the passages cited in section **V.2.3.1** above)- **D5** (ee the whole document, esp. pars. [0005], [0014], [0016]; Figs. 1, 4);
- the additional features defined in claim **20** are disclosed or hinted at in each of **D1** (see the passages cited in section **V.2.1** above), **D2** (see the passages cited in section **V.2.3.1** above) and **D3** (see the passages cited in section **V.2.3.2** above);
- the additional features defined in claims **22, 23** are disclosed or hinted at in each of **D1** (see the passages cited in section **V.2.1** above, in particular, from col. 28, line 5 to col. 29, line 11), **D2** (see the passages cited in section **V.2.3.1** above, in particular, the functions of the microcontroller in Fig. 13B) and **D3** (see the passages cited in section **V.2.3.2** above, in particular, the functions of the ASIC 330 throughout the figures).

Re Item VII

Certain defects in the international application (form or content).

1 The independent claims are not properly cast in the **two part form**, with those features which in combination are disclosed by **D1** being placed in the preamble.

2 Some eference signs in parentheses are missing in the claims (e.g. 20,120, 121, 122, 123, 130, 131, 132, 133, 141, 142, 143, 144, 145, ... etc.).

3 The documents **D1-D5** and their relevant background disclosed therein are not identified in the description.

4 Formal issues

4.1 The last sentence of page 3, line 10 of the description appears to be incomplete ("*As the radiation patterns of the at least three LEDs are typically*" ???).

4.2 It would appear that the wording "*A Led*", found on page 6, line 20 of the description, should be replaced by "An LED".

4.3 The wording found on page 10, lines 14-15 of the description should be delated, because the patent specification should, regarding the essential features of the invention, be self-contained, i.e. capable of being understood without reference to any other document.

4.4 The reference sign "160" mentioned on page 11, line 25 of the description is not indicated in Fig. 5.

5 The following passages in the description:

- page 13, lines 5-9 ("*Starting from this disclosure* [...] *and the disclosure of this patent*");
- page 14, lines 24-26 ("*The mere fact* [...] *used to advantage*");
- page 15, lines 27-29

render the definition of the subject-matter of the claims unclear.

6 The following passage in the description:

- page 15, line 30

constitutes unnecessary subject-matter.

Re Item VIII

Certain observations on the international application (clarity).

1 The subject-matter of claims **1**, **8-17, 19** and **21-23** are not clear.

1.1 The relative term "*nauwsluitend*" used in claims **1**, **11**, **15** and **16** is too broad, and leaves the reader in doubt as to the meaning of the technical features to which it refers (how much does "snugly fitting" mean with respect to the black-body locus?), thereby rendering the definition of the subject-matter of claims **1**, **11**, **15** and **16** unclear.

1.2 Claim **8** does not meet the requirement of clarity because the matter for which protection is sought is not clearly defined. The claim attempts to define the subject-matter in terms of the result to be achieved, which merely amounts to a statement of the underlying problem, without providing the technical features necessary for achieving this result. In particular, it is not clear which technical features are necessary in order to ensure that "*the convex polygon snugly fits around the locus curve section* <u>*during the operational time*</u>".

The same objection correspondingly applies to claim **16**.

1.3 Some of the features in the apparatus claims **9, 10** relate to a method of using the apparatus (claim **9**: "*wordt voorspeld*"; claim **10**: "*is getraind*"), rather than clearly defining the apparatus in terms of its technical features. The intended limitations are therefore not clear from claims **9, 10**. In particular, it is not clear which component within the claimed light device is configured to predict the predictable shift, or to train the neural network.

1.4 The term "*bij voorkeur*", found in claim **10**, results in the features following that term having <u>no limiting effect</u> on the scope of protection, thereby rendering the definition of the subject-matter of claim **10** unclear

1.5 Some of the features in the apparatus claims **12, 13** relate to a method of using the apparatus ("*wordt verwijderd*"), rather than clearly defining the apparatus in terms of its technical features. The intended limitations are therefore not clear from claims **12, 13**. In particular, it is not clear which component within the claimed light device is configured to predict the predictable shift, or to train the neural network.

1.6 The relative wording "*te veel verschuift*" used in claim **13** is too broad, and leave the reader in doubt as to the meaning of the technical features to which it refers (how much does "too much" mean? with respect to what is said shift defined?), thereby rendering the definition of the subject-matter of claim **13** unclear.

1.7 The wording "*steun-LED*", found in claim **14**, has no well-recognised meaning, and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of claim **14** unclear.

1.8 The wording "*om bij te dragen*", found in claim **14**, does not allow the reader to infer how the contribution of the support LED to the mimicked black-body radiation is actually defined, thereby rendering the definition of the subject-matter of claim **14** unclear.

1.9 In claim **15**, page 23, line 32, the wording "*de positie*" has no antecedent, and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of claim **15** unclear.

1.10 The wording found from page 23, line 34 to page 24, line 2 of claim **15** implies a condition to be fulfilled. However, the claim does not specify what happens if said condition does not occur (open end), thereby rendering the definition of the subject-matter of claim **15** unclear.

1.11 In claim **17**, line 32, the wording "*de verschuiving*" has no antecedent, and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of claim **17** unclear.

1.12 The wording "*het slechtste geval*" found in claim **19**, page 25, line 2, does not allow the reader to infer how said worst case convex polygon is actually defined, thereby rendering the definition of the subject-matter of claim **17** unclear.

1.13 The wording of claim 21 does not allow the reader to infer how the selection of LEDs from the at least three groups of LEDs for forming a new group of LEDs is actually carried out (i.e., based on which criteria?), thereby rendering the definition of the subject-matter of claim **21** unclear.

1.14 Claim **22** refers to "*de stappen van de besturingseenheit van eenvan de conclusies 1-20*". However, claims **1-14** are directed to a light device; the controller is only a part of the light device. The dependency and, thus, the subject-matter of claim **22** is unclear.

The same objection correspondingly applies to claim **23**.