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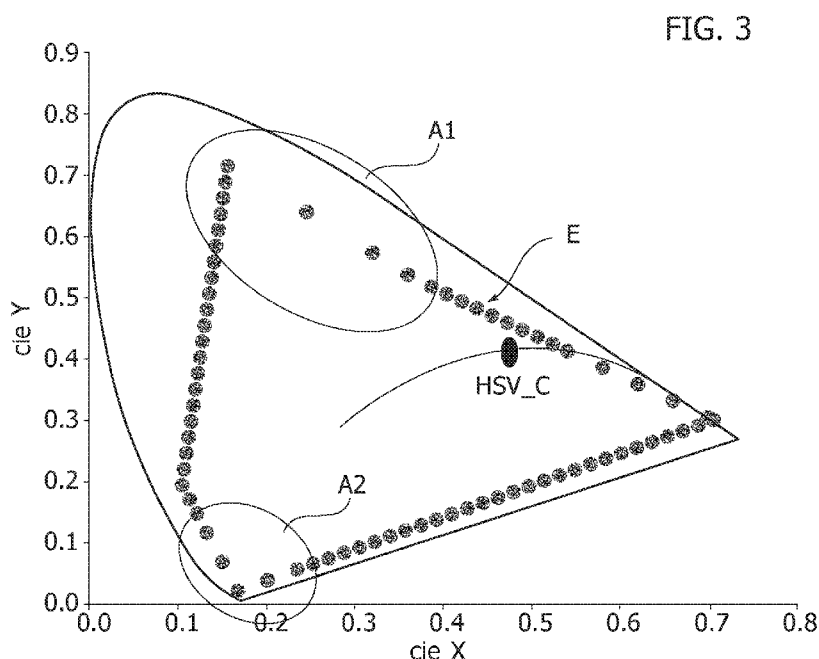
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(54) Title: A METHOD OF CONTROLLING LIGHTING SOURCES, CORRESPONDING SYSTEM AND COMPUTER PROGRAM PRODUCT



(57) Abstract: Colour points in a gamut area of a colour space, for reproduction by a plurality of e.g. LED light radiation sources (L1, L2, L3) of different colours, are identified by calculating successive points on the perimeter (E) of the gamut area, with said successive points having, in an HSV system (HSV_C), angular coordinate values representative of respective hue values. The method includes: selecting an increment step value for said angular coordinate, and calculating, from a starting colour point, a next colour point on the perimeter (E) of the gamut area, as a function of the increment step value (δ) selected for the angular coordinate, - calculating a metric (e.g. SDCM) indicative of the distance between the starting colour point and the next colour point, - applying to the calculated metric an acceptance test with at least one acceptance threshold, and i) if the calculated metric passes the acceptance test, calculating a further next colour point by using said next colour point as a new starting colour point, and ii) if the calculated metric fails the acceptance

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"A method of controlling lighting sources,
corresponding system and computer program product"

Technical Field

5 The present description relates to the control of
lighting sources.

One or more embodiments may be applied to the
control of electrically-powered light radiation
sources, e.g. solid-state light radiation sources such
10 as LED sources.

Technological Background

Lighting sources such as solid-state sources may
be employed in order to obtain colour points on a gamut
area, the possibility being given e.g. to obtain
15 tuneable white colour temperatures.

This result may be achieved by using sources (e.g.
LED sources) having different colours (which may be
defined as "LEDs of different types"). These LEDs may
be embedded in the same package (so-called multi-chip
20 LEDs) or may comprise a plurality of discrete LEDs
mounted on a support such as a Printed Circuit Board
(PCB).

The available colours define the gamut in a
chromatic coordinate system. Each point within the
25 gamut may be obtained by combining the light radiation
of a plurality of sources, e.g. LED sources, each
having a specific flux value (which may be adjustable
e.g. via a dimming action).

A currently established technique for representing
30 the coordinates of the colour points present in the
gamut area is the system known as HSV, acronym for Hue-
Saturation-Value. This system may be defined
essentially as a polar coordinate system, wherein the
hue value is represented by the angle, the saturation
35 value is given by the radius, and an added parameter is

the brightness value, corresponding e.g. to the dimming value.

Such a system implements a sort of rearrangement of the geometry of a colour space, e.g. RGB, which may
5 be more intuitive and perceptually relevant than a Cartesian representation.

A possible practical setup of an HSV system envisages the presence of a linear constant step size change for all the three control factors: in other
10 words, a constant angle step (hue), a constant distance step (saturation) and a constant dimming step (brightness). Such a choice identifies the resolution step of the system.

In this way, assuming a point having a given
15 Correlated Colour Temperature (CCT) inside the gamut area as a reference centre of the HSV system, changing the hue value equals to circle around said centre through all the available colours given by the combinations of the LEDs of different types (e.g. of
20 different colours), the resulting colour being more or less saturated and/or bright as a function of the values adopted.

This approach based on constant angle steps, however, does not consider that the human eye (or a
25 camera) perceives colour changes more or less evidently as a function of the position in the gamut and of the point changing direction: this can be understood easily by referring e.g. to the graph shown in Figure 1, which represents, within a CIE 1931 chromaticity diagram, the so-called MacAdam ellipses, i.e. ellipses which vary in
30 size and orientation within the gamut (see for example https://en.wikipedia.org/wiki/MacAdam_ellipse).

Specifically, the graph in Figure 1 represents standard variations in chromaticity, shown to a scale
35 which is tenfold the actual scale in the CIE 1931

chromaticity diagram.

This fact may be further appreciated with reference to the situation exemplified in Figure 2, wherein, assuming the reference to a general point
5 HSV_C, taken as the centre of the HSV system, it is evident that a certain angle variation step (denoted as θ) may originate different distances, denoted as L_1 and L_2 , between two points located at different (radial) distances R_1 , R_2 (i.e. having two different saturation
10 values) from centre point HSV_C.

Upon approaching one of the corners of the perimeter of the gamut area, the movement with a constant angle step may originate, with reference to intrinsically reachable points, resolution values which
15 in most cases may be insufficient.

Object and Summary

One or more embodiments aim at overcoming the drawbacks described in the foregoing.

According to one or more embodiments, said object
20 may be achieved by a method having the features set forth in the claims that follow.

One or more embodiments may concern a corresponding system for controlling lighting sources (e.g. a system operating according to the DMX (Digital
25 Multiplex) standard, e.g. DMX 256 or DMX 512), as well as a corresponding computer program product loadable into at least one processing device and including software code portions for performing the method according to one or more embodiments, when the product
30 is run on at least one processing device.

As used herein, the reference to said computer program product includes computer-readable media containing instructions for controlling a processing device, in order to coordinate the implementation of
35 the method according to the invention. The reference to

"at least one processing device" highlights the possibility of implementing the present invention in a modular and/or distributed form.

One or more embodiments may face the problem of the different ways in which the human eye recognizes and distinguishes colours in different areas of a colour space (such as the CIE 1931 colour space, as exemplified in the previous Figure 1, showing the MacAdam ellipses).

One or more embodiments may envisage recalibrating the achievable colour points by varying the angle step which is adopted, e.g. according to an HSV system, by a control device such as a DMX system, having for instance an 8-bit resolution.

One or more embodiments, therefore, may refer, at least conceptually, to the size of the MacAdam ellipse in each colour area, thus using a variable angle resolution which is implementable and acceptable for the various areas of interest.

Brief Description of the Figures

One or more embodiments will now be described, by way of non-limiting example only, with reference to the annexed Figures, wherein:

- Figures 1 and 2 have already been discussed in the foregoing,

- Figure 3 exemplifies, with reference to a chromaticity diagram as shown in Figure 1, some critical aspects which are dealt with in one or more embodiments,

- Figure 4 is a diagram representing the ways of recognizing colours in the human eye,

- Figure 5, which substantially refers to the representation of Figure 3, exemplifies implementation criteria of one or more embodiments,

- Figure 6 is an exemplary diagram of possible

operating criteria of a DMX system,

- Figure 7 is an exemplary diagram of criteria on which one or more embodiments may be based,

- Figure 8 represents, with the same representation criteria of Figures 3 and 5, the results achievable according to one or more embodiments,

- Figure 9 exemplifies, with possible reference to the diagram of Figure 6, the results achievable by one or more embodiments,

- Figure 10 is a block diagram of a DMX system which may be used in one or more embodiments, and

- Figure 11 is a flow chart exemplifying possible embodiments.

Detailed Description

In the following description, various specific details are given to provide a thorough understanding of various exemplary embodiments. The embodiments may be practiced without one or several specific details, or with other methods, components, materials, etc. In other instances, well-known structures, materials or operations are not shown or described in detail to avoid obscuring various aspects of the embodiments.

Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the possible appearances of phrases such as "in one embodiment" or "in an embodiment" in various places of the present specification are not necessarily all referring to the same embodiment. Furthermore, particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

The headings provided herein (including the references provided in Figures 1 and 2, already

described in the foregoing) are given for convenience only, and therefore do not interpret the extent of protection or scope of the embodiments.

Figure 3 exemplifies, with reference to a CIE 1931
5 chromaticity diagram, a possible mapping of colour points adapted to be achieved in the use of a lighting source including electrically-powered, e.g. solid-state, light radiation sources, e.g. LED sources, adapted to be defined as sources "of different types",
10 meaning that such light radiation sources emit light radiations having different wavelengths or situated about different wavelengths.

Such light radiation sources, which may be used e.g. for the generation of a generally white light
15 radiation with adjustable Correlated Colour Temperature (CCT), are in themselves known in the art, which makes it unnecessary to provide a more detailed description herein.

It is known, moreover, that one or more light
20 radiation sources of this type may be used in a DMX system (specifically in a so-called DMX "universe", e.g. a DMX 512 universe), wherein said light radiation sources may be configured "slave" devices L1, L2, L3 (which may be mutually connected in a "daisy chain"
25 configuration, with a so-called terminator T), adapted to be controlled by a controller M, as shown in the diagram of Figure 10.

The DMX system (originally developed by the Engineering Commission of the United States Institute
30 for theatre Technology - USITT) is the subject of an extensive literature, including regulations, which may be referred to for a general description of the features and the operation of such a system, as well as for the possible implementation of the operating modes
35 described in the following, e.g. referring to the flow

chart of Figure 11.

The diagram in Figure 3 exemplifies a possible mapping of the colour points reachable with a centre CCT of 2500 K with a maximum saturation value, assuming
5 that the angular coordinate of the HSV system is varied with a constant step δ .

With such a constant angle step (as previously illustrated with reference to Figure 2), the distance between pairs of adjacent points is not the same along
10 the achievable gamut perimeter. For example, as visible in the Figure, in the yellow-green area denoted as A1 there may be a remarkable gap between adjacent points; in other words, in this area the colour points are rather sparse. A similar, although less marked,
15 situation may be found e.g. in the blue-magenta area, denoted as A2 in the same Figure 3.

The diagram in Figure 4 exemplifies a possible graph of the SDCM (Standard Deviation of Colour Matching) value, on the y-axis, between adjacent points
20 in the diagram of Figure 3, as a function of the angle value (on the x-axis).

In the diagram of Figure 4 the presence is found of at least two peaks (even three, considering the right-most part of the graph), which correspond to
25 areas wherein two colour points are recognized by the human eye as having (markedly) different colours, although they are separated by a constant hue variation step.

The diagram of Figure 5 once again shows the
30 diagram of Figure 3, particular attention being paid to both the yellow-green area A1 and the blue-magenta area A2 (without showing the other areas for the sake of simplicity), highlighting that in the blue-magenta area A2, in addition to the presence of a low number of
35 points covering a rather large space of the gamut,

there is also present a rather sharp corner area with a low resolution of colour points.

The diagram in Figure 6 shows, always referring to a CCT value amounting to 2500 K (and therefore referring to a representation substantially corresponding to Figures 3 and 5), the possible functional relationship between the coarse hue regulation value of a DMX system (Hue Coarse DMX, assuming a system with 8-bit resolution) and the corresponding angle value, which is assumed as having a constant increment step value δ .

The diagram of Figure 7 exemplifies, by referring directly to the diagram of Figure 4, implementation possibilities of one or more embodiments, wherein the SDCM value (or optionally the value of another metric) for detecting the matching of different colours is treated by acting on the angle increment step value δ , by recalculating the new values of the angular coordinate of the HSV system in order limit SDCM (or another metric) with reference to at least one acceptance threshold, e.g. with reference to a range which is considered acceptable, such as a window of values [SDCM_min, SDCM_max].

Metrics adapted to be used as an alternative to SDCM (which is used herein by way of example) may be for instance:

$$Du'v' = \sqrt{(\Delta u')^2 + (\Delta v')^2}$$

i.e. the colour difference calculated as the Euclidean distance of the colour points in a colour plane such as CIELUV, CIEDE2000, CMC l:c, etc..

Other possible definitions of colour difference metrics may be found for example at:

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

http://www.colorwiki.com/wiki/Delta_E:_The_Color_Difference

One or more embodiments may envisage, e.g. at a controller M of a DMX system as schematically shown in Figure 10, the implementation of the steps exemplified in the flow chart of Figure 11.

5 In this chart, starting from an initial START step, step 10 (according to criteria known in themselves) envisages the identification of the edge region or perimeter E of the gamut area adapted to be implemented by the source(s) L1, L2, L3 included in the
10 lighting system.

This step may correspond to the identification of the polygonal path shown in Figure 3.

Step 12 in the chart of Figure 11 identifies the possible definition of at least one acceptance
15 threshold for the SDCM (or other) metric, calculated between two consecutive points on the perimeter of the gamut identified in step 10.

In one or more embodiments, such threshold may be identified as an acceptance window between two
20 thresholds, respectively a minimum and a maximum threshold, i.e. [SDCM_min, SDCM_max].

This involves an action such that the colour points deriving from the (new) mapping, which may be implemented according to one or more embodiments, are
25 not too sparse or too packed.

At least theoretically, in one or more embodiments only one threshold may be adopted, e.g. an upper threshold, so that the colour points are not too sparse.

30 For example, if the successive points already have a distance lower than an upper threshold, it is possible to proceed to the following steps.

In the case of frequent (very) small values, the available steps (e.g. 256 in the 8-bit instance) may be
35 insufficient to perform a re-calibration on the full

circle (360°), because the points are concentrated in useless regions. In this case it is particularly useful to perform (also) a check of $SDCM_{min}$.

Step 14 identifies the definition of the centre
5 reference point HSV_C , which is used as the origin of the polar system HSV, around which the angular coordinate must be varied through successive variation steps δ (which, according to one or more embodiments, may be made variable and no longer constant).

10 Step 16 corresponds to the definition of an (initial) value for said increment step value δ in the HSV operating mode.

It will be appreciated, however, that the sequence of performing the various steps as described herein is
15 merely exemplary and non-limiting.

Step 18 corresponds to identifying a starting colour point (Cx_0 , Cy_0) on the gamut of the available sources (e.g. LED sources): in this respect, see for example the diagram in Figure 5.

20 Step 20 corresponds to calculating a next colour point, e.g. (Cx_i , Cy_i) on the gamut (again, see for example the diagram in Figure 5), which is implemented by moving with an angle step δ as determined in the previous step 16.

25 Step 22 corresponds to calculating the metric (e.g. SDCM) between the two points (Cx_0 , Cy_0 ; Cx_i , Cy_i).

Step 24 corresponds to a step wherein the SDCM value calculated at step 22 is compared with at least
30 one acceptance threshold (e.g. a window).

If the comparison in step 24 yields a positive result (Y), the angle increment step value δ calculated at step 16 is maintained for calculating a further colour point, which is achieved by using the previously
35 obtained colour point as a (new) starting colour point.

If, on the contrary, the comparison at step 24 yields a negative result (N), indicating that the SDCM value calculated at step 22 is outside the range of acceptable values (exceeding the threshold, i.e. outside window [SDCM_min, SDCM_max]), the value δ is re-calculated in order to originate a colour point (step 20), so that the SDCM metric is recalculated in order to yield a positive comparison result in step 24. This sequence may also be iterated in succession, in case of a repetition of negative comparison results in step 24.

In one or more embodiments, the re-calculation of the increment step value δ may take into the account the direction in which the calculated metric (e.g. SDCM) value exceeds the acceptance threshold.

For example, in one or more embodiments it is possible to detect whether the calculated metric value exceeds, either upwards or downwards, the acceptance window, and the increment step value δ may be re-calculated, either by increasing or by decreasing it, thus bringing the SDCM value to the acceptance range again.

Step 26 involves a comparison, wherein it is checked whether the angular field 0° - 360° around centre HSV_C, which must be taken into account, has been wholly explored, by repeating steps 20, 22 and 24 until such angular field is completely explored (STOP).

In one or more embodiments, the repetition of steps 20, 22, 24 may be implemented by using, as a starting value for increment δ , the value obtained in the previous step.

On the other hand, when returning from step 26 to step 20, it is in no way mandatory to use the value δ obtained in the previous step: in one or more embodiments, it is possible to re-start with the value

δ which has initially been defined at step 16.

In one or more embodiments, it is possible to take into account that the identification of the threshold / window of acceptable values [SDCM_min, SDCM_max] may sometimes be too strict, so as not to enable a calculation throughout the 360° angular field with a given resolution.

For example, if a DMX system with 8-bit resolution is employed, 256 angle steps are available. If a higher number of steps is desirable, e.g. 512 steps, the system resolution may be increased.

One or more embodiments are adapted to originate a sort of "new mapping" of the colour points, as schematically shown in Figure 8, the possibility being offered (optionally on a 360° angular field) of covering the areas wherein the colour changes are more markedly perceived by the human eye with a number of points sufficient to support a smooth transition, optionally by covering the areas wherein such changes are less perceivable with a lower number of points.

For example, the diagram in Figure 8 exemplifies, via a direct comparison with the representations of Figures 3 and 5, that according to one or more embodiments the yellow-green area A1 and the blue-magenta area A2 may be covered with a proper number of points.

The re-definition of the HSV metric at perimeter E of the gamut area may be beneficial also for the points located within the corresponding polygonal path and positioned at a shorter distance from reference centre HSV, therefore having shorter distances between adjacent points achieved via the consecutive steps of angle increment.

The diagram in Figure 9 exemplifies, in a comparison with the diagram of Figure 6, the possible

functional relation which may be established between the angle value (determined by the succession of increments δ having variable values) and the Hue Coarse DMX parameter, in one or more embodiments.

5 The diagram in Figure 9 exemplifies a relation which, generally speaking, can no longer be expressed analytically.

10 In one or more embodiments, the threshold / window of admissible values for the SDCM metric (or other metric) may not have a constant value, as assumed for the diagram in Figure 11; on the contrary, different values are assumed for areas of different colour.

15 In this way, instead of having similar colour changes within the 360° exploration angle, some given colour areas may be highlighted.

20 In one or more embodiments, more than one mapping angle value may be created for different operating conditions (e.g. as a function of parameters such as e.g. the LED temperature(s), the reference centre point HSV, etc.), the possibility being given of creating different colour points by implementing the same colour control procedure.

25 As stated in the foregoing, in one or more embodiments it is possible to use metrics other than SDCM.

Similarly, in one or more embodiments gamut areas may be used other than the CIE 1931 reference gamut, by using e.g. chromaticity diagrams or colour spaces of different types, e.g. CIE RGB.

30 One or more embodiments may therefore concern a method of calculating colour points in a gamut area (see e.g. Figures 3, 5 and 8) of a colour space for reproduction by a plurality of light radiation sources (e.g. L1, L2, L3) of different colours, wherein said
35 gamut area includes a perimeter (e.g. E), the method

including calculating successive points on said perimeter (E), with said successive points, having angular coordinate values (Angle) in an HSV system (having e.g. a centre HSV_C), being representative of
5 respective hue values (Hue Coarse DMX: see for example the diagrams in Figures 6 and 9), wherein the method includes:

- selecting (e.g. 16 in Figure 11) an increment step value (δ) for said angular coordinate,
- 10 - calculating (e.g. 20), from a starting colour point (e.g. 18; Cx_0, Cy_0), a next colour point (e.g. Cx_i; Cy_i) on said perimeter as a function of the increment step value selected for said angular coordinate,
- 15 - calculating (e.g. 22) a metric indicative of the distance between said starting colour point and said next colour point,
 - applying to the calculated metric an acceptance test (e.g. 24) with at least one acceptance threshold
 - 20 (e.g. [SDCM_min;, SDCM_max]), and
 - i) if the calculated metric passes the acceptance test (step 24 = Y), calculating a further next colour point by using said next colour point as a new starting colour point, and
 - 25 - ii) if the calculated metric fails the acceptance test (step 24 = N), selecting an updated value for said increment step value for said angular coordinate, and re-calculating said next colour point from said starting colour point by using said updated
 - 30 value.

In one or more embodiments, said metric may include the Standard Deviation of Colour Matching (SDCM) metric.

One or more embodiments may include using for said
35 acceptance test (24) a window with lower and upper

thresholds (e.g. [SDCM_min;, SDCM_max]) for said metric.

One or more embodiments may include:

- detecting the direction in which said calculated
5 metric exceeds said at least one acceptance threshold,
- selecting said updated value for said increment
step value for said angular coordinate to a value lower
or higher than the previously selected value, as a
function of the direction in which said calculated
10 metric exceeds said at least one acceptance threshold.

One or more embodiments may include selecting for said acceptance test different acceptance thresholds in different areas of said colour space.

15 In one or more embodiments, said colour space may be the CIE 1931 colour space.

One or more embodiments may concern a control system for controlling a plurality of light radiation sources of different colours for the reproduction of colour points in a gamut area of a colour space,
20 wherein said gamut area includes a perimeter, the system being configured for calculating successive points on said perimeter, with said successive points having, in an HSV system, angular coordinate values which are representative of respective hue values, by
25 operating with the method according to one or more embodiments.

One or more embodiments may include a DMX controller.

One or more embodiments may include a controller
30 with selectively variable resolution (e.g. 8 bit or more) for calculating the angular coordinate values of said colour points.

One or more embodiments may concern a computer program product, loadable into the memory of at least
35 one processing system and including software code

portions for performing the method according to one or more embodiments.

Without prejudice to the basic principles, the details and the embodiments may vary, even appreciably,
5 with respect to what has been illustrated herein by way of non-limiting example only, without departing from the extent of protection.

The extent of protection is defined by the annexed claims.

CLAIMS

1. A method of calculating colour points in a gamut area in a colour space for reproduction by a plurality of light radiation sources (L1, L2, L3) of different colours, wherein said gamut area includes a perimeter (E), the method including calculating successive points on said perimeter (E) with said successive points having angular coordinate values (Angle) in an HSV system (HSV_C) representative of respective hue values, the method including:

- selecting (16) an increment step value (δ) for said angular coordinate,
- calculating (20) from a starting colour (18; Cx_0, Cy_0) a next colour point (Cx_i; Cy_i) on said perimeter (E) as a function of the increment step value (δ) selected for said angular coordinate,
- calculating (22) a metric indicative of the distance between said starting colour point (Cx_0, Cy_0) and said next colour point (Cx_i, Cy_i)
- applying to the calculated metric an acceptance test (24) with at least one acceptance threshold, and
 - i) if the calculated metric passes the acceptance test (24, Y), calculating a further next colour point by using said next colour point (Cx_i; Cy_i) as a new starting colour point, and
 - ii) if the calculated metric fails the acceptance test (24, N), selecting an updated value for said increment step value (δ) for said angular coordinate and re-calculating said next colour point (Cx_i; Cy_i) from said starting colour point (Cx_0, Cy_0) by using said updated value.

2. The method of claim 1, wherein said metric includes the Standard Deviation of Colour Matching or SDCM.

3. The method of claim 1 or claim 2, including

using for said acceptance testing (24) a window with lower and upper thresholds for said metric.

4. The method of any of the preceding claims, including:

5 - detecting the direction in which said calculated metric (22) exceeds said at least one acceptance threshold,

 - selecting said updated value for said increment step value (δ) for said angular coordinate to a value
10 higher or lower than the previously selected value as a function of the direction in which said calculated metric exceeds said at least one threshold of acceptance.

5. The method of any of the preceding claims,
15 including selecting for said acceptance test (24) different acceptance thresholds in different areas of said colour space.

6. The method of any of the preceding claims, wherein said colour space is the CIE 1931 colour space.

20 7. A control system (M) for controlling a plurality of light radiation sources (L1, L2, L3) of different colours to reproduce colour points in a gamut area of a colour space, wherein said gamut area includes a perimeter (E), the system being configured
25 for calculating successive points on said perimeter (E) with said successive points having angular coordinate values (Angle) in an HSV system (HSV_C) representative of respective hue values by operating with the method according to any of claims 1 to 6.

30 8. The control system (M) according to claim 7, wherein the system includes a DMX controller (M).

 9. The control system (M) of claim 7 or claim 8, wherein the system includes a controller (M) with a selectively variable resolution in calculating the
35 angular coordinate values of said colour points.

10. A computer program product, loadable into the memory of at least one processing system (M) and including software code portions for performing the method according to any of claims 1 to 6.

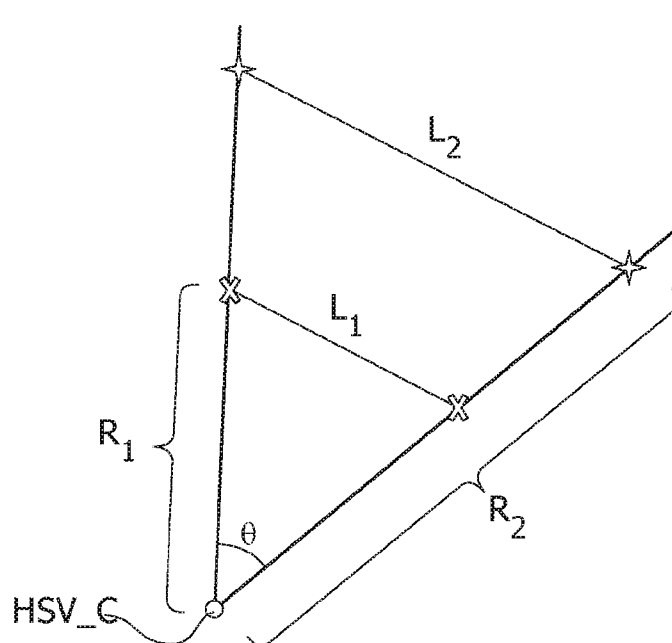
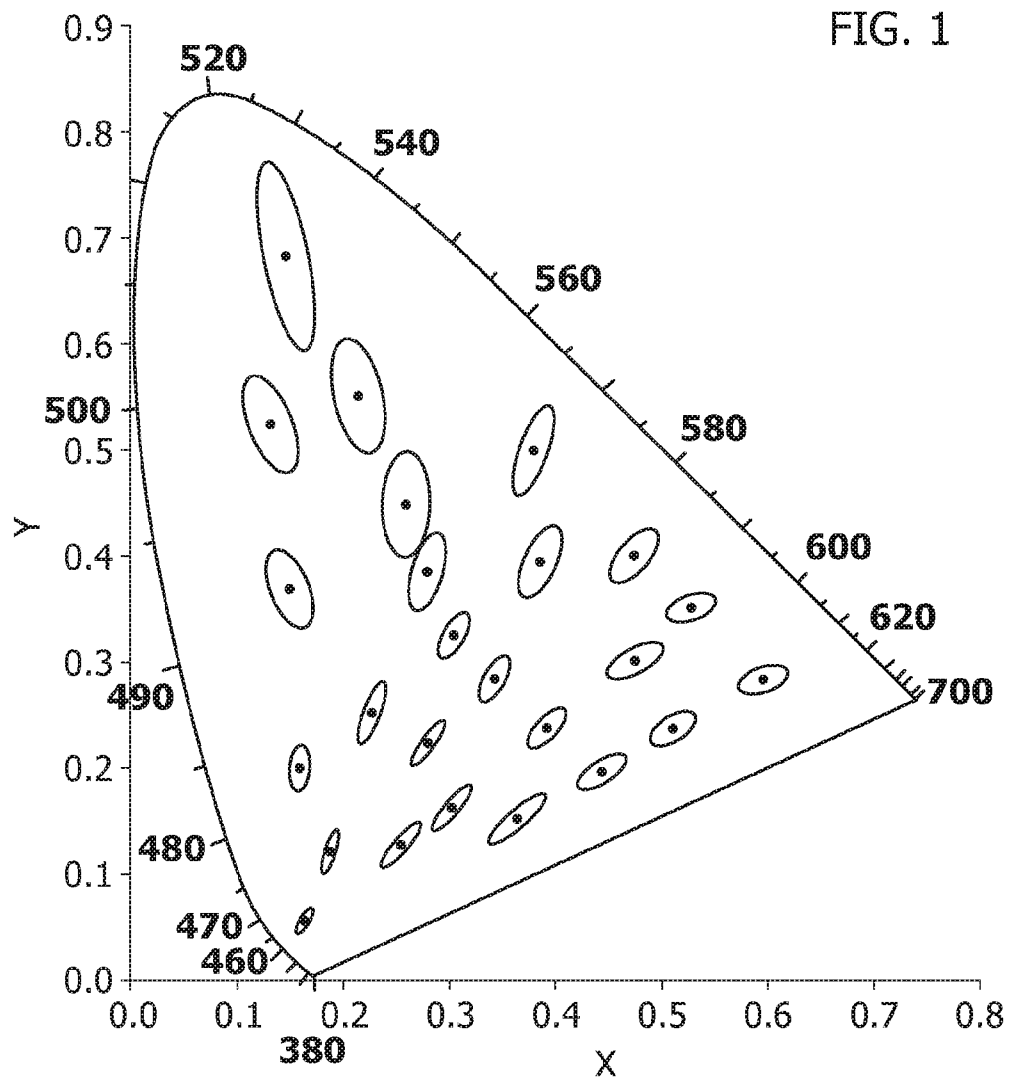


FIG. 3

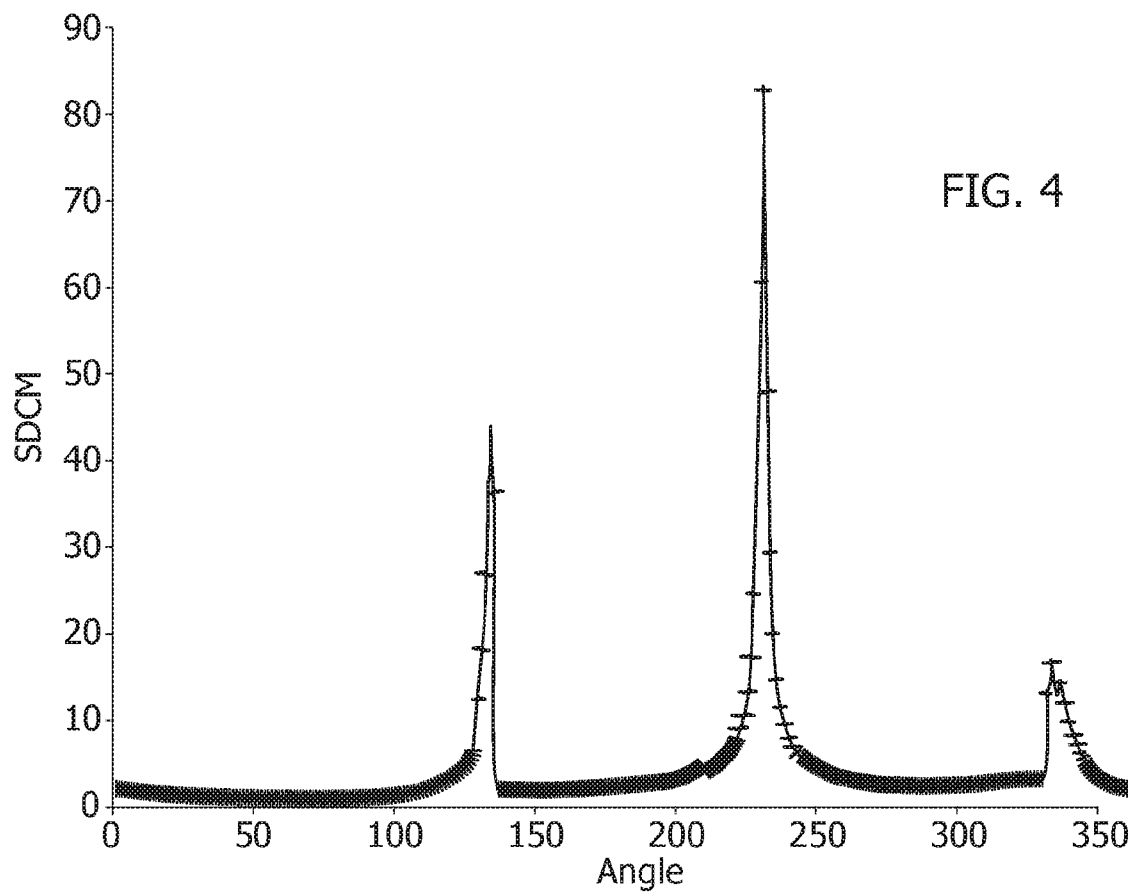
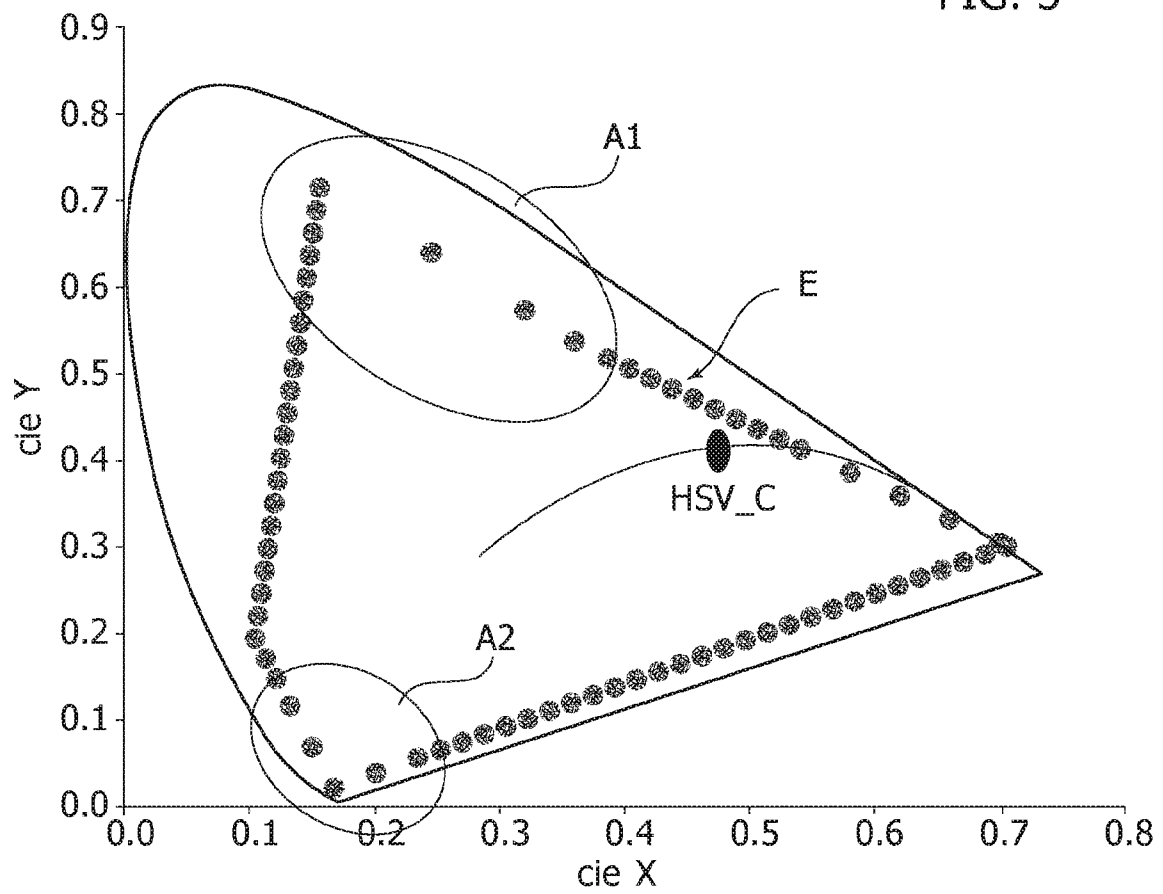


FIG. 5

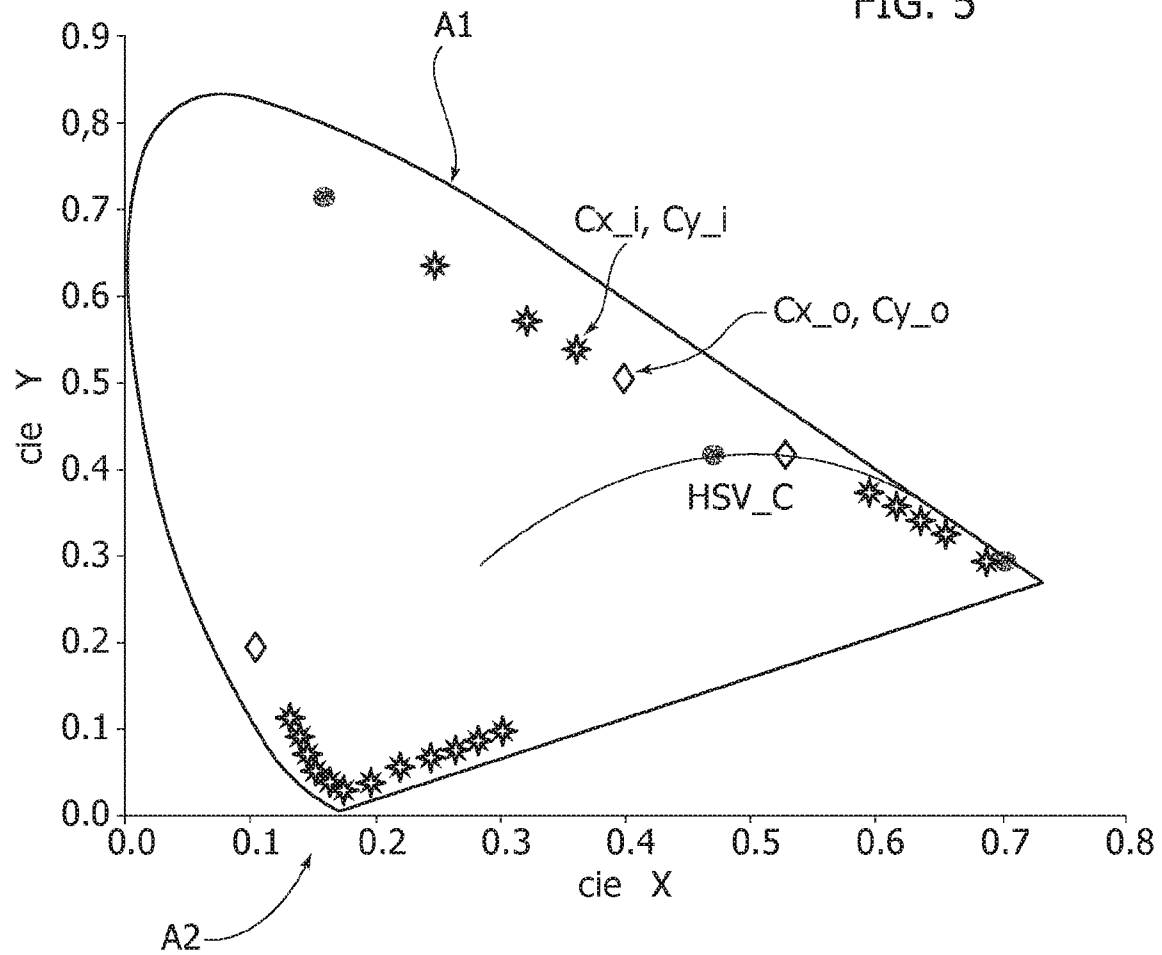


FIG. 6

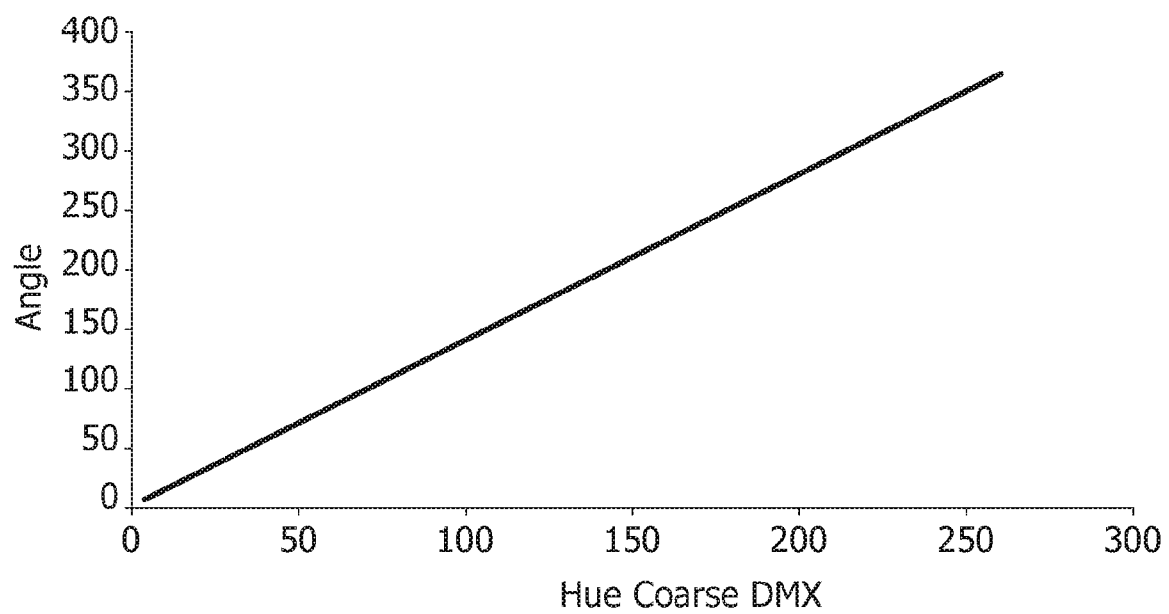


FIG. 7

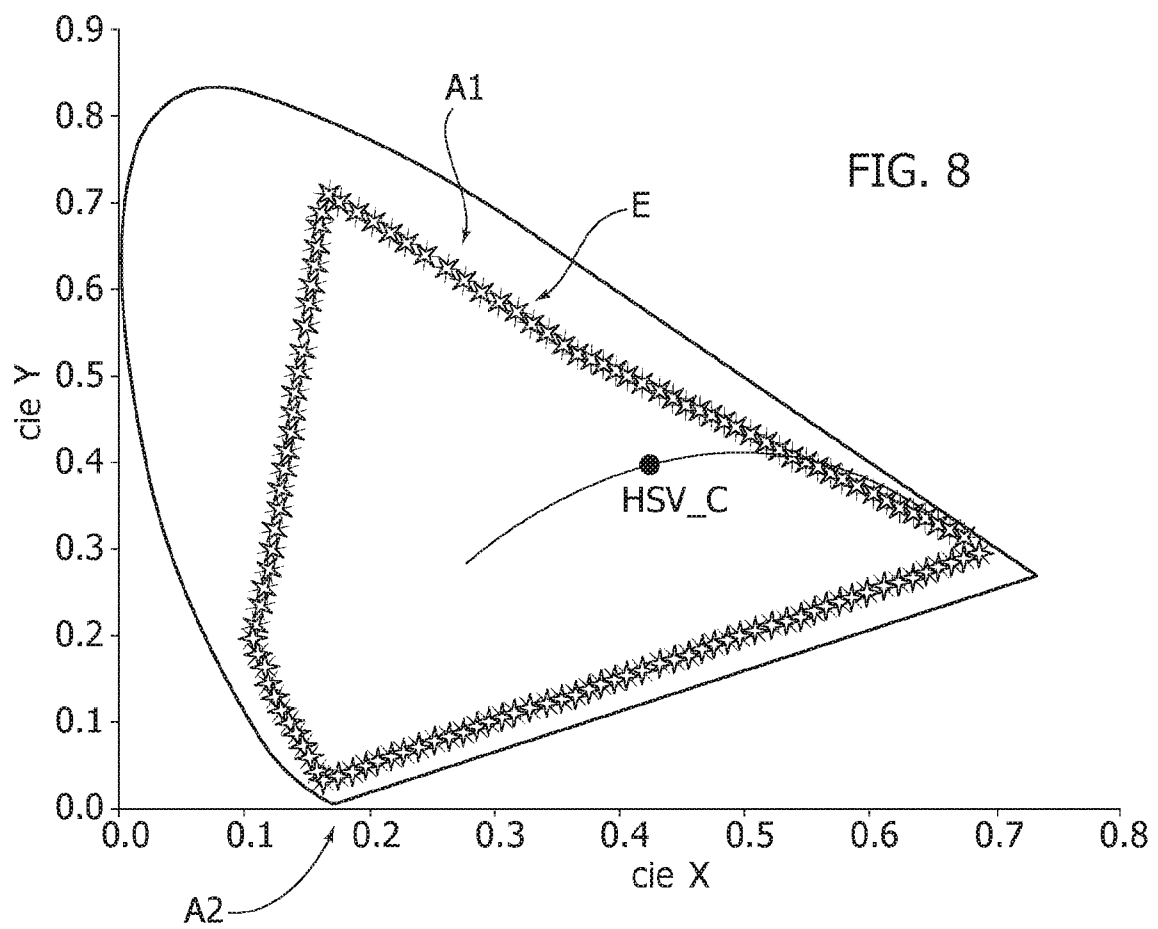
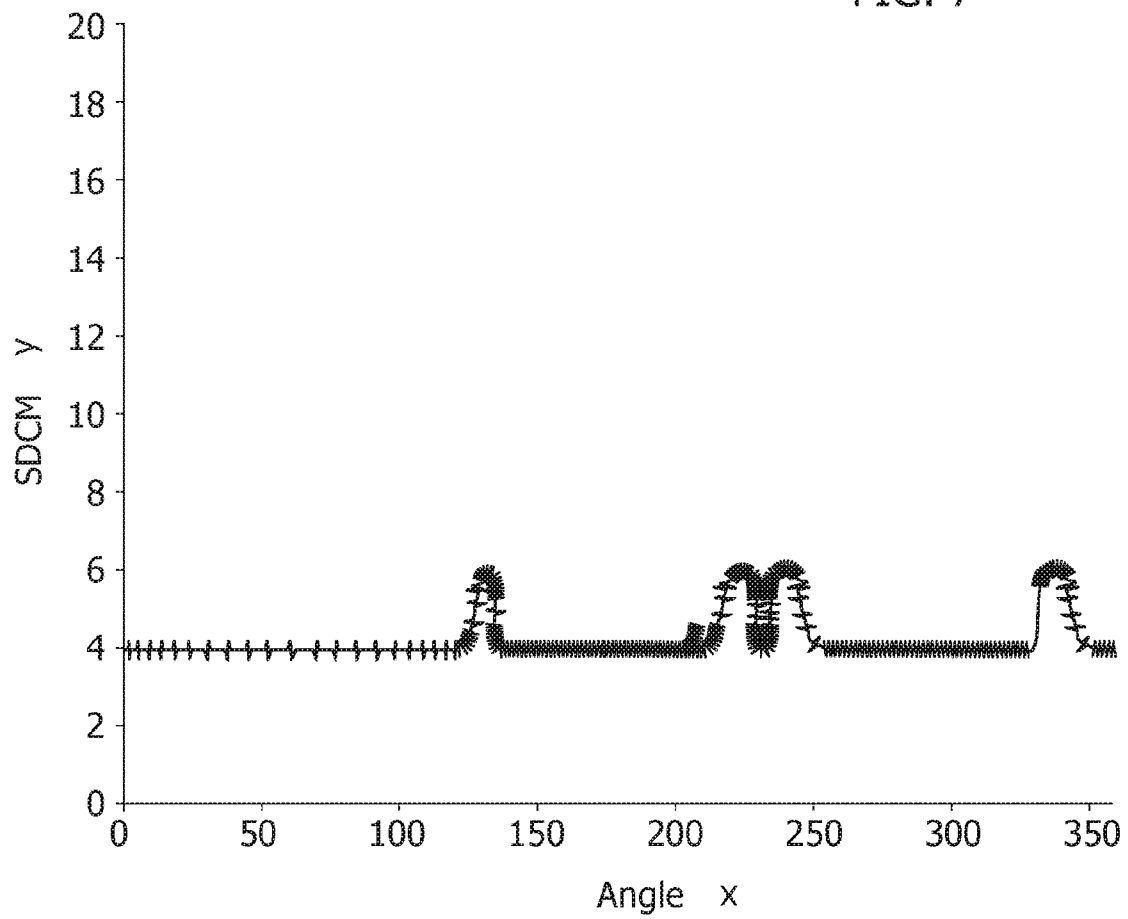


FIG. 9

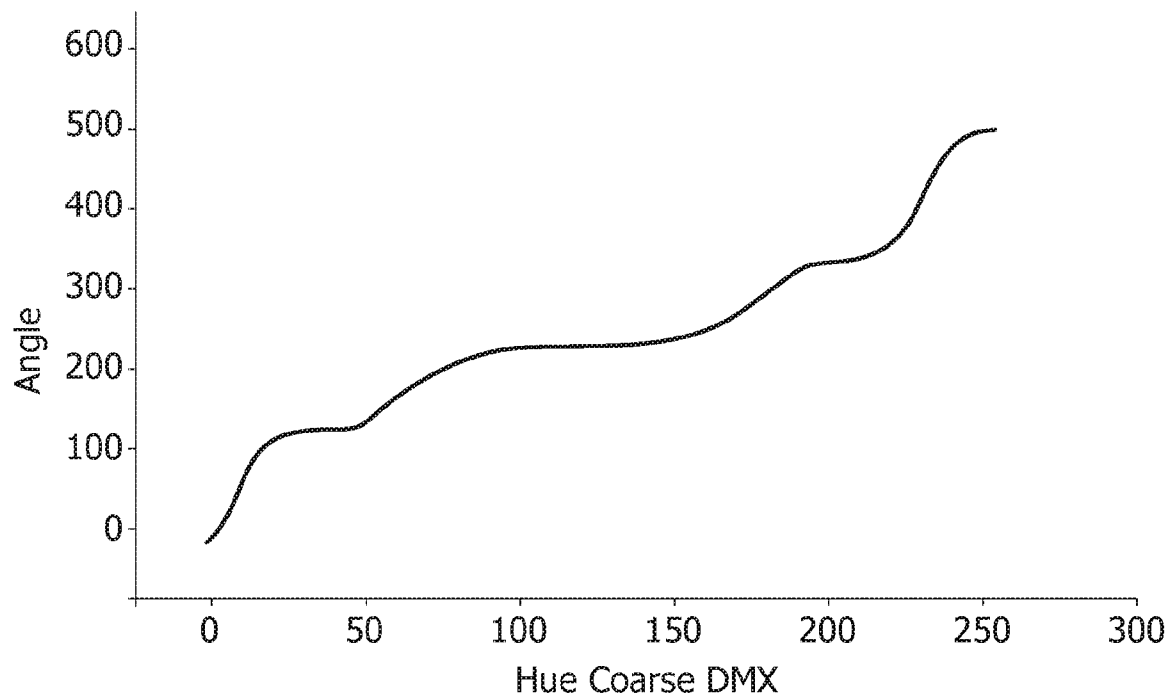


FIG. 10

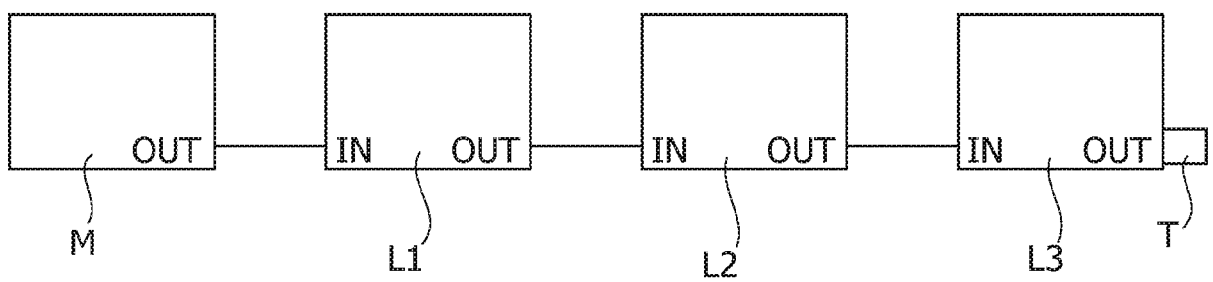
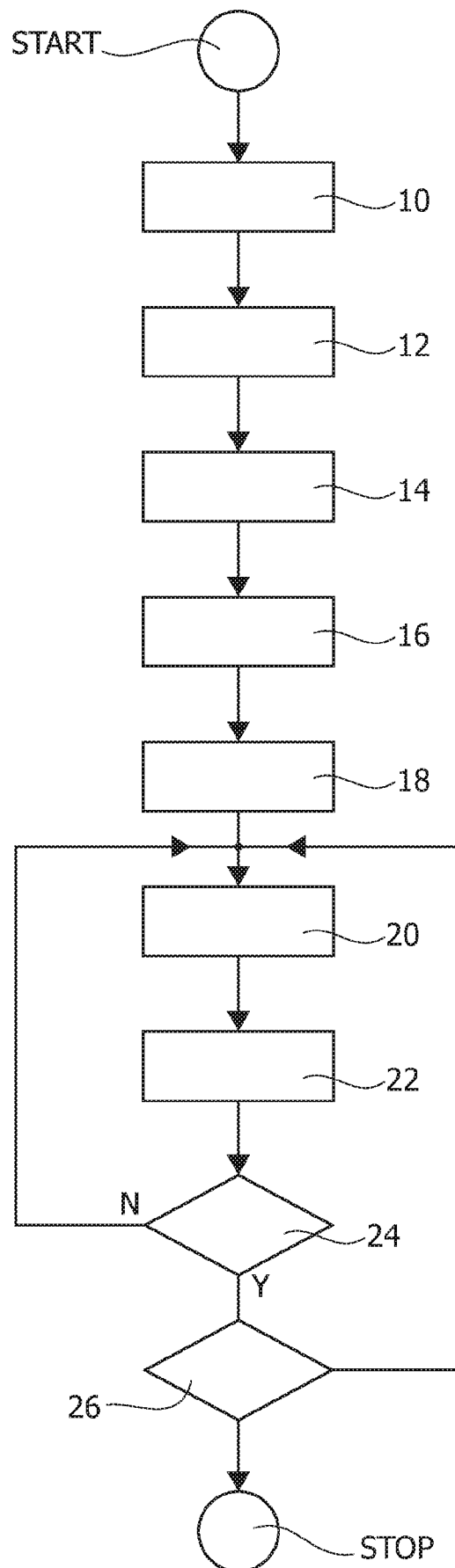


FIG. 11



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2017/055033

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04N1/60
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H05B H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2008/068713 A2 (KONINKL PHILIPS ELECTRONICS NV [NL]; BAAIJENS JOHANNES P W [NL]; VERBA) 12 June 2008 (2008-06-12)	1,3,5-7, 9,10
Y	abstract; figure all page 7, line 27 - line 33 page 12, line 16 - page 13, line 8 page 14, line 4 - line 31 page 15, line 30 - line 31 claim 1	2,4,8
Y	----- WO 2013/179215 A2 (KONINKL PHILIPS NV [NL]) 5 December 2013 (2013-12-05) abstract; figure all page 6, line 18 - line 24 page 9, line 10 - line 11 ----- -/-	2



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

6 November 2017

Date of mailing of the international search report

13/11/2017

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Authorized officer

Winne, Dominique

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2017/055033

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2008/001290 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; BAAIJENS JOHANNES P W [NL]) 3 January 2008 (2008-01-03) abstract page 8, line 1 - line 5 page 9, line 4 - line 14 page 10, line 26 - page 11, line 6 page 12, line 3 - line 10 -----	4
Y	US 2006/104058 A1 (CHEMEL BRIAN [US] ET AL) 18 May 2006 (2006-05-18) abstract; figure all paragraph [0125] -----	8

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International application No

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