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(54) **Title:** ALIGNMENT OF IMAGES OF A CALIBRATION IMAGE USING A PATTERN

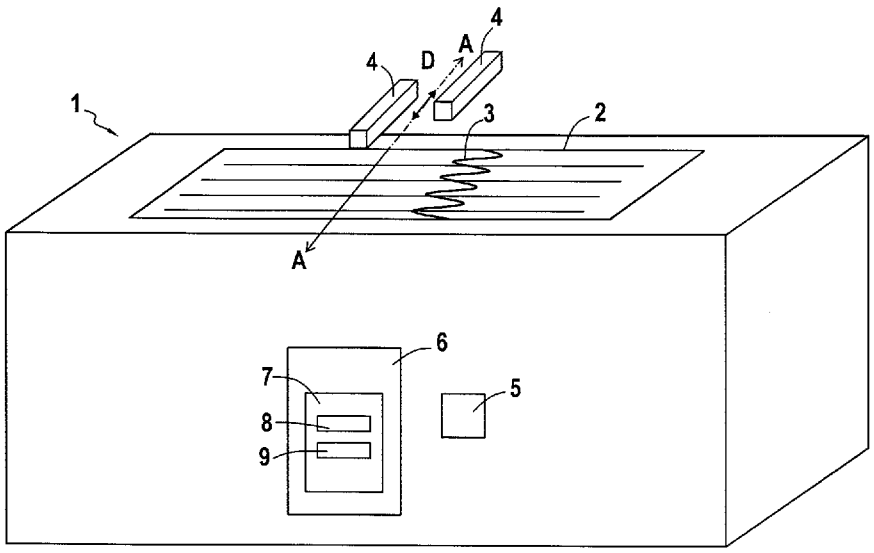


FIG.1

(57) **Abstract:** In an example, two images of a printed calibration image are acquired using two measurement devices. The measurement devices are offset along an axis so that the two images correspond to two portions of the printed calibration image overlapping along the axis. The printed calibration image comprises a pattern extending across the printed calibration image in the direction of the axis, the pattern defining a shape so that in each image, a portion of the pattern appears as different from a straight line parallel to the axis. The two images are aligned using the two portions of pattern.

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Alignment of images of a calibration image using a pattern

Background

Some printers can be calibrated, for example to control the color output of a printer, or its spatial stability, or the quality of its output. This allows obtaining more consistent outputs. Calibration may be done by scanning a printed calibration image.

Some printers print in wide formats and use a plurality of scanners for calibration. The outputs of each scanner have to be processed to allow calibration.

Brief Description of the Drawings

The following detailed description references the drawings, wherein:

FIG. 1 is a simplified schematic of an example printer;

FIG. 2 is flowchart of an example of a method for aligning scanned images;

FIG. 3 is an illustration of example of calibration images with a pattern;

FIG. 4 is an illustration of scanned images; and

FIG. 5 is an illustration of aligned images.

Detailed Description

The following detailed description refers to the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the following description to refer to the same or similar parts. While several examples are described in this document, modifications, adaptations, and other implementations are possible. Accordingly, the following detailed description does not limit the disclosed examples. Instead, the proper scope of the disclosed examples may be defined by the appended claims.

In a printer, various measurement devices or scanners may be used during the calibration. In printers, or in presses, which print on very wide sheet (for example more than 75 cm), a plurality of measurement devices may be used to calibrate the printers or presses.

A technical challenge arises in the aligning, or stitching of the images produced by the measurement devices, because aligning may require the use of stitching elements which occupy a large area which may therefore not be used for the calibration strictly speaking.

Improved aligning may be achieved according to the present disclosure because aligning is performed using a portions of a pattern which appears on each image acquired by the scanners,

On FIG. 1, an example printer 1 is shown. The printer 1 may be any appropriate printing device that performs an imaging operation, for example by printing fluid with color. The printer is able to print calibration images on media (such as paper). A printed image 2 has been represented on FIG. 1. The printed calibration image 2 is, in this example, an image used for Solid Uniformity Calibration (used for controlling the consistency of colors). However, the present disclosure applies to various calibration methods, for example Half Tone Uniformity Calibration, Scan Band Calibration, etc. For example, the present disclosure applies to calibration methods which use a plurality of measurement devices.

In the present example, the printed calibration image 2 comprises a plurality of stripes which are, during the printing and the scanning, perpendicular to an axis A-A of the printer. This axis is substantially perpendicular to the direction of the media in the printer.

The printed calibration image 2 comprises a pattern 3 extending across the printed image and in the direction of the axis A-A. In this example, the pattern 3 is a periodical pattern having a sinusoidal shape.

In order to perform calibration, the printer 1 comprises two measurement devices 4 which are offset to allow an overlap along the axis A-A by a distance D. The two images produced by the measurement devices 4 are overlapping along the axis by the distance D. For example the measurement devices 4 may be In-line Scanners, In-Line Cameras, or Spectrophotometers. The printer 1 further comprises a processor 5

and a storage 6 comprising a set of instructions 7. The storage 6 may include any electronic, magnetic, optical, or other physical storage device that stores executable instructions and data. Thus, storage 6 may be, for example, Random Access Memory (RAM), Electrically-Erasable Programmable Read-Only Memory (EEPROM), a storage drive, an optical disc, and the like.

It should be noted that more than two measurement devices may be used by the printer 1.

The set of instructions 7 comprises an instruction 8 to acquire two images of a printed calibration image using the two measurement devices 4, and an instruction 9 to align the two images using the two portions of pattern 3.

Using the two measurement devices 4, two images may be obtained which will each comprise a portion of the printed image and a portion of the pattern.

Because the pattern is sinusoidal, by cancelling the phase between the two portions of pattern, it is possible to align the images to obtain a scanned image of the entire printed image 2. In each image acquired by the measurement devices 4, a portion of a sinusoidal signal appears and this allows the aligning.

Also, in this example, the spatial period of the pattern is chosen to be greater than the length D of the overlapping between the two measurement devices. This allows obtaining a monovalent alignment when the phase is cancelled.

FIG. 2 is a flowchart of a method for aligning images which correspond to portions of a printed calibration pattern. This method may be performed, for example, by a printer such as the one described in reference to FIG. 1.

Firstly, a calibration image is printed 201 with a pattern having the following properties. The pattern may extend across the printed calibration image in the direction of an axis substantially perpendicular to the direction of the paper through the printer, the axis being also the direction in which a plurality of measurement devices of the printer offset.

Prior to the printing, the pattern may be superimposed on the calibration image if the calibration image does not comprise the pattern.

Then, the offset measurement devices acquire 202 a plurality of images of the printed calibration image. Each image corresponds to a portion of the printed calibration image and because of the offset, a sub-portion of the image is also in another image obtained by another measurement device. Also in each image, a portion of the pattern is present and this portion may differ from a line parallel to the axis in the image. The shape of the pattern may be chosen to achieve this.

For example, the pattern may have a periodical shape. It may also be a straight line with an angle with respect to the axis. The pattern may be a line (periodical, curved, or angled) having a small thickness (for example the smallest resolution of the printer, or the smallest resolution detected by the measurement devices). The pattern may comprise white dots forming a line (or dots of the color of the media in which no fluid is deposited). Using a thin pattern such as a line (periodical, curved, or angled) which crosses the printed image allows losing few information. For example, in a Solid Uniformity Calibration image, colored stripes are printed in a direction perpendicular to the axis, and a thin pattern will only cost a loss of information corresponding to the thickness of the line (or of the dots forming the line).

The images are aligned 203, using the portions of pattern. If the pattern is periodical, then the phase may be cancelled between the portions of pattern. If the pattern has other shapes, then having knowledge of the initial shape may allow aligning the images.

FIG. 3 shows an example of a printed calibration image 302, here a Solid Uniformity Calibration image, comprising a plurality of stripes which are perpendicular to the axis A-A described in reference to FIG. 1.

This printed calibration image 302 comprises a periodical pattern 303 formed by white dots. In this example, the periodical pattern has a triangular shape, and it extends across the printed calibration image 302 in the direction of the axis A-A.

FIG. 4 shows four images 401, 402, 403, and 404, acquired using four measurement devices (for examples four scanners of a printer). Each image 401, 402, 403, or 404 corresponds to a portion of the printed calibration image 302 described on FIG. 3. The four measurement devices used for this example are each offset so that each image 401, 402, 403, or 404 overlaps with another image or with two images (for example for images 402 and 403).

The images 401, 402, 403, and 404 each comprise a portion of the pattern 303 of FIG. 3. More precisely, image 401 comprises a portion 411 of the pattern, image 402 comprises a portion 412 of the pattern, image 403 comprises a portion 413 of the pattern, and image 404 comprises a portion 414 of the pattern. On the right of image 401, part of the portion 411 of the pattern corresponds to a part of the portion 412 of the pattern of image 402. This part of the portion has a length which corresponds to the overlapping between the measurement devices and which is denoted d12. In this example, the three dots of the pattern 411 on the right correspond to the three dots of the pattern 412 on the left. Thus, it is possible to align images 401 and 402.

Similarly, it is possible to align image 402 and image 403, and it is possible to align image 403 with image 404. The length of the overlapping between the measurement devices of images 402 and 403 is denoted d23. The length of the overlapping between the measurement devices of images 403 and 404 is denoted d34.

The three alignments may be performed to cancel the phase between the portions of patterns, for example by displacing the images to obtain a matching overlap. Also, the spatial period P of the pattern is chosen in this example to be greater than the overlaps between the measurement devices d12, d23, and d34. This facilitates the aligning because cancelling the phase only leads to a single possible aligning.

FIG. 5 shows the image 501 obtained after aligning the images 401 to 404 of FIG. 4. The aligned image may also be called a stitched image.

Also, on this figure, the overlapped portions of the final images, obtained by overlapping images 401, 402, and 403, are denoted 512, 523, and 534.

It should be noted that in the above examples, aligning of images is obtained using a small area of the printed calibration images. In the above examples, there is a minimal loss of information used for calibration in the direction perpendicular to the axis.

CLAIMS

1. A method comprising:

acquiring two images of a printed calibration image using two measurement devices,

the measurement devices offset along an axis so that the two images correspond to two portions of the printed calibration image overlapping along the axis,

the printed calibration image comprising a pattern extending across the printed calibration image in the direction of the axis,

the pattern defining a shape so that in each image, a portion of the pattern appears as different from a straight line parallel to the axis, and

aligning the two images using the two portions of pattern.

2. The method of claim 1, comprising acquiring n images using n measurement devices, with n>2.

3. The method of claim 1, wherein the measurement devices are in-line scanners or in-line cameras or spectrophotometers.

4. The method of claim 1, wherein the pattern is a periodical pattern.

5. The method of claim 4, wherein the spatial period of the pattern is chosen to be greater than the length of the overlapping between the two measurement devices.

6. The method of claim 4, wherein aligning comprises cancelling the phase between the two portions of pattern.

7. The method of claim 1, wherein the pattern comprises a plurality of white dots.

8. The method of claim 1, wherein the pattern is a color calibration pattern comprising a plurality of stripes perpendicular to the axis.

9. The method of claims 7, wherein the pattern comprises a plurality of white dots and each stripe comprises a white dot of the plurality of white dots.

10. The method of claim 1, comprising printing the calibration image comprising the pattern.

11. The method of claim 1, comprising, prior to printing the calibration image, superimposing the pattern on a calibration image.

12. A device comprising a storage and a processor, the storage comprising executable instructions to:

acquire two images of a printed calibration image using two measurement devices,

the measurement devices offset along an axis so that the two images correspond to two portions of the printed calibration image overlapping along the axis,

the printed calibration image comprising a pattern extending across the printed calibration image in the direction of the axis,

the pattern defining a shape so that in each image, a portion of the pattern appears as different from a straight line parallel to the axis, and

align the two images using the two portions of pattern.

13. The device of claim 12, wherein the pattern is a periodical pattern.

14. A printer comprising a storage, a processor, and a plurality of scanners offset along an axis,
the storage comprising executable instructions to:
print a calibration image comprising a pattern extending across the printed calibration image in the direction of the axis,
acquire a plurality of images of the printed calibration image using the plurality of scanners, the plurality of images corresponding to a plurality of portions of the printed calibration image overlapping along the axis,
the pattern defining a shape so that in each image, a portion of the pattern appears as different from a straight line parallel to the axis,
align the plurality of images using the plurality of portions of pattern.

15. A non-transitory computer readable medium containing computer executable instructions, that when executed by a processor in a printer comprising two measurement devices offset along an axis so that two images acquired by the measurement devices of a printed calibration image correspond to two portions of the printed calibration image overlapping along the axis, performs the following method:

acquiring two images of the printed calibration image using the two measurement devices,

the printed calibration image comprising a pattern extending across the printed calibration image in the direction of the axis,

the pattern defining a shape so that in each image, a portion of the pattern appears as different from a straight line parallel to the axis,

aligning the two images using the two portion of patterns.

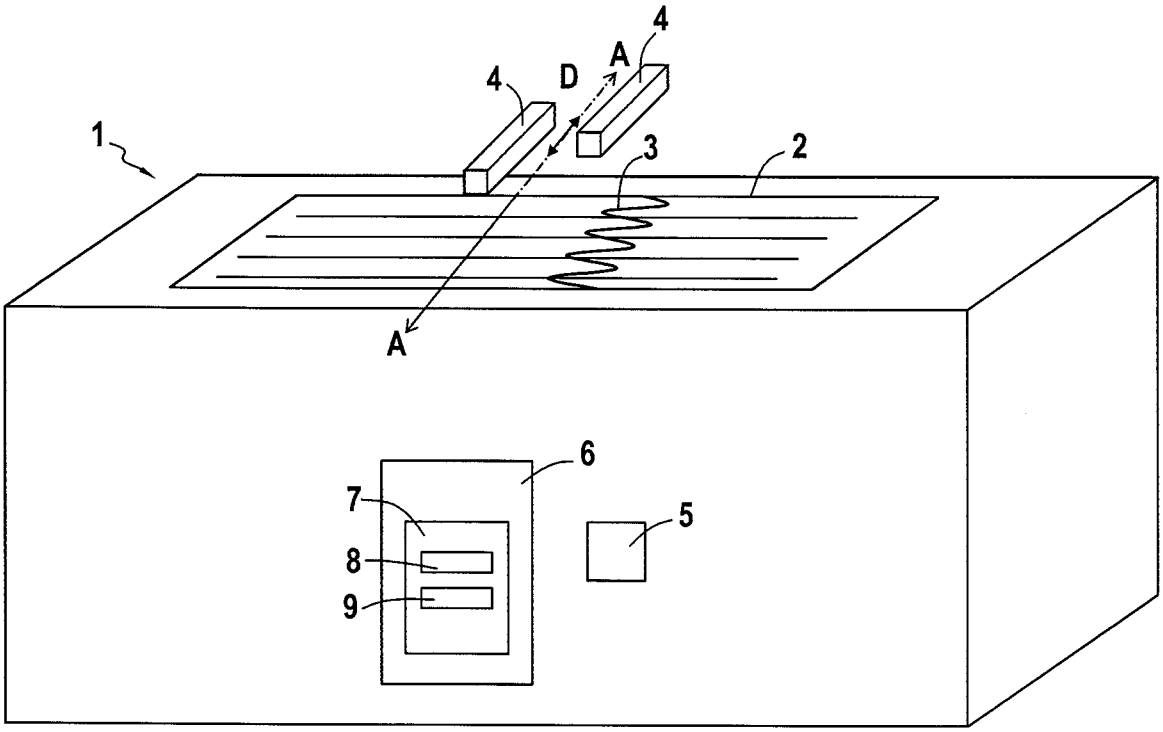

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FIG.1

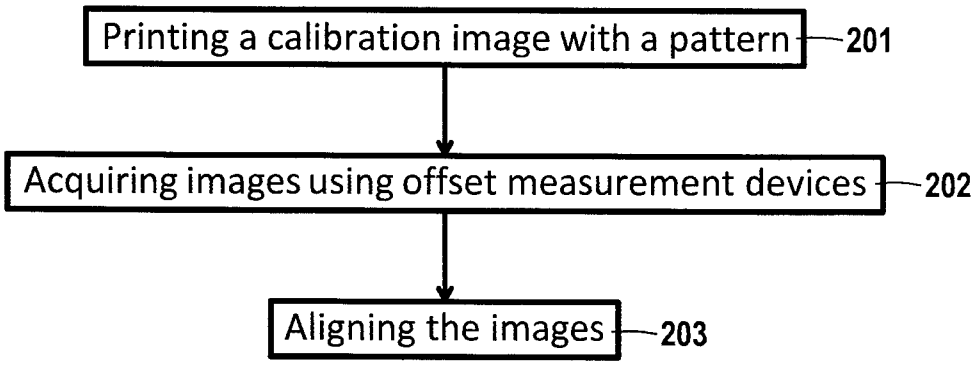

Printing a calibration image with a pattern
201
Acquiring images using offset measurement devices
202
Aligning the images
203

FIG.2

FIG.3

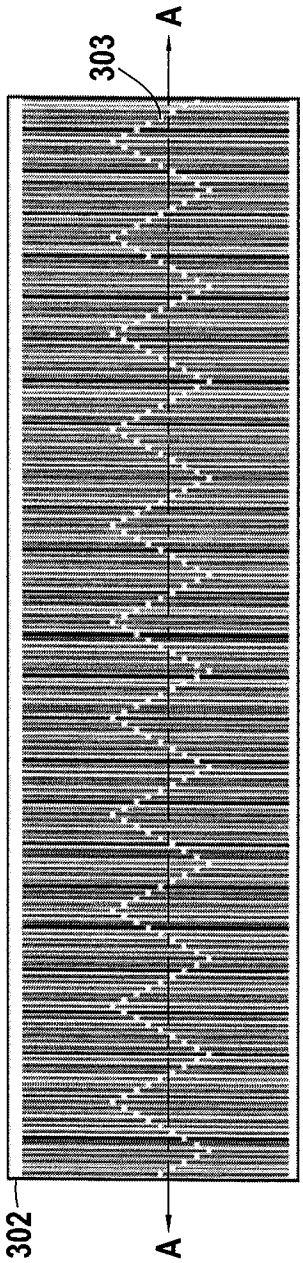


FIG.4

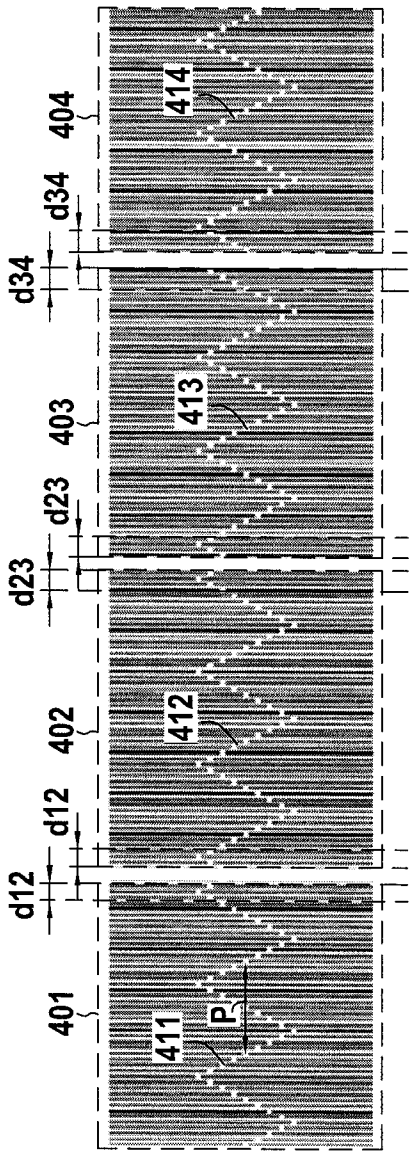
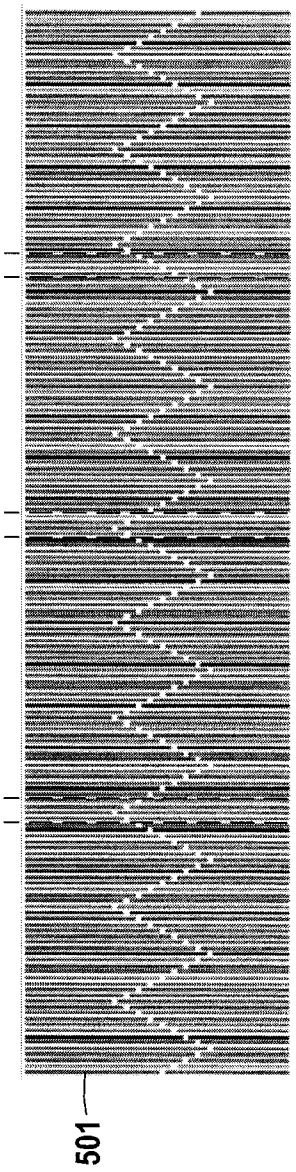


FIG.5



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/076129

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04N1/387 H04N1/407 H04N1/60 G06T7/80
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)
H04N G06T

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 2016/141984 A1 (HUAWEI TECH CO LTD [CN]; PIOTTO NICOLA [DE]; KONDRAD LUKASZ [DE]; CORD) 15 September 2016 (2016-09-15)	1-8,12, 13,15
Y	abstract; figures 1-5,8,9 page 2, lines 19-22 page 3, lines 14-28,31 page 18, line 30 - page 20, line 4 page 22, lines 11-20	9-11,14

Y	WO 2011/054815 A1 (OCE TECH BV [NL]; GEURTS MATHIJS P W [NL]) 12 May 2011 (2011-05-12)	9-11,14
A	abstract; claims 1,9-13; figures 1-3 page 1, line 11 - page 6, line 22	1-8,12, 13,15

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
30 June 2017	11/07/2017

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/076129

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2009/115855 A1 (COUNCIL SCIENT IND RES [IN]; DEPT OF INFORMATION TECHNOLOGY [IN]; SARD) 24 September 2009 (2009-09-24) abstract; figure 5 page 12, lines 4-33	1-15
A	LI BO ET AL: "A multiple-camera system calibration toolbox using a feature descriptor-based calibration pattern", 2013 IEEE/RSJ INTERNATIONAL CONFERENCE ON INTELLIGENT ROBOTS AND SYSTEMS, IEEE, 3 November 2013 (2013-11-03), pages 1301-1307, XP032537577, ISSN: 2153-0858, DOI: 10.1109/IROS.2013.6696517 [retrieved on 2013-12-26] the whole document	1-15

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2016/076129

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WO 2011054815 A1	12-05-2011	EP 2497260 A1	12-09-2012
		US 2012200632 A1	09-08-2012
		WO 2011054815 A1	12-05-2011
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