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(54) **METHOD FOR CHARACTERISATION OF A LASER ENGRAVING OF A FABRIC, CORRESPONDING COMPUTER PROGRAM AND SYSTEM**

(57) Method for characterisation of a laser engraving of a fabric, corresponding computer program and system. The method comprising providing a pattern (100) having a plurality of engraved zones (101) for different degrees of engraving, and a processing stage comprising the steps of:
[a] providing a fabric image (200) and at least one fabric parameter, thus characterising a target fabric;
[b] providing at least one laser engraving parameter, thus characterising a target laser engraving;
[c] generating a plurality of output images (301), each for

a different degree of engraving;
[d] establishing a correspondence between each engraved zone (101) and the output image that is more similar;
[e] thus obtaining a correspondence between degrees of engraving in said pattern (100) and degrees of engraving for said target laser engraving applied to said target fabric;
thus obtaining a characterisation of said target laser engraving for said target fabric given said pattern.

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Description

Field of the invention

[0001] The invention relates to the field of laser engraving of fabric, in particular for the kind of fabrics known as denim or jeanswear, and preferably aimed to create a worn look simulating the appearance of cloths that have been worn by a user and aged in a natural way.

[0002] More specifically, the invention relates to a method for characterisation of a laser engraving of a fabric, in particular denim, said laser engraving being able to apply different degrees of engraving in fabrics, in particular depending on the amount of energy transmitted by a laser.

[0003] The invention also relates to the corresponding computer program and system.

State of the art

[0004] Laser engraving of fabrics is a process where a laser beam impinges the surface of a fabric, removing by combustion a surface layer of said fabric, usually removing part of the dye that usually is attached to the outer fibres of the fabric. This is also referred as engraving or wearing the fabric. After removing the combustion ashes and washing the fabrics, a change in colour is obtained. In many cases, for example, denim, the dye is darker than the base fabric material, and thus, the change in colour tends to whiten the outer surface of the fabric. For a given fabric, the amount of layer that is removed, and therefore, the amount of change in colour, depends on the energy received by the surface of the fabric. In general, laser engraving machines are configured to control the energy by controlling the level of power in the laser that scans the fabric, as well as the time dedicated for each spot of the scan. Every machine can be different and have other parameters that define its behaviour. Therefore, the range of degrees or shades of engraving that can be obtained for a fabric, depend on the laser characteristics and the fabric itself, for example, the type/amount of pigment, the fabric material, etc.

[0005] In the field of laser engraving of fabrics it is usual that a designer creates a specific model, for example some trousers that have a pattern of wear, even including wrinkles simulating the normal look of a cloth that has been worn by a user during a period of time. The designer sends the model to the manufacturers that will try to replicate said model using their premises, in this case, using laser engraving.

[0006] In order to obtain the same results of the model, the manufacturer usually has to start a trial and error iterative process using his/her premises. In each iteration, an experienced user has to select the laser adjustments, based on experience. Afterwards, the fabric has to be engraved, cleaned, washed and let dry. If the results are not as expected, the user has to start over a new iteration. If different laser engraving machines are used,

this same process has to be repeated for each different machine.

[0007] Due to its iterative nature, the process described above is time consuming: in the best-case scenario, at least one iteration has to be performed. This is also associated to a possible high cost due to machine usage, testing materials, etc. Finally, the process has an impact on the environment; in particular, due to the washing step that typically uses detergents or other chemical products.

[0008] Besides, for the iterative process described above it is necessary a user with a high level of experience in order to be able to determine the engraving adjustments that could potentially obtain a better result.

[0009] Is therefore needed a more efficient solution, both in terms of time and cost, with less environmental impact and that could be performed by a user without the level of experience required by the current methods.

Summary of the invention

[0010] It is an object of the invention to overcome the technical problems stated above. This purpose is achieved by a method for characterisation of a laser engraving of a fabric of the type indicated at the beginning, characterized in that in that the method comprises:

- providing a pattern having a plurality of engraved zones, corresponding to a plurality of degrees of engraving; and
- a processing stage comprising the steps of:

[a] providing a fabric image and at least one fabric parameter, thus characterising a target fabric;

[b] providing at least one laser engraving parameter, thus characterising a target laser engraving;

[c] generating a plurality of output images, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric;

[d] establishing a correspondence between each engraved zone of said plurality of engraved zones and the output image of said plurality of output images that is more similar to said engraved zone;

[e] thus obtaining a correspondence between degrees of engraving in said pattern and degrees of engraving for said target laser engraving applied to said target fabric that most resemble those in said pattern;

thus obtaining a characterisation of said target laser engraving for said target fabric given said pattern.

[0011] In the context of this document, target laser engraving refers to the laser engraving that is aimed to be used. Accordingly, target fabric refers to the fabric that

is aimed to be used in said target laser engraving. Both are characterised by their corresponding parameters and, in the case of the target fabric, also by the fabric image. The expert will understand that default values can be used if no parameter is provided, in particular, by a user through a user interface. In this case, the method will still be using the corresponding predefined default parameters even if they are not explicitly inputted by said user, because said predefined parameters would have been provided before the user interaction.

[0012] In the context of this document, said pattern is generally a model provided by the designer of the engraving to be done. In particular, it usually corresponds to a piece of fabric with the different engraved zones, each one with a different degree of engraving. As an example, for a typical piece of blue denim, the appearance of these different engravings usually corresponds to a gradation of blue tones, from the darkest zone, where the engraving has removed less of the superficial layer (or even none at all), to the lightest zone, where the engraving has removed more of the superficial layer.

[0013] Therefore, the method is able to obtain a correspondence each degree of engraving of in a pattern, i.e. a physical piece of fabric, and the degree of engraving that is needed to obtain the same degree of engraving given a target laser engraving and a target fabric. It will be evident for the expert that, depending on the target laser engraving and/or the target fabric, not all the degrees of engraving could be achieved. For example, if the target laser engraving is not able to remove enough surface material, some of the degrees of engraving could not be possible. The correspondence obtained in step [e] can be used in several ways but, generally, it is a preferred embodiment to generate a correspondence computer file that is later used by a computer-aided design and/or a computer-aided manufacturing software, thus automating and simplifying the global procedure from the design to the manufacture. In any case, no particular high-level skills are required for the user, since he/she is not in charge to determine the engraving adjustments. Finally, the method described above, does not rely on physical laser engraving iterations, and consequently, the amount of material, time and energy used is minimal or even zero, thus increasing the efficiency and being more environmental-friendly. Moreover, the method described above can be used to obtain a result as close as possible to the pattern, even if the target fabric is different from that in the pattern. This is particularly advantageous for obtaining results close to those in high quality fabrics with others having less grammage or less tint, further reducing the amount of waste and increasing the environmental-friendly characteristics. It also allows using different fabric materials, for different clothing types, without the need of re-designing for each material. Indeed, the designer can create a single design, and this process can be used to obtain the adjustments necessary for different materials. A further advantage is that the method can be done in centralised premises, not

necessarily at the same premises where the laser engraving machines are. In this case, the pattern could be sent only to these centralised premises, thus simplifying the logistics in the manufacturing chain.

[0014] It will be evident for the expert that said plurality of output images could be generated as independent or grouped images. Also, said plurality of output images are preferably arranged as a gradient, from more to less degree of engraving or vice versa, which facilitates the step of establishing the correspondence described in [d]. In most of the embodiments, the plurality of output images are generated by computer means, simulating the expected result of a target laser engraving over a target fabric. The expert will understand that this simulation can be obtained by multiple algorithms, and the results can have a latitude of accuracy depending on the accuracy of the algorithm being used: the more accurate the simulation, the more accurate will be the outcome of the method. In this case, the term accuracy refers to the similarity between the expected result obtained by the simulation, and the real physical result that will be the outcome of a real laser engraving with the same parameters. A good simulation algorithm should be as close as possible to the real result, at least for the types of fabrics and laser parameters used more frequently. Some exemplary simulation algorithms will be later discussed in the section dedicated to the exemplary embodiments. Nevertheless, for the sake of clarity, a simple algorithm will be described hereinafter. As a simplification, the example will consider that fabrics is always blue denim, also, the example uses a set of only one parameter for the fabric (fabric material), and only one parameter for the laser engraving (laser engraving machine model for a certain manufacturer). This exemplary simulation algorithm uses a predefined curve for each type of machine model, among a predefined list of machine models, and for each type of fabric material, among a predefined list of fabric materials. In the example, this curve determines how much clearer becomes the fabric for each degree of engraving, but it could also contain if there is a change in the colour tone, for example, a yellow component. Once the curve is determined, the simulation algorithm applies the values of the curve homogeneously to every pixel of the provided fabric image, for each degree of engraving, thus obtaining a plurality of output images.

[0015] The invention further includes a number of preferred features that are object of the dependent claims and the utility of which will be highlighted hereinafter in the detailed description of an embodiment of the invention.

[0016] Preferably, said fabric image corresponds to a zone of said pattern. This facilitates the image acquisition, for example, using a camera with the pattern. It also facilitates the characterisation of the target fabric, being as close as the pattern as possible. Preferably, the image corresponds to a neutral and non-engraved zone, thus minimizing the effect of any inhomogeneity in the output images.

[0017] Preferably, said at least one fabric parameter correspond to the fabric of said pattern, thus characterising a target fabric that is the same as the pattern.

[0018] Preferably, said step [d] is done by a user using visual comparison. Therefore, the user only has to compare each of the engraved zones of the pattern with the output images, and finding which one is closer to which one. This does not require any special devices or components, and the requirement regarding to the skill level of the user is still low.

[0019] Preferably, each of said engraved zones has a different identification marker, preferably related to the degree of engraving used for said engraved zone. Thus helping to establish the correspondence. Each of the identification markers is preferably a parameter called pixel value, which is a value relative to the monochrome intensity of the laser engraving, sometimes also referred in the art as "colour" or "greyscale level". In particular, each of said plurality of engraved zones in the pattern correspond to a range of said pixel values. This facilitates the visual comparison, because in general, it could be difficult for the user to discriminate a very fine gradation.

[0020] Preferably, said at least one fabric parameter comprise at least one of fabric composition, fabric thickness and fabric grammage. A series of hypothesis have been considered during the development of the invention since pure exhaustive experimentation with all the possible parameters and combinations, its relative effects and even, the determination of what exactly could be a parameter was not possible. The parameters stated above have been found to become a good characterisation of the fabric for this particular method.

[0021] The laser scans the surface in different lines and irradiates every point of each line during a time known as pixel time. Accordingly, the pixel time corresponds to the time that the laser is emitting for each point in the fabric and, therefore, it relates to the maximum energy applied to each point in the fabric. High pixel time values correspond to high energy levels and, consequently, more material being burnt. The pixel time value is also referred in the art as "laser energy emission time" or similar names.

[0022] Preferably, said at least one laser engraving parameter comprise at least one of laser engraving machine type and pixel time. This has the advantage that the user does not need to know the particular characteristics of each machine, further simplifying the usage. Each of the machines is characterised by its type, for example, by its commercial name, and the user only has to select which one. It will be clear for the skilled person that the manufacturer of the machines has to have a quality control procedure that is able to provide machines with the same calibration in their adjustments. On the other hand, the pixel time relates to the time that the focus of the laser stays in every scanned point in the fabric during the engraving, the longer the time, the more material that is removed by burning. This way, the user can simulate for different times and obtain different intensities.

[0023] Preferably, said processing stage further comprises a step of adjusting said fabric image in at least one of colour, saturation and brightness. If the fabric image has been taken in conditions that do not grant that the visualization is correct, for example, due to a bad illumination, a biased image sensor, etc. the visualization colours and brightness of this image could not correspond with the pattern. The same can happen if the image is visualized in a screen that is not adjusted properly or if the illumination conditions where the comparison is done are not correct. By adjusting colour, saturation and brightness, the comparison can be adapted to the particular conditions. This step could also be used, for example, when using fabrics with a general woven pattern that is the same as the target fabric, but that have slightly different colours.

[0024] In the field of fabric engraving, and especially in the case of denim, worn out effects are highly appreciated by the customers. Some of the engraving described above can be used for simulating the natural worn look of a piece of cloth that has been worn by a user. That is, having scratched zones, wrinkle lines due to the folding in some parts, etc. all of these effects only affect to the surface layer of the fabric. Other more aggressive effects can also be obtained using laser engraving of fabrics, among them, there are of particular interest the drilled effects and ripped effects. Drilled effects, sometimes referred as "popping", are perforations in the fabric that can even create through holes. These kind of effects can be used for simulating worn clothes, for example, drills caused by sharp objects like keys or the like inside a jeans pocket. Ripped effects, sometimes referred as "breakages", are similar but affecting to a larger area. The degree of engraving in any of these effects is linked to different results: as an illustrative example, in the case of the typical blue denim, all of them can go from simply exposing the underlying white layer of threads to even creating a hole in the fabric. These different degrees of engraving are usually dependent on the energy transmitted by the laser of the engraving machine.

[0025] Preferably, said processing stage further comprises the steps of:

- generating a plurality of drilled effect images, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric; and
- selecting one drilled effect image of said plurality of drilled effect images as a target drilled effect;

thus obtaining the degree of engraving for said target drilled effect corresponding to said target laser engraving applied to said target fabric. When using drilling effects in the design of an engraving model, the designer typically has to send to the manufacturer a piece of fabric containing the desired degree of engraving for the dripping effect. A skilled operator, and possibly iterative testing, is required for determining the laser engraving adjust-

ments necessary to obtain the same results as in the original piece of fabrics sent by the designer. Therefore, with this preferred embodiment, no special skills are required for the operator and, besides, the method becomes more efficient in terms of cost and time. Those skilled in the art will understand that the algorithm used for generating a plurality of drilled effect images has to be more complex than simply altering the colour and brightness of the input image. Indeed drilling can create complex visual patterns. An example of how this can be achieved is by using template images for different degrees of engraving, in this case drilled effect engraving. These templates images are obtained by experimentation with different target fabrics and target laser engravings. Then, in accordance with the provided laser engraving parameters and the fabric parameters, a set of image templates, each for a different degree of engraving, is selected by the algorithm. Finally, each image template of the set is blended with the original fabric image, thus obtaining a drilled effect image for that

[0026] Preferably, said processing stage further comprises the steps of:

- generating a plurality of ripped effect images, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric; and
- selecting one ripped effect image of said plurality of ripped effect images as a target ripped effect;

thus obtaining the degree of engraving for said target ripped effect corresponding to said target laser engraving applied to said target fabric. Therefore, the technical effect and elements are equivalent than in the case of the drilled effect.

[0027] Another object of the invention is a computer program containing program code instructions, which, upon being executed by a computer, perform operations carrying out the processing stage of the method of any of the preferred embodiments described above. Therefore having the equivalent technical effects that will not be repeated here for the sake of conciseness.

[0028] Another object of the invention is a system for characterisation of a laser engraving of a fabric, in particular denim, starting from a pattern; said laser engraving being able to apply different degrees of engraving in fabrics, in particular depending on the amount of energy transmitted by a laser; and said pattern having a plurality of engraved zones, corresponding to a plurality of degrees of engraving; the system comprising:

- a user interface, configured for receiving:
 - a fabric image and at least one fabric parameter, thus characterising a target fabric;
 - at least one laser engraving parameter, thus characterising a target laser engraving;

- processing means, configured for generating a plurality of output images, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric;

wherein said user interface is further configured for receiving a correspondence between each engraved zone of said plurality of engraved zones, and the output image of said plurality of output images that is more similar to said engraved zone; thus obtaining a correspondence between degrees of engraving in said pattern and degrees of engraving for said target laser engraving applied to said target fabric that most resemble those in said pattern; thus obtaining a characterisation of said target laser engraving for said target fabric given said pattern.

[0029] Therefore, the system is configured to carry out the processing stage of the method of any of the preferred embodiments described above. For the sake of brevity, the description and technical effect will not be repeated here and only the particularities or differences will be further discussed hereinafter.

[0030] Preferably, said processing means are separated from said user interface, using a communication network, and more preferably being a physical or virtual server or group of servers. This improves the scalability of the solution and it simplifies that the computer program is managed and updated by the manufacturer of the laser engraving machine.

[0031] Preferably, said user interface is a light front-end, preferably a so-called web front-end using Hyper-Text Markup Language or the like. Thus minimizing the software and hardware requirements of the computer where the user interface is used.

[0032] Preferably, said user interface is further configured for displaying said plurality of output images, so that said correspondence between each engraved zone and the output image that is more similar can be done by a user by visual comparison.

[0033] Preferably, the system is further configured for displaying said fabric image and receiving an adjustment in at least one of colour, saturation and brightness.

[0034] Preferably, said processing means are further configured for generating a plurality of drilled effect images, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric; and said user interface is further configured for receiving a selection of one drilled effect image of said plurality of drilled effect images as a target drilled effect, thus obtaining the degree of engraving for said target drilled effect corresponding to said target laser engraving applied to said target fabric; and transmitting said selection to said processing means.

[0035] Preferably, said processing means are further configured for generating a plurality of ripped effect images, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric; and said user interface is

further configured for receiving a selection of one ripped effect image of said plurality of ripped effect images as a target ripped effect, thus obtaining the degree of engraving for said target ripped effect corresponding to said target laser engraving applied to said target fabric.

[0036] Likewise, the invention also includes other features of detail illustrated in the detailed description of an embodiment of the invention and in the accompanying figures.

Brief description of the drawings

[0037] Further advantages and features of the invention will become apparent from the following description, in which, without any limiting character, preferred embodiments of the invention are disclosed, with reference to the accompanying drawings in which:

Figure 1 is an example of a pattern having different engraved zones.

Figure 2 is an example of a fabric image.

Figure 3 is an example of a plurality of output images, grouped in a single frame, corresponding to the fabric image of figure 2.

Figure 4 is an example of a plurality of drilled effect images and a plurality of ripped effect images.

Detailed description of embodiments of the invention

[0038] The figures show some images used to exemplify a method for characterisation of a laser engraving of a fabric. The exemplary embodiments described hereinafter will consider that the fabrics are denim. More specifically, they will be used for creating clothing, this clothing being jeans trousers. In these cases, the laser engraving will be aimed to simulate the look of clothing that has been naturally worn by usage.

[0039] Said laser engraving being able to apply different degrees of engraving in fabrics, in particular depending on the amount of energy transmitted by a laser. In these exemplary embodiments, the laser engraving machine drives the light of a pulsed laser to the surface of the fabric to be engraved. The laser scans the surface in different lines and irradiates every point of each line during a time known as pixel time, with a power level necessary to obtain the required degree of engraving. Other laser types are available in the market or could appear in the future. The laser engraving machine described here is just an exemplary and non-limiting option, used for clarifying a typical example and provide an overview of the general engraving process.

[0040] Besides, these embodiments are not limitative of the scope of usage of the method. Indeed, other embodiments are possible that use different types of fabrics, aimed for different final products, not only for clothing,

and with different objectives for laser engraving, for example, engraving text or images in fabrics.

[0041] The exemplary method comprises providing a pattern 100 having a plurality of engraved zones 101, corresponding to a plurality of degrees of engraving. Figure 1 shows an example of such pattern 100. The lower part of the pattern 100 shows several variations of a design for laser engraving. Different engraving effects are shown, for example worn zones and wrinkles due to folding. At the top of the image of Figure 1 said engraved zones 101 are shown. In this case, the different engraved zones 101 are arranged as a gradation of levels of brightness. Since the fabrics of the example is denim, the brighter areas correspond to higher degrees of engraving, that is, where the laser has burn out more of the external layer of the dyed fabric and exposed more of the underlying fabric colour, while darker areas are lower degrees of engraving.

[0042] At the top of Figure 1 is shown that each of said engraved zones 101 has a different identification marker 102, which is related to the degree of engraving used for said engraved zone 101. In particular, in the examples, the laser engraving is guided by a design, which is a computer image file. In this image file, the values of each pixel, from 0 to 255, determine the spots to burn in the fabric and, for each spot, the value of the corresponding pixel in the design image is the degree of engraving for the spot. Indeed, for the example, 0 corresponds to the maximal energy, while 255 is the minimum. Therefore, Figure 1 shows identification markers 102 that are pixel values. As shown, not all pixel values are represented: there is a step of 10 between an engraved zone 101 and the next one.

[0043] The method comprises a processing stage that, in these exemplary embodiments, is done by a computer program. The main part of this computer program is executed by processing means, in particular, by a server or group of servers. Those skilled in the art of information technologies will understand that the concept of a server is not always associated with a specific physical computer, but can also be a virtual machine, or supported by any of the infrastructures commonly known as "cloud computing". Other part of the software is executed for generating a user interface, so a user can interact with the method. In particular, in the examples, the user interface is an HTML-based interface displayed in a browser of a personal computer, tablet, smartphone or any device capable to browse html content.

[0044] Said processing stage comprises several steps. Step [a] comprises providing a fabric image 200 and at least one fabric parameter, thus characterising a target fabric. In the embodiment, this step is done through the user interface. In particular, the user takes a picture of the pattern 100 in a neutral and non-engraved zone, like the one shown in Figure 2. Then provides the image to the interface. In some embodiments, when the user is using a camera-enabled device for browsing the user interface, for example, a tablet, the image is preferably

captured using the device camera.

[0045] In the embodiments shown here, the target fabric is the same than the fabric of the pattern 100. This means that said at least one fabric parameter also corresponds to the fabric of said pattern 100. In particular, for the example, the fabric parameters are fabric composition, fabric thickness and fabric grammage. Other fabric parameters could be envisaged without falling out of the scope of the main claim.

[0046] Step [b] comprises providing at least one laser engraving parameter, thus characterising a target laser engraving. In the example, said at least one laser engraving parameter comprise laser engraving machine type and pixel time. The user interface displays a list of all the available machines, so the user only has to select the one that will be used for the target laser engraving.

[0047] In the embodiment, step [c] comprises generating, by the processing means (i.e. the server executing its corresponding computer program), a plurality of output images 301, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric. Figure 3 shows one example of the plurality of images 301 starting from the fabric image of Figure 2. In this example, a total number of 25 output images 301 are generated, and displayed in the user interface as a group image where all the output images 301 are arranged from more degree of engraving in the top left, to less degree of engraving in the bottom right. Other arrangements are possible in further embodiments.

[0048] As already seen, simple embodiments of the simulation algorithm used to generate the output images 301 can be used. Nevertheless, in this exemplary embodiment the algorithm is more complex than the one described before in the document.

[0049] In particular, the steps are:

- Calculate the average colour of the fabric image 200.
- Based on the fabric parameters and laser engraving parameters, select a predefined curve. The curve determining a change in brightness for every pixel value, corresponding to a degree of engraving. Some embodiments use an equation as a curve, but tables can also be used.
- Optionally, the curve further determines a change in colour modelling how the fabric reacts to the laser, for example, becoming more brown, white or blue. This optional step can be equivalent to select separate brightness curves and a colour curves.
- For each degree of engraving corresponding to an output image 301, apply the modification determined by said curve or curves to the average colour, and blend the result with the fabric image 200.
- Generate an initial grid containing all the output images 301.

[0050] In the example, these curves are generated in a previous step by experimentation with different fabrics

and machines. They can also be theoretical models, or a combination of both. In addition, interpolation tools can be used if the parameters for a specific combination of target fabric and target laser engraving are not available.

Other embodiments use different simulation algorithms, for example, applying local adjustments to the fabric image 200 instead of average values, or even using neural networks to determine the most likely output for the fabric image 200, based on target fabric and laser engraving parameters. In the latter example, the neural network should be previously trained with enough amount of experimental data.

[0051] The exemplary embodiment also includes a step [d], comprising establishing a correspondence between each engraved zone 101 of said plurality of engraved zones and the output image of said plurality of output images that is more similar to said engraved zone 101. In the example, this is done by a user. In particular, the user interface displays the image of Figure 3 containing the plurality of output images 301, and the user compares which one of the output images 301 is more similar to each engraved zone 101 of the pattern 100, for example, those shown in Figure 1, and inputs the correspondence in the user interface.

[0052] This correspondence is then sent to the server thus obtaining a correspondence between degrees of engraving in said pattern 100 and degrees of engraving for said target laser engraving applied to said target fabric that most resemble those in said pattern 100. Therefore, the server receives the information, obtaining a characterisation of said target laser engraving for said target fabric given said pattern. This characterisation is then stored as a computer file that is later user by a computer-aided design and/or a computer-aided manufacturing software. Those skilled in the art will understand that an equivalent solution to generating files is to use the memory storage and/or data transmission for storing and/or sending the information.

[0053] The following embodiments share most of the elements disclosed above. Therefore, hereinafter only the differentiating elements will be mentioned, while the common characteristics are disclosed in the above embodiments.

[0054] In some embodiments, the processing stage further comprises an optional step of adjusting said fabric image 200 in at least one of colour, saturation and brightness, in particular, the user interface displays the fabric image 200, and three sliders for adjusting brightness and hue. When the user moves the slider the displayed image is modified accordingly. Further embodiments also adjust saturation. Other types of controls can be envisaged, as they are usual in user interfaces for images. In this case, the fabric image 200 that will be used by the simulation algorithm will be the adjusted image.

[0055] Other embodiments the said processing stage further comprises, by the server, generating a plurality of drilled effect images 401, each for a different degree of engraving, and each being a simulated result of ap-

plying said target laser engraving to said target fabric. Figure 4 shows said drilled effect images 401 in its lower part.

[0056] Afterwards, the drilled effect images 401 are shown in the user interface and, the user selects one drilled effect image 401 of said plurality of drilled effect images 401 as a target drilled effect. Thus obtaining the degree of engraving for said target drilled effect corresponding to said target laser engraving applied to said target fabric.

[0057] In some embodiments, the drilled effect images are selected from a database of previously generated image templates, stored according specific combinations of fabric and laser engraving parameters, and obtained by experimentation. Then, the selected templates are blended with the fabric image 200 in order to generate the drilled effect images 401. The blending is not pure overlap of images, since it takes into account the zones where the surface has been completely removed or destroyed by the laser. Other embodiments can make use of different algorithms, for example, they can use neural networks in a similar fashion as stated above.

[0058] In still other embodiments, the processing stage further comprises, by the server, generating a plurality of ripped effect images 502, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric. The upper part of Figure 4 shows an example of this ripped effect images 502. Afterwards, the ripped effect images 501 are shown in the user interface and, the user selects one ripped effect image 502 of said plurality of ripped effect images as a target ripped effect. Thus obtaining the degree of engraving for said target ripped effect corresponding to said target laser engraving applied to said target fabric. These embodiments use equivalent algorithms to those described for the case of drilled effect.

[0059] Those skilled in the art will understand that the embodiments disclosed here are non-limitative examples, and other embodiments are possible within the scope or the claims, for example but not limited to, different sequences of the method steps or different combinations of technical features.

Claims

1. Method for characterisation of a laser engraving of a fabric, in particular denim, said laser engraving being able to apply different degrees of engraving in fabrics, in particular depending on the amount of energy transmitted by a laser; **characterised in that** the method comprises:

- providing a pattern (100) having a plurality of engraved zones (101), corresponding to a plurality of degrees of engraving; and
- a processing stage comprising the steps of:

[a] providing a fabric image (200) and at least one fabric parameter, thus characterising a target fabric;

[b] providing at least one laser engraving parameter, thus characterising a target laser engraving;

[c] generating a plurality of output images (301), each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric;

[d] establishing a correspondence between each engraved zone (101) of said plurality of engraved zones and the output image of said plurality of output images that is more similar to said engraved zone (101);

[e] thus obtaining a correspondence between degrees of engraving in said pattern (100) and degrees of engraving for said target laser engraving applied to said target fabric that most resemble those in said pattern (100);

thus obtaining a characterisation of said target laser engraving for said target fabric given said pattern.

2. Method according to claim 1, **characterised in that** said fabric image corresponds to a zone of said pattern (100), preferably, a neutral and non-engraved zone.
3. Method according to claim 2, **characterised in that** said at least one fabric parameter correspond to the fabric of said pattern (100).
4. Method according to any of the claims 1 to 3, **characterised in that** said step [d] is done by a user using visual comparison.
5. Method according to any of the claims 1 to 4, **characterised in that** each of said engraved zones (101) has a different identification marker (102), preferably related to the degree of engraving used for said engraved zone (101).
6. Method according to any of the claims 1 to 5, **characterised in that** said at least one fabric parameter comprise at least one of fabric composition, fabric thickness and fabric grammage.
7. Method according to any of the claims 1 to 6, **characterised in that** said at least one laser engraving parameter comprise at least one of laser engraving machine type and pixel time.
8. Method according to any of the claims 1 to 7, **characterised in that** said processing stage further comprises a step of adjusting said fabric image (200) in

at least one of colour, saturation and brightness.

9. Method according to any of the claims 1 to 8, **characterised in that** said processing stage further comprises the steps of:

- generating a plurality of drilled effect images (401), each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric; and
- selecting one drilled effect image (401) of said plurality of drilled effect images (401) as a target drilled effect;

thus obtaining the degree of engraving for said target drilled effect corresponding to said target laser engraving applied to said target fabric.

10. Method according to any of the claims 1 to 9, **characterised in that** said processing stage further comprises the steps of:

- generating a plurality of ripped effect images (502), each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric; and
- selecting one ripped effect image (502) of said plurality of ripped effect images as a target ripped effect;

thus obtaining the degree of engraving for said target ripped effect corresponding to said target laser engraving applied to said target fabric.

11. Computer program containing program code instructions, which, upon being executed by a computer, perform operations carrying out the processing stage of the method of any of the claims 1 to 10.

12. System for characterisation of a laser engraving of a fabric, in particular denim, starting from a pattern (100); said laser engraving being able to apply different degrees of engraving in fabrics, in particular depending on the amount of energy transmitted by a laser; and said pattern (100) having a plurality of engraved zones (101), corresponding to a plurality of degrees of engraving; the system comprising:

- a user interface, configured for receiving:
 - a fabric image and at least one fabric parameter, thus characterising a target fabric;
 - at least one laser engraving parameter, thus characterising a target laser engraving;

- processing means, configured for generating a plurality of output images, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric;

wherein said user interface is further configured for receiving a correspondence between each engraved zone (101) of said plurality of engraved zones, and the output image of said plurality of output images that is more similar to said engraved zone (101); thus obtaining a correspondence between degrees of engraving in said pattern (100) and degrees of engraving for said target laser engraving applied to said target fabric that most resemble those in said pattern (100); thus obtaining a characterisation of said target laser engraving for said target fabric given said pattern.

13. System according to claim 12, **characterised in that** said user interface is further configured for displaying said plurality of output images, so that said correspondence between each engraved zone (101) and the output image that is more similar can be done by a user by visual comparison.

14. System according to any of the claims 12 or 13, **characterised in that** it is further configured for displaying said fabric image and receiving an adjustment in at least one of colour, saturation and brightness.

15. System according to any of the claims 12 to 14, **characterised in that** said processing means are further configured for generating a plurality of drilled effect images, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric; and said user interface is further configured for receiving a selection of one drilled effect image of said plurality of drilled effect images as a target drilled effect, thus obtaining the degree of engraving for said target drilled effect corresponding to said target laser engraving applied to said target fabric; and transmitting said selection to said processing means.

16. System according to any of the claims 12 to 15, **characterised in that** said processing means are further configured for generating a plurality of ripped effect images, each for a different degree of engraving, and each being a simulated result of applying said target laser engraving to said target fabric; and said user interface is further configured for receiving a selection of one ripped effect image of said plurality of ripped effect images as a target ripped effect, thus obtaining the degree of engraving for said target ripped effect corresponding to said target laser engraving applied to said target fabric.

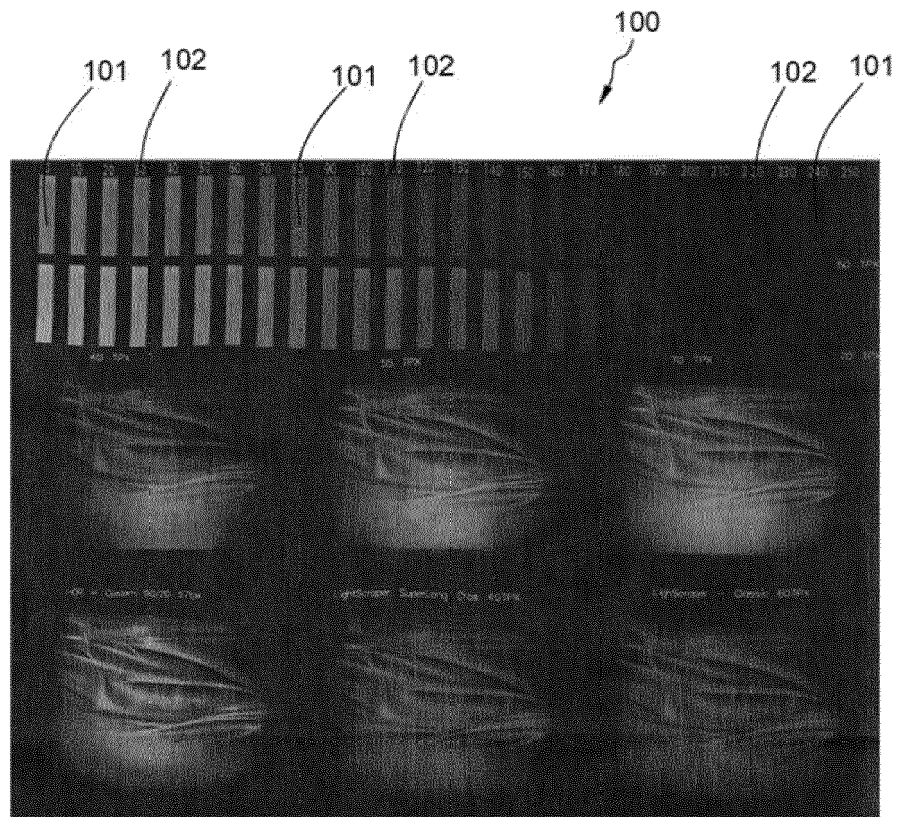


FIG. 1

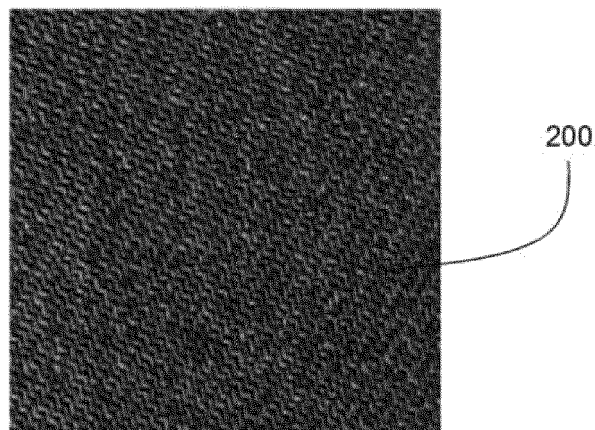


FIG. 2

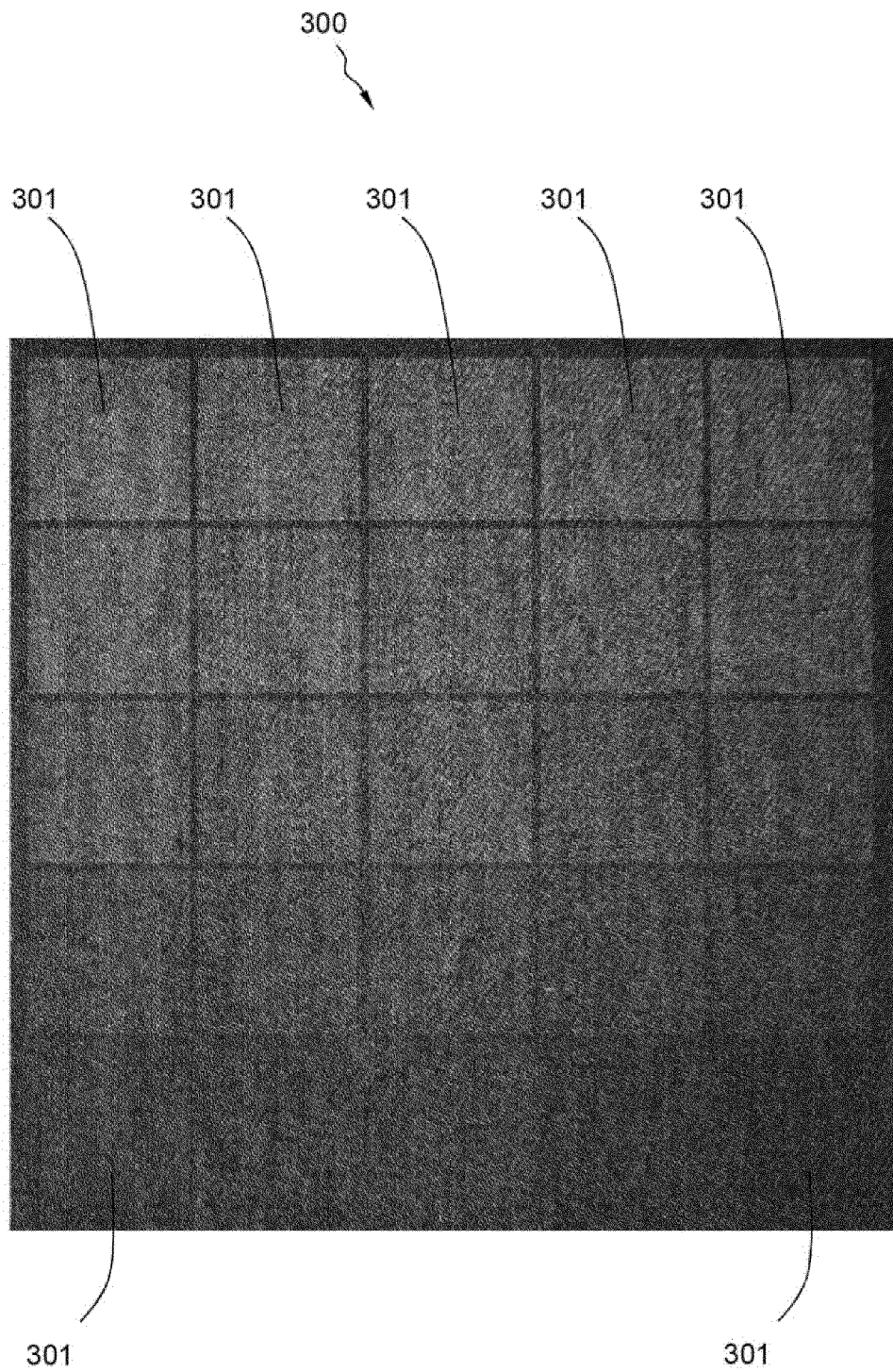


FIG. 3

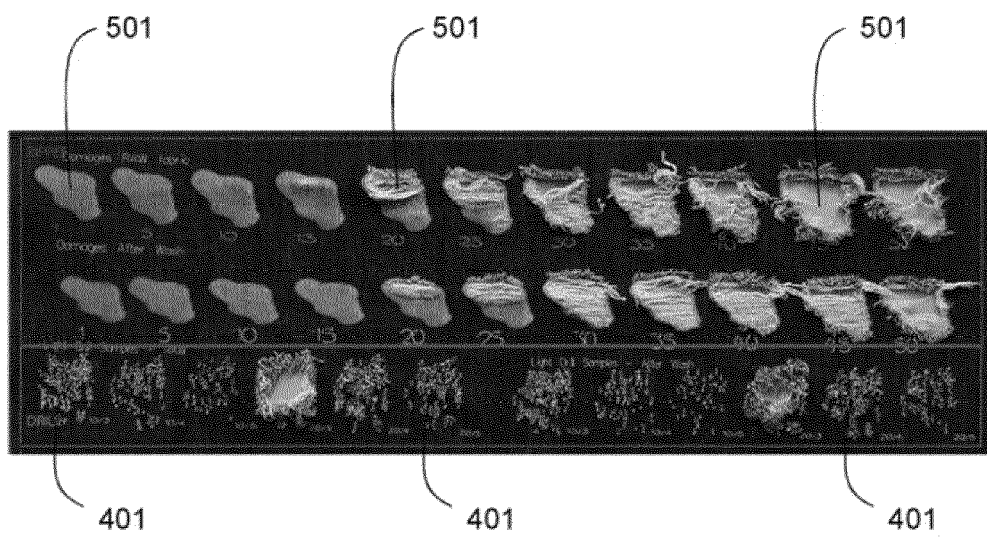


FIG. 4



EUROPEAN SEARCH REPORT

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Place of search The Hague		Date of completion of the search 6 February 2019	Examiner Rella, Giulia
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 18 38 2607

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

06-02-2019

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