

Claims

1. A method comprising:
point matching a first plurality of relatively permanent pigmented or vascular skin marks (RPPVSMs) in a first image with a second plurality of RPPVSMs in a second image;
and
determining a correspondence probability between the first plurality of RPPVSMs and the second plurality of RPPVSMs based on using variables comprising: a size of overlapped total skin area of two images containing RPPVSMs, a distance threshold between two RPPVSMs to be considered matching, and a number of matching RPPVSMs of the first and second images,
wherein one of the point matching or the determining is performed by a processor.
2. The method of claim 1, wherein determining a correspondence probability comprises determining a correspondence probability that the first plurality of RPPVSMs and the second plurality of RPPVSMs are from a same person.
3. The method of claim 1, wherein determining comprises determining based on using variables comprising: area $C=\pi r^2$ around a first RPPVSM for finding a matching RPPVSM, "A" the size of overlapped total skin area of the first and second plurality of RPPVSMs, "r" the distance threshold between a first RPPVSM of the first plurality of RPPVSMs and a second RPPVSM of the second RPPVSM for the first and second RPPVSMs to be considered matching, and "p" the number of matching RPPVSMs of the first and second plurality of RPPVSMs.
4. The method of claim 3, wherein determining the correspondence probability comprises:
estimating the size of overlapped total skin area of two images containing RPPVSMs,
estimating the distance threshold between two RPPVSMs to be considered matching, and
estimating the number of matching RPPVSMs of the first and second images.
5. The method of claim 4, wherein estimating the size of overlapped total skin area of two images containing RPPVSMs and estimating the distance threshold between two

RPPVSMs to be considered matching comprises using: $\Pr(\sqrt{(x_1-x_2)^2+(y_1-y_2)^2} \leq r) \geq 0.975$, where (x_1, y_1) and (x_2, y_2) are two genuine corresponding nevi from the same person.

6. The method of claim 4, wherein estimating the size of overlapped total skin area comprises counting an area of overlap of a first area of skin in the first image with a second area of skin of the second image; wherein estimating the distance threshold between two RPPVSMs to be considered matching comprises selecting a value of the distance threshold between two RPPVSMs to be considered matching for which a probability $\Pr$ of genuine correspondence of any two RPPVSMs to be considered matching is a selected threshold; and wherein the correspondence probability is determined based on the distance threshold.

7. The method of claim 1, wherein the first plurality of RPPVSMs are on a first area of skin of a person in the first image, and the second plurality RPPVSMs are on a second area of skin of a person in the second image, and wherein the second plurality of RPPVSMs includes at least a third plurality of RPPVSMs in at least a third image and the third plurality RPPVSMs are on a third area of skin of a person in the third image.

8. The method of claim 1, further comprising, prior to point matching, detecting the first plurality of RPPVSMs in the first image and the second plurality of RPPVSMs in the second image using a computer.

9. A method of claim 1, wherein point matching includes image registration and parameter estimation comprising:

selecting a base image from the first and second images;

selecting registration points for the first and second images; and

transforming and translating the first and second images to align the registration points,

wherein transforming and translating comprises one of a global transformation, an Affine transformation, a combined transformation for all images, or a transformation using a parameter matrix (A) and a vector (b) where $x \rightarrow Ax+b$.

10. The method of claim 9, wherein selecting a base image comprises selecting an image with the lowest resolution; and

wherein selecting the registration points comprises one of selecting skin marks that are not a RPPVSM, selecting points at a boundary of an area of skin that the RPPVSMs are within, selecting points with a larger distance between the points than between any two adjacent RPPVSMs of the first or second image, or selecting three registration points.

11. The method of claim 9, wherein transforming and translating comprises:
preserving co-linearity relation between the registration points; and
preserving ratios of distances along lines between the registration points.

12. A method of claim 1, wherein point matching the images comprises a transformation using a parameter matrix (A) and a vector (b) where $x \rightarrow Ax+b$, and calculating the parameter matrix A and the vector b using:

$$\begin{bmatrix} u \\ v \end{bmatrix} = \begin{bmatrix} a_0 & a_1 & a_2 \\ b_0 & b_1 & b_2 \end{bmatrix} \begin{bmatrix} 1 \\ x \\ y \end{bmatrix}$$

where (u, v) is the transformed coordinate of (x, y) and

$$\begin{bmatrix} a_0 & a_1 & a_2 \\ b_0 & b_1 & b_2 \end{bmatrix}$$

is a parameter matrix that can be obtained by solving the three equations,

$$\begin{bmatrix} x_{ei} \\ y_{ei} \end{bmatrix} = \begin{bmatrix} a_0 & a_1 & a_2 \\ b_0 & b_1 & b_2 \end{bmatrix} \begin{bmatrix} 1 \\ x_{si} \\ y_{si} \end{bmatrix},$$

where $i=1, 2$ and 3 .

13. A non-transitory machine-readable medium having data therein which when accessed by a processor causes the processor to:

point match a first plurality of RPPVSMs in a first image with a second plurality of RPPVSMs in a second image; and

determine a correspondence probability between the first plurality of RPPVSMs and the second plurality of RPPVSMs based on using variables comprising: a size of overlapped total skin area of two images containing RPPVSMs, a distance threshold between two RPPVSMs to be considered matching, and a number of matching RPPVSMs of the first and second images.

14. The non-transitory machine-readable medium of claim 13, further comprising non-transitory machine-readable medium having data therein which when accessed by the processor causes the processor to: prior to point matching, detect the first plurality of RPPVSMs in the first image and the second plurality of RPPVSMs in the second image.

15. The non-transitory machine-readable medium of claim 13, wherein point matching includes image registration and parameter estimation comprising:

selecting a base image from the first and second images;

selecting registration points for the first and second images; and

transforming and translating the first and second images to align the registration points,

wherein transforming and translating comprises one of a global transformation, an Affine transformation, a combined transformation for all images, or a transformation using a parameter matrix (A) and a vector (b) where $x \rightarrow Ax+b$.

16. A system comprising:

a processor;

a digital image input;

a memory coupled to said processor and containing code which when executed:

point matches a first plurality of RPPVSMs in a first image with a second plurality of RPPVSMs in a second image; and

determines a correspondence probability between the first plurality of RPPVSMs and the second plurality of RPPVSMs based on using variables comprising: a size of overlapped total skin area of two images containing RPPVSMs,

a distance threshold between two RPPVSMs to be considered matching, and a number of matching RPPVSMs of the first and second images.

17. The system of claim 16, wherein the code further comprises code which when executed: detects, prior to point matching, the first plurality of RPPVSMs in the first image and the second plurality of RPPVSMs in the second image.

18. The system of claim 16, wherein point matching includes image registration and parameter estimation comprising:

selecting a base image from the first and second images;

selecting registration points for the first and second images; and

transforming and translating the first and second images to align the registration points,

wherein transforming and translating comprises one of a global transformation, an Affine transformation, a combined transformation for all images, or a transformation using a parameter matrix (A) and a vector (b) where $x \rightarrow Ax+b$.