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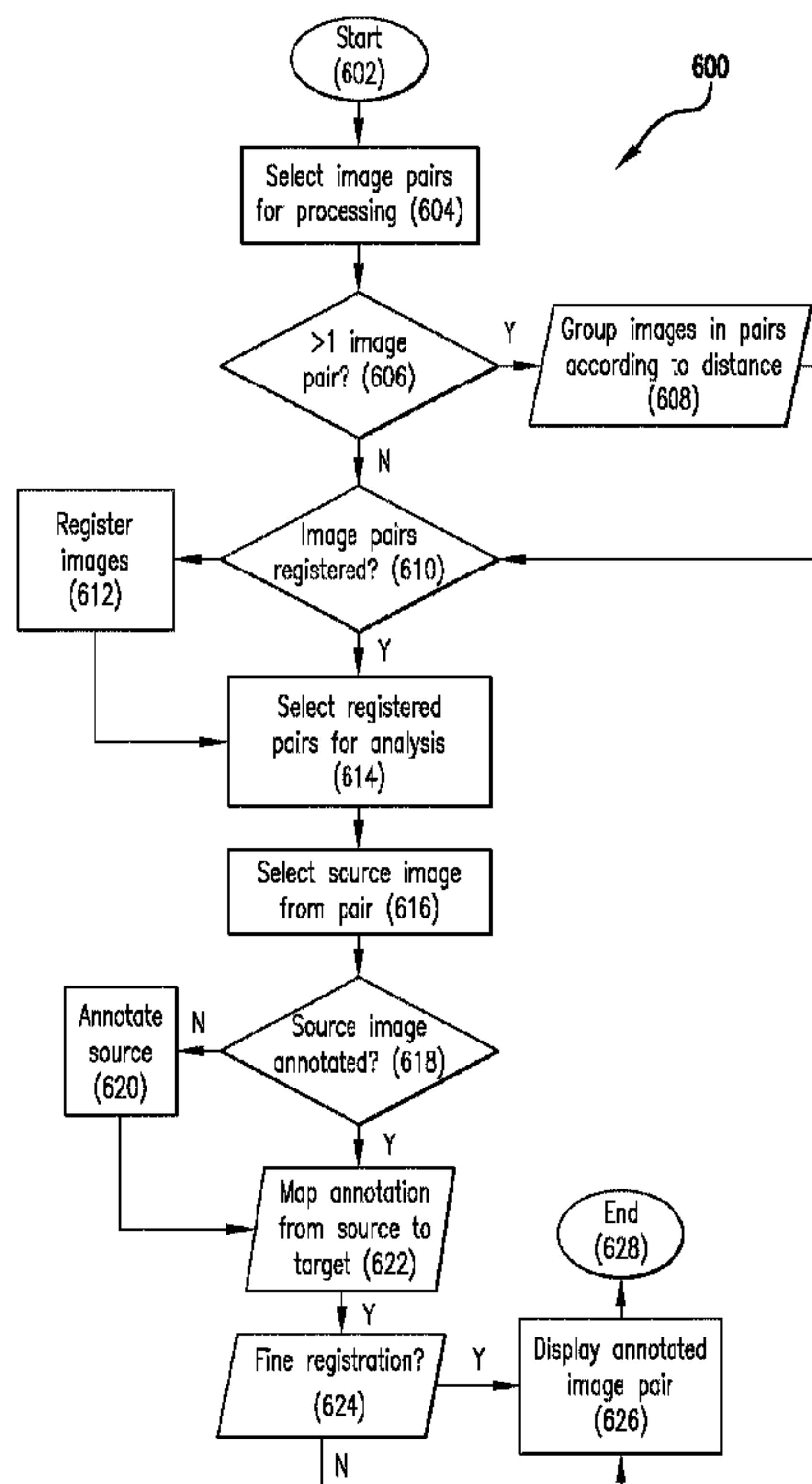
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(54) Titre : DISPOSITIFS, SYSTEMES ET PROCEDES D'ALIGNEMENT D'IMAGES PLEIN CHAMP ET D'ANNOTATION D'IMAGES CROISEES
(54) Title: WHOLE SLIDE IMAGE REGISTRATION AND CROSS-IMAGE ANNOTATION DEVICES, SYSTEMS AND METHODS



(57) Abrégé/Abstract:

The disclosure relates to devices, systems and methods for image registration and annotation. The devices include computer software products for aligning whole slide digital images on a common grid and transferring annotations from one aligned image to

(57) Abrégé(suite)/Abstract(continued):

another aligned image on the basis of matching tissue structure. The systems include computer-implemented systems such as work stations and networked computers for accomplishing the tissue-structure based image registration and cross-image annotation. The methods include processes for aligning digital images corresponding to adjacent tissue sections on a common grid based on tissue structure, and transferring annotations from one of the adjacent tissue images to another of the adjacent tissue images.

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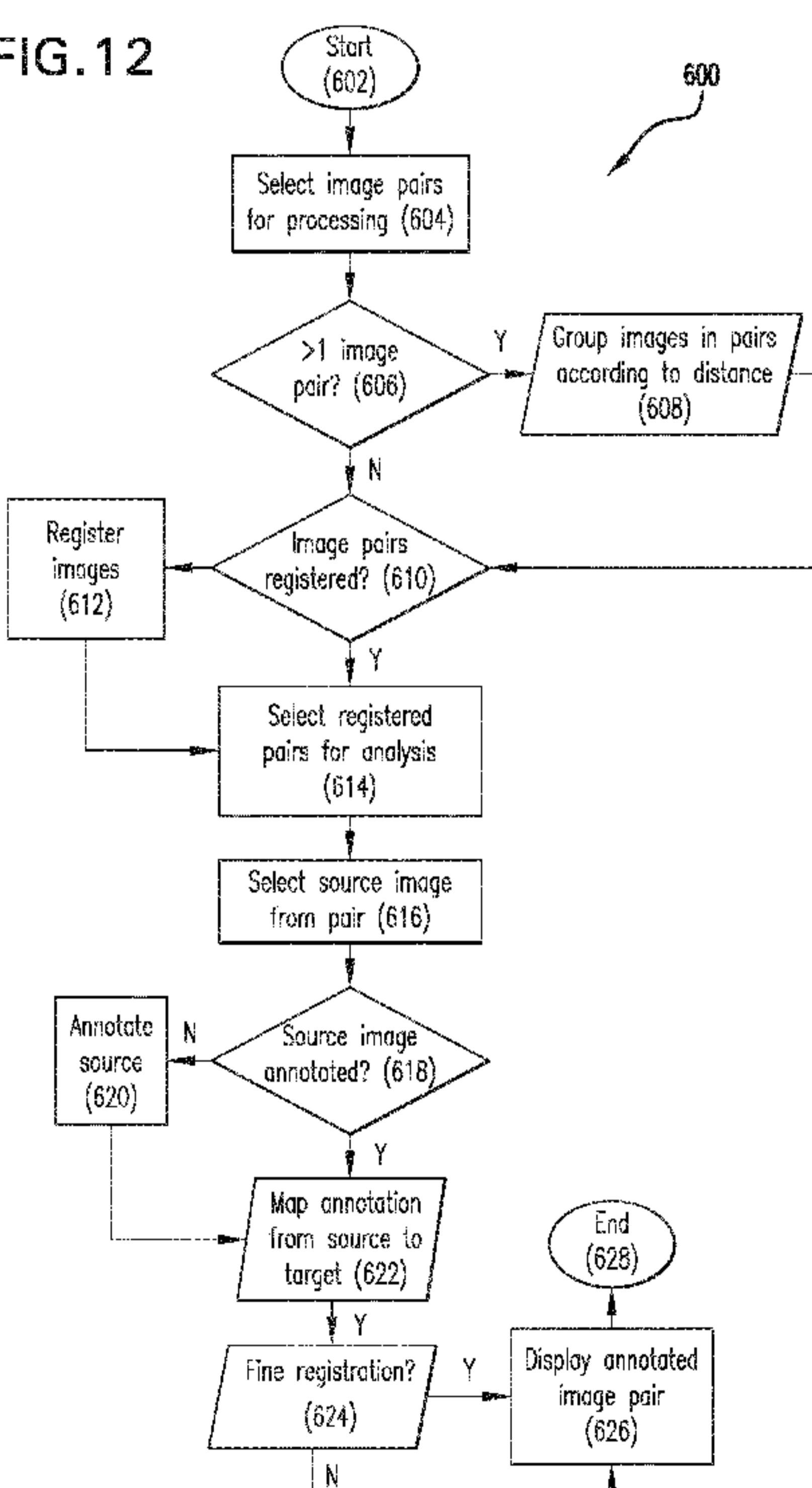
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(54) Title: WHOLE SLIDE IMAGE REGISTRATION AND CROSS-IMAGE ANNOTATION DEVICES, SYSTEMS AND METHODS

FIG.12



(57) Abstract: The disclosure relates to devices, systems and methods for image registration and annotation. The devices include computer software products for aligning whole slide digital images on a common grid and transferring annotations from one aligned image to another aligned image on the basis of matching tissue structure. The systems include computer-implemented systems such as work stations and networked computers for accomplishing the tissue-structure based image registration and cross-image annotation. The methods include processes for aligning digital images corresponding to adjacent tissue sections on a common grid based on tissue structure, and transferring annotations from one of the adjacent tissue images to another of the adjacent tissue images.

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What is claimed is:

1. A computerized image registration process, comprising:
 - a. selecting a first digital image of a first tissue section from a set of digital images of adjacent tissue sections of a single patient;
 - b. selecting a second digital image of a second tissue section from the set;

- c. matching tissue structure between the first digital image and the second digital image, wherein matching the tissue structure comprises a coarse registration mode, wherein matching the tissue structure further comprises a fine registration mode to refine alignment of the first digital image and the second digital image; and

- d. automatically mapping an annotation drawn on the first digital image to the second digital image;

wherein the coarse registration mode comprises:

generating a first gray-level tissue foreground image from the first digital image and generating a second gray-level tissue foreground image from the second digital image;

computing a first tissue binary edge map from the first gray-level tissue foreground image and computing a second tissue binary edge map from the second gray-level tissue foreground image;

computing global transformation parameters to align the first binary edge map and the second binary edge map; and,

mapping the first digital image and the second digital image to a common grid encompassing both the first and second digital images based on the global transformation parameters;

wherein the fine registration mode comprises:

annotating the first digital image;

mapping the annotation on the common grid to a corresponding location in the second digital image; and,

updating the location using Chamfer-distance matching based on the binary tissue edge maps;

wherein cropped versions of the tissue edge binary maps are used and the fine registration further comprises selecting a minimum cost window which improves matching relative to the coarse mode registration, wherein the minimum cost window is selected to surround the annotation.

2. A computerized image registration process according to claim 1, wherein the first digital image is derived from an image obtained using a stain and an imaging mode, and the second digital image is derived from an image obtained using a different stain, a different imaging mode, or both as compared to the first digital image.

3. A computerized image registration process according to claim 2, wherein the stain is chosen from a hematoxylin and eosin, HE, stain, ImmunoHistoChemistry, IHC, stain or Fluorescent stain.

4. A computerized image registration process according to claim 2, wherein the imaging mode is chosen from brightfield microscopy and fluorescent microscopy.

5. A computerized image registration process according to claim 1, wherein computing global transformation parameters comprises using a moments-based mapping method to generate an affine mapping between the first binary edge map and the second binary edge map.

6. An image registration system, comprising:

- e. a processor;
- f. a memory containing instructions for execution by the processor, which if executed performs a process according to any one of claims 1 to 5;

g. a client user interface for triggering the processor to execute the instructions; and,

h. a monitor which can display the client user interface, the first image and the second image, the results and combinations thereof

7. The image registration system according to claim 6, implemented on a workstation comprising at least one of a computer comprising the processor, the memory, the client user interface, and the monitor.

8. The image registration system according to claim 6, implemented on a computer network.

9. The image registration system according to claim 8, wherein the computer network comprises one or more client computers, a server, and a network-accessible database, all connected via a network, wherein the one or more client computers comprise the processor, the monitor, and the client user interface; the network-accessible database stores at least one set of images of adjacent tissue sections; and the memory resides on the server or one or more client computers or both.

10. The image registration system of any one of claims 6 to 9, wherein each of the one or more images is prepared using a different stain, a different imaging mode, or both.

11. A computer program product for aligning images and mapping an annotation from one aligned image to another aligned image, the computer program product comprising: a tangible computer readable storage medium having a computer readable program code embedded therein, which, if executed by a processor, causes the computer to perform a process according to any one of claims 1 to 5.

12. The computer program product of claim 11, wherein each image in the set is obtained using a different stain, a different imaging mode, or both.