Claims

1. A system for imaging a surface defect on an object, the system comprising:

an actuator;

a sensor assembly connected to the actuator, the sensor assembly comprising a plurality of sensors configured to capture a plurality of images of the object, the plurality of sensors comprising at least one geometry sensor configured to capture two-and-a-half-dimensional and/or three-dimensional images of the object and at least one texture sensor configured to capture two-dimensional images of the object; and

a processor configured to control the actuator and the sensor assembly to:

identify a region of interest associated with the surface defect using an image of the object;

determine, using the two-and-a-half-dimensional and/or the three-dimensional images of the object, geometrical properties of the object;

determine, using the two-dimensional images of the object, texture properties of the object; and

repeatedly identify at least one subsequent region of interest associated with the surface defect using at least a preceding region of interest such that the surface defect is identified according to a predetermined criterion, wherein the at least one subsequent region of interest is identified based on both the geometrical properties and the texture properties of the object.

2. The system of claim 1, wherein the predetermined criterion comprises a predetermined number of pixels per unit length.

3. The system of claim 2, wherein the predetermined number of pixels per unit length is at least 5 pixels per millimeter.

4. The system of any one of claims 1 to 3, wherein the plurality of sensors captures the plurality of images of non-regions of interest of the object in a first resolution while capturing the at least one subsequent region of interest associated with the surface defect in a second resolution, wherein the second resolution is higher than the first resolution.

5. The system of any one of claims 1 to 4, wherein the sensor assembly further comprises at least one additional sensor, the at least one additional sensor comprising a global-view sensor configured to capture overall coarse geometry of the object,

wherein the processor is configured to identify the region of interest using an image of the overall coarse geometry of the object captured by the global-view sensor.

6. The system of any one of claims 1 to 5, wherein the predetermined criterion comprises a first predetermined sampling threshold and a second predetermined sampling threshold of the at least one geometry sensor, and wherein the at least one geometry sensor samples the at least one subsequent region of interest at a first sampling density larger than the first predetermined sampling threshold and samples the non-regions of interest at a second sampling density larger than the second predetermined sampling threshold, and wherein the first predetermined sampling threshold is greater than the second predetermined sampling threshold to support capture of three-dimensional images.

7. The system of any one of claims 1 to 6, wherein the predetermined criterion comprises a predetermined accuracy threshold of the at least one geometry sensor, and wherein the at least one geometry sensor captures each point of the at least one subsequent region of interest at an accuracy larger than the predetermined accuracy threshold.

8. A method of imaging a surface defect on an object, the method comprising:

capturing, using a sensor assembly connected to an actuator, a plurality of images of the object, wherein the sensor assembly comprises at least one geometry sensor and at least one texture sensor, and wherein capturing the plurality of images of the object comprises capturing two-and-a-half-dimensional and/or three-dimensional images of the object using the geometry sensor and capturing two-dimensional images of the object using a texture sensor;

identifying, using a processor configured to control the actuator and the sensor assembly, a region of interest associated with the surface defect using an image of the object; and

repeatedly identifying at least one subsequent region of interest associated with the surface defect using at least a preceding region of interest such that the surface defect is identified according to a predetermined criterion, wherein identifying the region of interest and the at least one subsequent region of interest comprises:

determining geometrical properties of the object using the two-and-a-half-dimensional and/or the three-dimensional images of the object and determining texture properties of the object using the two-dimensional images of the object; and

identifying the region of interest and identifying the at least one subsequent region of interest in response to both the geometrical properties and the texture properties of the object.

9. The method of claim 8, wherein the predetermined criterion comprises a predetermined number of pixels per unit length.

10. The method of claim 9, wherein the predetermined number of pixels per unit length is at least 5 pixels per millimeter.

11. The method of any one of claims 8 to 10, wherein capturing the plurality of images of the object using the at least one sensor comprises capturing at least one image of a non-region of interest of the object in a first resolution while capturing the at least one subsequent region of interest associated with the surface defect in a second resolution, wherein the second resolution is higher than the first resolution.

12. The method of any one of claims 8 to 11, wherein capturing the plurality of images of the object comprises capturing, using a global-view sensor, an overall coarse geometry of the object, and wherein identifying the region of interest associated with the surface defect comprises identifying the region of interest associated with the surface defect using an image of the overall coarse geometry of the object captured by the global-view sensor.

13. The method of any one of claims 8 to 12, wherein the predetermined criterion comprises a first predetermined sampling threshold and a second predetermined sampling threshold of the at least one geometry sensor, and wherein capturing the plurality of images of the object comprises capturing three-dimensional images of the object using the geometry sensor by the at least one geometry sensor sampling the at least one subsequent region of interest at a first sampling density larger than the first predetermined sampling threshold and sampling the non-regions of interest at a second sampling density larger than the second predetermined sampling threshold, and wherein the first predetermined sampling threshold is greater than the second predetermined sampling threshold to support capture of the three-dimensional images of the object.

14. The method of any one of claims 8 to 13, wherein the predetermined criterion comprises a predetermined accuracy threshold of the at least one geometry sensor, and wherein capturing the plurality of images of the object comprises the at least one texture sensor capturing each point of the at least one subsequent region of interest at an accuracy larger than the predetermined accuracy threshold.

15. A non-transitory computer readable medium having stored thereon an application which when executed by a computer causes the computer to perform operations

comprising:

capturing, using a sensor assembly connected to the actuator, at least a two-and-a-half-dimensional and/or three-dimensional image of the object using a geometry sensor and capturing a two-dimensional image of the object using a texture sensor;

identifying, using a processor configured to control the actuator and the sensor assembly, a region of interest associated with the surface defect using an image of the object; and

repeatedly identifying at least one subsequent region of interest associated with the surface defect using at least a preceding region of interest such that the surface defect is identified according to a predetermined criterion, wherein identifying the region of interest and the at least one subsequent region of interest comprises:

determining geometrical properties of the object using the two-and-a-half-dimensional and/or the three-dimensional image of the object and determining texture properties of the object using the two-dimensional image of the object; and

identifying the region of interest and identifying the at least one subsequent region of interest in response to both the geometrical properties and the texture properties of the object.

System and Method for Imaging a Surface Defect on an Object

Abstract

A system and a method for imaging a surface defect on an object are provided. The system includes an actuator, a sensor assembly connected to the actuator, and a processor configured to control the actuator and the sensor assembly. The sensor assembly includes at least one sensor configured to capture at least one image of the object. The processor is configured to control the actuator and the sensor assembly to identify a region of interest associated with the surface defect using an image of the object and to repeatedly identify at least one subsequent region of interest associated with the surface defect using at least a preceding region of interest such that the surface defect is identified according to a predetermined criterion.

Fig. 3