WHAT IS CLAIMED IS:

1. A method for determining axial displacement of rotor blades, comprising the steps of:

monitoring an output signal of a sensor configured to detect the proximity of the rotor blades, at least one of the rotor blades being marked with a position marker that is configured to cause a recognizable inconsistency in the output signal only when the rotor blades rotate at a known default axial position; and

determining the axial displacement of the rotor blades if the inconsistency is not detected in the output signal for at least one full revolution of the rotor blades.

2. The method of claim 1, wherein the position marker is configured to prevent detection of the marked rotor blade by the sensor when the rotor blades are rotating in the default axial position.

3. The method of claim 1, wherein the sensor is optics-based and configured to emit light at the rotating rotor blades, the sensor being configured to detect any light that is reflected by a blade tip of the rotor blades and vary the output signal according to a magnitude of light that is detected.

4. The method of claim 3, wherein the position marker is formed as a slot having a slot floor at a predefined slot depth, the slot floor being inclined at an angle that is sufficient to divert any reflected light away from the sensor so as to prevent detection of the marked rotor blade.

5. The method of claim 3, wherein the position marker includes one or more optically detectable structural variations disposed on the marked rotor blade, the structural

variations being configured to interact with light emitted by the sensor and modify detectability of the marked blade such that a change in the axial displacement of the rotor blades causes a corresponding change in the perceived distance of arrival, the structural variations of the marked rotor blade including any one or more of varying edge width, edge depth, edge radius, and edge curvature.

6. The method of claim 1, further comprising the steps of determining a first distance of arrival of an unmarked rotor blade as detected at the default axial position, determining a second distance of arrival of the unmarked rotor blade as detected at an axially displaced position, and calculating the axial displacement based on a difference between the first and second distances of arrival, a rotor blade tip angle formed between an unmarked rotor blade and a central axis about which the rotor blades rotate, and trigonometric relationships therebetween.

7. The method of claim 6, further comprising the step of calculating the axial displacement according to the relationship

$$\Delta A = \frac{DOA_1 - DOA_2}{tan\theta}$$

where ΔA is the axial displacement, DOA_1 is the distance of arrival of the unmarked rotor blade as detected at the default axial position, DOA_2 is the distance of arrival of the unmarked rotor blade as detected at the axially displaced position, and θ is the angle between the unmarked rotor blade tip and a central axis about which the rotor blades rotate.

8. The method of claim 1, further comprising the step of monitoring a secondary output signal of a secondary sensor configured to detect one or more markers

disposed on a non-bladed rotor segment coaxially associated with the rotor blades, the markers being configured to interact with the secondary sensor in a manner which indicates the axial location of the non-bladed rotor segment.

9. The method of claim 1, further comprising the steps of determining a blade vibratory deflection amplitude based on differences between distances of arrival of vibrating rotor blades and distances of arrival of non-vibrating rotor blades, and determining blade stress based the blade deflection amplitude and a predefined stress to deflection calibration ratio, the stress to deflection calibration ratio being adjusted based on the axial displacement of the rotor blades.

10. A system for determining axial displacement of rotor blades, comprising:

a sensor configured to generate an output signal corresponding to the proximity of the rotor blades, at least one of the rotor blades being marked with a position marker that is configured to cause a recognizable inconsistency in the output signal only when the rotor blades rotate at a known default axial position; and

a controller in communication with the sensor, the controller being configured to monitor the output signal of the sensor for any inconsistencies, and determine the axial displacement of the rotor blades if the inconsistency is not detected in the output signal for at least one full revolution of the rotor blades.

11. The system of claim 10, wherein the position marker is configured to prevent detection of the marked rotor blade by the sensor when the rotor blades are rotating in the default axial position.

12. The system of claim 10, wherein the sensor is optics-based and configured to emit light at the rotating rotor blades, the sensor being configured to receive any light that is reflected by a blade tip of the rotor blades, the output signal varying in response to a magnitude of light received, the controller being configured to interpret variances in the output signal as detection of one of the rotor blades, the position marker being formed as a slot having a slot floor at a predefined slot depth and width, the slot floor being inclined at an angle that is sufficient to divert any reflected light away from the sensor so as to prevent detection of the marked rotor blade.

13. The system of claim 12, wherein the position marker includes one or more optically detectable structural variations disposed on the marked rotor blade, the structural variations being configured to interact with light emitted by the sensor and modify

detectability of the marked blade such that a change in the axial displacement of the rotor blades causes a corresponding change in a magnitude of light that is reflected by the position marker and received by the sensor, the structural variations of the marked rotor blade including any one or more of varying edge width, edge depth, edge radius, and edge curvature.

15. The system of claim 10, wherein the controller is configured to determine a first distance of arrival of an unmarked rotor blade as detected at the default axial position, determine a second distance of arrival of the unmarked rotor blade as detected at an axially displaced position, and calculate the axial displacement based on a difference between the first and second distances of arrival, a rotor blade tip angle formed between an unmarked rotor blade tip and a central axis about which the rotor blades rotate, and trigonometric relationships therebetween.

16. The system of claim 15, wherein the controller is configured to calculate the axial displacement according to the relationship

$$\Delta A = \frac{DOA_1 - DOA_2}{tan\theta}$$

where ΔA is the axial displacement, DOA_1 is the distance of arrival of the unmarked rotor blade as detected at the default axial position, DOA_2 is the distance of arrival of the unmarked rotor blade as detected at the axially displaced position, and θ is the angle between the unmarked rotor blade tip and a central axis about which the rotor blades rotate.

17. The system of claim 10, further comprising a secondary sensor that is in communication with the controller and configured to detect one or more markers disposed

on a non-bladed rotor segment coaxially associated with the rotor blades, the markers being configured to interact with the secondary sensor in a manner which indicates the axial location of the non-bladed rotor segment to the controller.

18. The system of claim 10, wherein the controller is configured to determine a blade vibratory deflection amplitude based on differences between distances of arrival of vibrating rotor blades and distances of arrival of non-vibrating rotor blades, and determine blade stress based the blade deflection amplitude and a predefined stress to deflection calibration ratio, the controller adjusting the stress to deflection calibration ratio based on the axial displacement of the rotor blades.

19. The system of claim 10, further comprising a dedicated sensor configured to detect a position marker only when the rotor blades are axially displaced from the default axial position.

20. The system of claim 10, wherein the controller is configured to continuously track the axial location of the rotor blades relative to the sensor.

WHAT IS CLAIMED IS:

1. A method for determining axial displacement of rotor blades, comprising the steps of:

monitoring an output signal of a sensor configured to detect the proximity of the rotor blades, at least one of the rotor blades being marked with a position marker that is configured to cause a recognizable inconsistency in the output signal only when the rotor blades rotate at a known default axial position, wherein the position marker is a structural alteration on the at least one of the rotor blades, the structural alteration being an alteration of the shape of the at least one rotor blade; and

determining the axial displacement of the rotor blades if the inconsistency is not detected in the output signal for at least one full revolution of the rotor blades.

2. The method of claim 1, wherein the position marker is configured to prevent detection of the marked rotor blade by the sensor when the rotor blades are rotating in the default axial position.

3. The method of claim 1, wherein the sensor is optics-based and configured to emit light at the rotating rotor blades, the sensor being configured to detect any light that is reflected by a blade tip of the rotor blades and vary the output signal according to a magnitude of light that is detected.

4. A method for determining axial displacement of rotor blades, comprising the steps of:

monitoring an output signal of a sensor, at least one of the rotor blades being marked with a position marker that is configured to cause a recognizable inconsistency in the output signal only when the rotor blades rotate at a known default axial position, wherein the sensor is optics-based, configured to detect the proximity of the rotor blades by emitting light at the rotating rotor blades, configured to detect any light that is reflected by a blade tip of the rotor blades, and configured to vary the output signal according to a magnitude of light that is detected, and wherein the position marker is

formed as a slot having a slot floor at a predefined slot depth the slot floor being inclined at an angle that is sufficient to divert any reflected light away from the sensor so as to prevent detection of the marked rotor blade; and

determining the axial displacement of the rotor blades if the inconsistency is not detected in the output signal for at least one full revolution of the rotor blades.

5. The method of claim 4, wherein the position marker includes one or more optically detectable structural variations disposed on the marked rotor blade, the structural variations being configured to interact with light emitted by the sensor and modify detectability of the marked blade such that a change in the axial displacement of the rotor blades causes a corresponding change in the perceived distance of arrival, the structural variations of the marked rotor blade including any one or more of varying edge width, edge depth, edge radius, and edge curvature.

6. The method of claim 4, further comprising the steps of determining a first distance of arrival of an unmarked rotor blade as detected at the default axial position, determining a second distance of arrival of the unmarked rotor blade as detected at an axially displaced position, and calculating the axial displacement based on a difference between the first and second distances of arrival, a rotor blade tip angle formed between an unmarked rotor blade and a central axis about which the rotor blades rotate and trigonometric relationships therebetween.

7. The method of claim 6, further comprising the step of calculating the axial displacement according to the relationship

$$\Delta A = \frac{DOA_1 - DOA_2}{\tan\theta}$$

where ΔA is the axial displacement, DOA_1 is the distance of arrival of the unmarked rotor blade as detected at the default axial position, DOA_2 is the distance of arrival of the unmarked rotor

blade as detected at the axially displaced position, and θ is the angle between the unmarked rotor blade tip and a central axis about which the rotor blades rotate.

8. The method of claim 4, further comprising the step of monitoring a secondary output signal of a secondary sensor configured to detect one or more markers disposed on a non-bladed rotor segment coaxially associated with the rotor blades, the markers being configured to interact with the secondary sensor in a manner which indicates the axial location of the non-bladed rotor segment.

9. The method of claim 4, further comprising the steps of determining a blade vibratory deflection amplitude based on differences between distances of arrival of vibrating rotor blades and distances of arrival of non-vibrating rotor blades, and determining blade stress based the blade deflection amplitude and a predefined stress to deflection calibration ratio, the stress to deflection calibration ratio being adjusted based on the axial displacement of the rotor blades.

10. A system for determining axial displacement of rotor blades, comprising:

a sensor configured to generate an output signal corresponding to the proximity of the rotor blades, at least one of the rotor blades being marked with a position marker that is configured to cause a recognizable inconsistency in the output signal only when the rotor blades rotate at a known default axial position, wherein the position marker is a structural alteration on the at least one of the rotor blades, the structural alteration being an alteration of the shape of the at least one rotor blade; and

a controller in communication with the sensor, the controller being configured to monitor the output signal of the sensor for any inconsistencies, and determine the axial displacement of the rotor blades if the inconsistency is not detected in the output signal for at least one full revolution of the rotor blades.

11. The system of claim 10, wherein the position marker is configured to prevent detection of the

marked rotor blade by the sensor when the rotor blades are rotating in the default axial position.

12. A system for determining axial displacement of rotor blades, comprising:

a sensor configured to generate an output signal corresponding to the proximity of the rotor blades, at least one of the rotor blades being marked with a position marker that is configured to cause a recognizable inconsistency in the output signal only when the rotor blades rotate at a known default axial position, wherein the sensor is optics-based and configured to emit light at the rotating rotor blades, the sensor being configured to receive any light that is reflected by a blade tip of the rotor blades, the output signal varying in response to a magnitude of light received, and wherein the position marker is formed as a slot having a slot floor at a predefined slot depth and width, the slot floor being inclined at an angle that is sufficient to divert any reflected light away from the sensor so as to prevent detection of the marked rotor blade; and

a controller in communication with the sensor, the controller configured to monitor the output signal of the sensor for any inconsistencies, to interpret variances in the output signal as detection of one of the rotor blades, and to determine the axial displacement of the rotor blades if the inconsistency is not detected in the output signal for at least one full revolution of the rotor blades.

13. The system of claim 12, wherein the position marker includes one or more optically detectable structural variations disposed on the marked rotor blade, the structural variations being configured to interact with light emitted by the sensor and modify detectability of the marked blade such that a change in the axial displacement of the rotor blades causes a corresponding change in a magnitude of light that is reflected by the position marker and received by the sensor, the structural variations of the marked rotor blade including any one or more of varying edge width, edge depth, edge radius, and edge curvature.

14. The system of claim 12, wherein the controller is configured to determine a first distance of

arrival of an unmarked rotor blade as detected at the default axial position, determine a second distance of arrival of the unmarked rotor blade as detected at an axially displaced position, and calculate the axial displacement based on a difference between the first and second distances of arrival, a rotor blade tip angle formed between an unmarked rotor blade tip and a central axis about which the rotor blades rotate, and trigonometric relationships therebetween.

15. The system of claim 14, wherein the controller is configured to calculate the axial displacement according to the relationship

$$\Delta A = \frac{DOA_1 - DOA_2}{\tan\theta}$$

where ΔA is the axial displacement, DOA_1 is the distance of arrival of the unmarked rotor blade as detected at the default axial position, DOA_2 is the distance of arrival of the unmarked rotor blade as detected at the axially displaced position, and θ is the angle between the unmarked rotor blade tip and a central axis about which the rotor blades rotate.

16. The system of claim 12, further comprising a secondary sensor that is in communication with the controller and configured to detect one or more markers disposed on a non-bladed rotor segment coaxially associated with the rotor blades, the markers being configured to interact with the secondary sensor in a manner which indicates the axial location of the non-bladed rotor segment to the controller.

17. The system of claim 12, wherein the controller is configured to determine a blade vibratory deflection amplitude based on differences between distances of arrival of vibrating rotor blades and distances of arrival of non-vibrating rotor blades, and determine blade stress based the blade deflection amplitude and a predefined stress to deflection calibration ratio, the controller adjusting the stress to deflection calibration ratio based on the axial displacement of the rotor blades.

18. The system of claim 12, further comprising a dedicated sensor configured to detect a position marker only when the rotor blades are axially displaced from the default axial position.

19. The system of claim 12, wherein the controller is configured to continuously track the axial location of the rotor blades relative to the sensor.

20. The system of claim 12, wherein the one or more optically detectable structural variations disposed on the marked rotor blade are incremental structural variations which affect certain characteristics of the output signal.