Claims

1. A method for damping rotational oscillation about a vertical axis of a load-handling element of a lifting device via a damping controller having at least one controller parameter, wherein the load-handling element is connected to a suspension element of the lifting device by at least three holding elements, the method comprising:
   adjusting a length of at least one holding element between the load-handling element and the suspension element by the damping controller via at least one actuator, acting on the at least one holding element,
   determining at least one controller parameter by a rotational oscillation model of the load-handling element as a function of a lifting height; and
   adapting the at least one controller parameter to the lifting height to dampen the rotational oscillation of the load-handling element at any lifting height;
   exciting the load-handling element to rotationally oscillate at a certain lifting height of the load-handling element;
   sensing, at a same time, at least an actual angle of rotation of the load-handling element about the vertical axis and an actual actuator position; and
   from the sensed actual angle of rotation and the actual actuator position, identifying model parameters of the rotational oscillation model of the load-handling element at the given lifting height by an identification method.
2. The method according to claim 1, wherein the at least one actuator is hydraulically or electrically actuated.
3. The method according to claim 1, wherein at least four holding elements are provided between the load-handling element and the suspension element.
4. The method according to claim 1, wherein the at least one actuator comprises at least two actuators.
5. The method according to claim 4, wherein the at least one actuator comprises one actuator per holding element.
6. The method according to claim 1, further comprising measuring the lifting height with a camera system arranged on the suspension element or on the load-handling element or by a lifting drive of the lifting device.

7. The method according to claim 1, further comprising measuring the actual angle of rotation of the load-handling element with a measuring device arranged on the suspension element or on the load-handling element.

8. The method according to claim 7, wherein the measuring device comprises a camera system or a gyro sensor.

9. The method according to claim 1, wherein the identification method is a mathematical method.

10. The method according to claim 9, wherein the mathematical method includes an online least-squares method.

11. The method according to claim 1, wherein the damping controller comprises a state controller.

12. The method according to claim 11, wherein the state controller has five controller parameters.

13. The method according to claim 1, wherein a desired angle of rotation (β_{soll}) of the load-handling element is specified and the desired angle of rotation (β_{soll}) of the load-handling element is attained in a specified angle range.

14. The method according to claim 13, wherein the specified angle range is $10° \leq \beta_{soll} \leq +10°$.

15. The method according to claim 1, wherein the lifting device comprises a crane, the holding elements comprise cables and the load-handling element comprises a spreader.

16. A method for damping rotational oscillation about a vertical axis of a load-handling element of a lifting device by a damping controller having at least one controller parameter, wherein the load-handling element is connected to a suspension element of the lifting device by at least three holding elements, the method comprising:
adjusting a length of at least one holding element between the load-handling element and the suspension element by the damping controller via at least one actuator acting on the at least one holding element,
determining at least one controller parameter by a rotational oscillation model of the load-handling element as a function of a lifting height; and
adapting the at least one controller parameter to the lifting height to dampen the rotational oscillation of the load-handling element at any lifting height, wherein the rotational

oscillation model is a second-order differential equation having at least three model parameters

17. The method according to claim 16, wherein the three model parameters are a dynamic parameter, a damping parameter, and a system gain parameter.

18. A method for damping rotational oscillation about a vertical axis of a load-handling element of a lifting device by a damping controller having at least one controller parameter, wherein the load-handling element is connected to a suspension element of the lifting device by at least three holding elements, the method comprising:
adjusting a length of at least one holding element between the load-handling element and the suspension element by the damping controller via at least one actuator acting on the at least one holding element,
determining at least one controller parameter by a rotational oscillation model of the load-handling element as a function of a lifting height; and
adapting the at least one controller parameter to the lifting height to dampen the rotational oscillation of the load-handling element at any lifting height, wherein anti-windup protection is integrated in the damping controller, wherein actuator limits of the at least one actuator are specified to the damping controller.

19. The method according to claim 18, wherein the actuator limits of the at least one actuator comprise a maximum permissible actuator position, a maximum permissible actuator velocity, and a maximum permissible actuator acceleration of the actuator.

20. A method for damping rotational oscillation about a vertical axis of a load-handling element of a lifting device, wherein the load-handling element is connected to a suspension element of the lifting device by at least three holding elements, the method comprising:
adjusting a length of at least one holding element between the load-handling element and the suspension element via at least one actuator acting on the at least one holding element,
determining at least one parameter by a rotational oscillation model of the load-handling element as a function of a lifting height; and
adapting the at least one parameter to the lifting height to dampen the rotational oscillation of the load-handling element at any lifting height;
exciting the load-handling element to rotationally oscillate at a certain lifting height of the load-handling element;

sensing, at a same time, at least an actual angle of rotation of the load-handling element about the vertical axis and an actual actuator position; and

from the sensed actual angle of rotation and the actual actuator position, identifying model parameters of the rotational oscillation model of the load-handling element at the given lifting height by an identification method.