Claims

1. A method for moving with a crane control system in automatic operation a load with a crane in a collision-free manner in a space having at least one obstacle,

providing with a SIL (Safety Integrity Level) or PL (Performance Level) certified sensor a position of the at least one obstacle,

determining with the SIL or PL certified sensor a height profile of the at least one obstacle,

providing at least one safe state variable of the load, which includes a position of at least one movement axis, a velocity or an acceleration of the load,

determining from the at least one safe state variable with a SIL or PL certified sensor system a safety zone surrounding the load,

dynamically monitoring the safety zone in relation to the position of the obstacle, and

sending with an independent, safe monitoring module, which implements a safety certification of the crane control system according to SIL or PL, a stop signal to the crane control system when the position of the obstacle is located in the safety zone surrounding the load.

2. The method of claim 1, further comprising acquiring a safe position of the obstacle using SIL or PL certified sensors constructed for distance measurement.

3. The method of claim 1, wherein the at least one safe state variable of the load is determined from a safe state variable of at least one of a running gear, a lifting gear and a trolley of the crane.

4. The method of claim 1, further comprising

determining from the height profile a safe trajectory for moving the load across the at least one obstacle, wherein along the safe trajectory is located outside the safety zone surrounding the load.

5. The method of claim 1, further comprising

adapting a size of the safety zone to the safe state variable of the load.

6. The method of claim 1, wherein the safety zone is determined with a controller which comprises a safety program in a secure region.

7. The method of claim 6, further comprising

sending with the safety program the stop signal to the crane control system.

8. The method of claim 1, wherein the safety zone is determined in real time.

9. The method of claim 1,

wherein the safety zone is determined periodically in temporal intervals that depend on the safe state variable of the load.

10. The method of claim 1, wherein the safety zone is determined with an oscillation model.

11. The method of claim 1, further comprising

executing the method independently of a movement of the load.

12. A controller comprising a safety program in a secure region, the controller configured to determine a safety zone surrounding

a load that is moved with a crane in a collision-free manner in a space having at least one obstacle by

providing with a SIL (Safety Integrity Level) or PL (Performance Level) certified sensor a position of the at least one obstacle,

determining with the SIL or PL certified sensor a height profile of the at least one obstacle,

providing at least one safe state variable of the load, which includes a position of at least one movement axis, a velocity or an acceleration of the load,

determining from the at least one safe state variable with a SIL or PL certified sensor system a safety zone surrounding the load,

dynamically monitoring the safety zone in relation to the position of the obstacle, and

sending with an independent, safe monitoring module a stop signal to the crane control system when the position of the obstacle is located in the safety zone surrounding the load.

13. A system having a crane for moving a load in a space having at least one obstacle, the system comprising an independent, safe monitoring module for collision detection between the load and the at least one obstacle and a controller comprising a safety program in a secure region, the controller configured to determine a safety zone surrounding a load that is moved with a crane in a collision-free manner in a space having at least one obstacle and implementing a safety certification of the system according to SIL (Safety Integrity Level) or PL (Performance Level), by

providing with a SIL or PL certified sensor a position of the at least one obstacle,

determining with the SIL or PL certified sensor a height profile of the at least one obstacle,

providing at least one safe state variable of the load, which includes a position of at least one movement axis, a velocity or an acceleration of the load,

determining from the at least one safe state variable with a SIL or PL certified sensor system a safety zone surrounding the load,

dynamically monitoring with the independent, safe monitoring module the safety zone in relation to the position of the obstacle, and

sending with the independent, safe monitoring module a stop signal to the crane control system when the position of the obstacle is located in the safety zone surrounding the load.