CLAIMS

1. A pile holding system for installing offshore foundation piles into ground, the pile holding system comprising:

a pile gripper assembly;

a mounting assembly for attachment of the pile holding system to a marine vessel;

a connection assembly comprising a connection member; and

actuation means connected to at least one of the pile gripper assembly, the mounting assembly or the connection member;

wherein the connection member is pivotally connected to the pile gripper assembly, the connection member being pivotable relative to the pile gripper assembly about a first pivot axis,

wherein the connection member is pivotally connected to the mounting assembly, wherein the connection member is pivotable relative to the mounting assembly about a second pivot axis, wherein the first pivot axis and the second pivot axis are substantially parallel, and

wherein the actuation means is configured to pivot the connection member about the first pivot axis and the second pivot axis to move the pile gripper assembly relative to the mounting assembly between a first extreme position and a second extreme position.

2. A pile holding system according to claim 1, wherein in the first extreme position and the second extreme position an angle between a gripping plane of the pile gripper assembly and a plane of the mounting assembly is less than 45°, and preferably less than 10°.

3. A pile holding system according to any preceding claim, wherein, in the first and second extreme positions, a gripping plane of the pile gripper assembly is substantially parallel with a plane of the mounting assembly; and optionally

wherein, in all intermediate positions of the pile gripper assembly between the first and second extreme positions, the gripping plane of the pile gripper assembly is substantially parallel with the plane of the mounting assembly.

4. A pile holding system according to any preceding claim, wherein, in the first extreme position and the second extreme position the pile gripper assembly is in a spaced arrangement with the mounting assembly.

5. A pile holding system according to any preceding claim, wherein the connection member is a primary connection member, wherein the connection assembly further comprises a secondary connection member pivotally connected to at least one of the pile gripper assembly and the mounting assembly; and optionally

wherein the secondary connection member is pivotally connected to the pile gripper assembly, the secondary connection member being pivotable relative to the pile gripper assembly about a third pivot axis, the third pivot axis being substantially parallel to the first and second axes; and optionally

wherein the secondary connection member is pivotally connected to the mounting assembly, wherein the connection member is pivotable relative to the mounting assembly about a fourth pivot axis, the fourth pivot axis being substantially parallel to the first and second axes.

6. A pile holding system according to any preceding claim, wherein the first extreme position is an outboard, or deployed, position and the second extreme position is an inboard, or retracted, position.

7. A pile holding system according to any preceding claim, wherein the actuation means comprises at least one actuation assembly, each actuation assembly comprising a linear actuator and optionally

wherein each of the at least one actuation assembly is pivotally connected, at one end, to the mounting assembly, and is pivotally connected, at another end, to the connection member; and optionally

wherein each of the at least one actuation assembly comprises an articulating arm with a first end pivotally connected to the mounting assembly and a second end pivotally connected to the connection member, and wherein a first end of the respective linear actuator is pivotally connected to the mounting assembly, and a second end of the respective linear actuator is pivotally mounted to the articulating arm.

8. A pile holding system according to any preceding claim, wherein the mounting assembly comprises a translation assembly comprising two, parallel, first rails and two, parallel, second rails, the first and second rails being substantially perpendicular to one another, and the translation assembly comprising driving means configured to move the pile gripper assembly and the linkage assembly along the first and second rails, to provide dynamic position control of the pile gripper assembly, in use.; and optionally

wherein the pile holding system further comprises a motion control system configured to compensate motion of the vessel to which the offshore foundation pile is mounted, via the pile gripper assembly, in use; and optionally

wherein the translation assembly is controlled by the motion control system, such that the movement of the two, parallel, first rails and two, parallel, second rails is perpendicular to one another.

9. A pile holding system according to any preceding claim, wherein the pile gripper assembly comprises articulating jaws configured to surround the circumference of a pile, in use.

10. A marine vessel comprising a pile holding system according to any preceding claim, the mounting assembly of the pile holding system being mounted to the marine vessel.

11. A method of moving a pile gripper assembly of a pile holding system between a first extreme position and a second extreme position, the method comprising:
actuating actuation means of the pile holding system to pivot a connection member of a connection assembly relative to the pile gripper assembly about a first pivot axis and to pivot the connection member relative to a mounting assembly of the pile holding system about a second pivot axes, to move the pile gripper assembly relative to the mounting assembly, wherein the first and second pivot axes are substantially parallel to one another and wherein the mounting assembly is for attachment of the pile holding system to a marine vessel.

12. A method according to claim 11 wherein the pile gripper assembly has a gripping plane, the gripping plane of the pile gripper assembly being normal to the longitudinal axis of a gripped offshore foundation pile in use, and wherein in the first extreme position and the second extreme position an angle between the gripping plane of the pile gripper assembly and a plane of the mounting assembly is less than 45°, and preferably less than 10°.

13. A method according to claim 12, wherein, in the first and second extreme positions, the gripping plane of the pile gripper assembly is substantially parallel with the plane of the mounting assembly.

14. A method according to claim 13 wherein during movement between the first and second extreme positions, the plane of the pile gripper assembly is substantially parallel with the plane of the mounting assembly; and/or

wherein, during movement between the first and second extreme positions, the pile gripper assembly is maintained in a spaced arrangement with the mounting assembly.

15. A method according to any of claims 11 to 14, wherein the first extreme position is an outboard, or deployed, position and the second extreme position is an inboard, or retracted, position.

16. A method according to any of claims 11 to 15, wherein the actuation means comprises at least one actuation assembly which comprises a linear actuator, and wherein actuation of the actuation means comprises extending or retracting the linear actuator of the at least one actuation assembly.

17. A method of installing an offshore pile using a pile holding system mounted to a marine vessel, the method comprising:

gripping the offshore pile in a pile gripper assembly;

moving the pile holding system from a second extreme position to a first extreme position according to any of claims 9 to 14, the second extreme position being a retracted position, the first extreme position being a deployed position; and

performing a piling operation to drive the offshore pile into ground.

18. A method according to claim 17, the method comprising actuating driving means to move the pile gripper assembly and connection assembly along substantially perpendicular first and second rails of a translation assembly which is comprised in the mounting assembly, the translation assembly also comprising the driving means, to provide dynamic position control of the pile gripper assembly relative to the marine vessel, when installing the pile; and/or

wherein gripping the offshore pile comprises gripping the offshore pile between articulating jaws of the pile gripper assembly which surround the circumference of the offshore pile.