CLAIMS:

1. Computer-implemented method for autonomous marine vessel docking, the method comprising:

determining a transit control mode associated with route plan data defining transit operation between ports;

determining an autonomous docking control mode associated with harbor track data comprising a set of waypoint properties and defining approach zone information and track segments joined at waypoints, wherein the approach zone information comprises:

location area information for the approach zone;

characterized in that the approach zone information further comprises:

maximum vessel speed for entering the approach zone; and

maximum heading deviation for entering the approach zone;

and in that the method comprises

determining vessel location, speed and heading;

comparing the vessel location, speed and heading to the approach zone information and changing from the transit control mode to the autonomous docking control mode in response to:

the vessel location comprised in the approach zone defined by the location area information;

the vessel speed being lower than the maximum vessel speed for entering the approach zone; and

the vessel heading matching criteria defined by the maximum heading deviation for entering the approach zone.

2. The method of claim 1, further comprising:

determining a dynamic setpoint based on the waypoint properties, wherein the dynamic setpoint comprising a setpoint position, a setpoint speed and a setpoint heading that change based on the harbor track data.

3. The method of claim 2, further comprising:

determining difference information between the dynamic setpoint and the determined vessel location using a closed loop controller;

determining a force vector based on the difference information; and

controlling thruster commands of the autonomous docking control mode based on the force vector.

4. The method of claim 2 or 3, further comprising:

aligning the vessel heading to the setpoint heading and the vessel speed to the setpoint speed, wherein the setpoint heading and the setpoint speed are configurable parameters.

5. The method of any claim 2 to 4, further comprising:

interpolating the setpoint heading and the setpoint speed between waypoints and respective setpoint values based on the marine vessel's location on the track segment; and

aligning the vessel heading to the interpolated setpoint heading and the vessel speed to the interpolated setpoint speed.

~~6. The method of claim 5, wherein interpolating is enabled based on a waypoint property of the waypoint to which the marine vessel is heading.~~

~~7~~6. The method of any claim 2 to ~~6~~5, further comprising:

defining a lower speed threshold and a higher speed threshold; and

determining sway control information based on the dynamic setpoint and the determined vessel location.

~~8~~7. The method of claim ~~7~~6, further comprising:

controlling, in a low speed mode, sway controlling thruster commands of at least one thruster of the marine vessel based on the sway control information by activating full scale three axis position and heading control by allocating full scale thrust to the at least one thruster of the marine vessel, when the marine vessel speed being less than the lower speed threshold.

~~9~~8. The method of claim ~~7 6~~ or ~~8~~7, further comprising:

disabling, in a high-speed mode, sway controlling thruster commands of at least one thruster of the marine vessel when the marine vessel speed being greater than the higher speed threshold.

~~10~~9. The method of any claim ~~7 6~~ to ~~9~~8, further comprising:

controlling, in an intermediate speed mode, sway controlling thruster commands of at least one thruster of the marine vessel based on the sway control information by activating partial scale three axis position and heading control by allocating partial scale thrust to the at least one thruster of the marine vessel, when the marine vessel speed being between the lower and higher speed threshold.

~~11~~10. The method of claim ~~10~~9, wherein the partial scale is smaller than the full scale.

~~12~~11. The method of claim ~~10 9~~or ~~11~~10, wherein in the intermediate speed mode, the partial scale is gradually changed between zero and the full scale with respect to the marine vessel speed.

~~13~~12. The method of claim ~~12~~11, wherein in the intermediate speed mode, the partial scale is gradually increased from zero to the full scale with respect to the marine vessel speed decreasing from the higher speed threshold to the lower speed threshold.

~~14~~13. The method of any claim 1 to ~~13~~12, further comprising:

maintaining the harbor track data for a port of ca!i and a berthing position within the port, wherein the harbor track data comprises:

approach corridor data defining bounds on maximum track position deviation allowed during harbor maneuvering; and

the approach zone information.

~~15~~14. The method of claim ~~14~~13, wherein the approach zone information further comprises maximum lateral deviation for entering the approach zone, and the method further comprising:

comparing the vessel location, speed and heading to the approach zone information and changing from the transit control mode to the autonomous docking control mode in response to:

the vessel deviation is less than the maximum lateral deviation for entering the approach zone.

~~16~~15. The method of any claim 1 to ~~15~~14, further comprising:

determining entry leg data in response to changing to the autonomous docking control mode, wherein the entry leg data is configured to guide the marine vessel onto a harbor track defined by the harbor track data.

~~17. The method of any claim 1 to 16, wherein in the transit control mode the marine vessel is configured to be at least partially in manual control mode.~~

~~18~~16. The method of any claim 1 to ~~17~~15, further comprising:

determining alignment of the marine vessel in view of a harbor track using the harbor track data; and

selecting sail direction based on the determined alignment.

~~19~~17. A marine vessel apparatus for autonomous docking, comprising:

at least one sensor:

a communication interface for transceiving data;

at least one processor; and

at least one memory including computer program code;

the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

determine a transit control mode associated with route plan data defining transit operation between ports;

determine an autonomous docking control mode associated with harbor track data comprising a set of waypoint properties and defining approach zone information and track segments joined at waypoints, ~~wherein~~ characterized in that the approach zone information comprises:

location area information for the approach zone;

maximum vessel speed for entering the approach zone; and maximum heading deviation for entering the approach zone;

and in that the at least one memory and the computer program code are further configured to, with the at least one processor, cause the apparatus to:

determine vessel location, speed and heading;

compare the vessel location, speed and heading to the approach zone information and changing from the transit control mode to the autonomous docking control mode in response to:

the vessel location comprised in the approach zone defined by the location area information;

the vessel speed being lower than the maximum vessel speed for entering the approach zone; and

the vessel heading matching criteria defined by the maximum heading deviation for entering the approach zone.

~~20. The apparatus of claim 19, wherein the at least one sensor is configured to provide position related data or environment related data.~~

~~21. The apparatus of claim 19 or 20, wherein the at least one sensor comprises at least one of the following:~~

~~a global navigation satellite system (GNSS) position sensor;~~

~~a docking sensor for providing relative positioning information relative to a berth;~~

~~a gyro compass sensor for providing heading information;~~

~~a motion reference unit (MRU) sensor for providing pitch and information; and~~

~~a wind sensor for providing wind speed and direction information.~~

~~22~~18. The apparatus of any claim ~~19 17to 21~~, wherein the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

select the global navigation satellite system (GNSS) position sensor as positioning information source in a first set of the track segments; and

determine vessel distance to the berth and select the docking sensor as positioning information source in a second set of the track segments in response to the vessel distance being less than a pre-defined threshold.

~~23~~19. The apparatus of any claim ~~19 17~~ to ~~22~~18, wherein the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

determine a dynamic setpoint based on the waypoint properties, wherein the dynamic setpoint comprising a setpoint position, a setpoint speed and a setpoint heading that change based on the harbor track data.

~~24~~20. The apparatus of any claim ~~19 17~~ to ~~23~~19, wherein the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

determine difference information between the dynamic setpoint and the determined vessel location using a closed loop controller;

determine a force vector based on the difference information; and

control thruster commands of the autonomous docking control mode based on the force vector.

~~25~~21. The apparatus of claim ~~24~~20, further comprising:

at least one thruster; and

wherein the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

determine external force information;

combine the force vector with the external force information;

determine the thruster commands based on the combination; and

control the at least one thruster based on the thruster commands.

~~26. The apparatus of claim 25, wherein the external force information comprises wind information.~~

~~27. The apparatus of claim 25, further comprising:~~

~~a plurality of thrusters; and~~

~~wherein the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:~~

~~control full three axis position and heading by allocating thrust to the plurality of thrusters.~~

~~28~~22. A computer program product embodied on a computer readable medium comprising computer executable program code, which code, when executed by at least one processor of an apparatus, causes the apparatus to:

determine a transit control mode associated with route plan data defining transit operation between ports;

determine an autonomous docking control mode associated with harbor track data comprising a set of waypoint properties and defining approach zone information and track segments joined at waypoints, wherein the approach zone information comprises:

location area information for the approach zone;

maximum vessel speed for entering the approach zone; and

maximum heading deviation for entering the approach zone;

determine vessel location, speed and heading;

compare the vessel location, speed and heading to the approach zone information and changing from the transit control mode to the autonomous docking control mode in response to:

the vessel location comprised in the approach zone defined by the location area information;

the vessel speed being lower than the maximum vessel speed for entering the approach zone; and

the vessel heading matching criteria defined by the maximum heading deviation for entering the approach zone.