US Patent & Trademark Office
Patent Public Search | Text View

United States Patent Application Publication	20250263162
Kind Code	A1
Publication Date	August 21, 2025
Inventor(s)	Liu; Bin et al.

STOPPING FUNCTION FOR MARINE VEHICLE PROPULSION SYSTEM

Abstract

Different solutions to stop automatically a vessel, which includes at least a first cycloidal propeller unit and a second cycloidal propeller unit, are disclosed. During a stopping procedure motion control values of at least the first cycloidal propeller unit are adjusted to cause, while maintaining a movement direction of the vessel to be according to a latest steering command, the first cycloidal propeller unit to brake in a first mode or in a second mode. In the first mode the main wheel is rotating, and blades of the cycloidal propeller unit are rotated to change a thrust direction towards to a reverse thrust direction. In the second mode either the main wheel is kept in a first position and the blades are positioned individually towards a corresponding predetermined angle to the movement direction or the blades are kept in first positions and the main wheel is rotated.

Inventors: **Liu; Bin (Västerås, SE), Ji; Wei (Stockholm, SE), Peljo; Veli-Pekka (Helsinki, FI), Nuutinen; Mika (Helsinki, FI), Jehkonen; Teemu (Helsinki, FI), Säkkinen; Petri (Helsinki, FI), Feyzmahdavian; Hamid (Stockholm, SE), Rahman; Moksadur (Västerås, SE), Fransson; Peter (Västerås, SE), Qi; LiWei (Västerås, SE), Ahmad; Aftab (Västerås, SE), Johansson; Axel (Solna, SE), Moya; Javier (Lempäälä, FI), Hameed; Qureeb Olasunkanmi (Tampere, FI)**

Applicant: **ABB Schweiz AG** (Baden, CH)

Family ID: **1000008615118**

Appl. No.: **19/023900**

Filed: **January 16, 2025**

Foreign Application Priority Data

EP	24152555.9	Jan. 18, 2024

Publication Classification

Int. Cl.: **B63H25/48** (20060101); **B63H1/10** (20060101); **B63H25/04** (20060101)

U.S. Cl.:

CPC **B63H25/48** (20130101); **B63H1/10** (20130101); **B63H25/04** (20130101); B63H2001/105 (20130101)

Background/Summary

REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to a European patent application no 24152555, filed on Jan. 18, 2024, the contents of which is hereby incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The invention relates to stopping a vessel.

BACKGROUND

[0003] Typically a vessel, for example a merchant vessel or ship, is provided with a propulsion system to move the ship through the water. There are numerous types of propulsion systems. One example is an azimuthing propulsion system that comprises one or more azimuthing propulsion units, in which propellers are rotatable horizontally to any angle. A rather new propulsion system is a cycloidal-type propulsion system. The cycloidal-type propulsion system comprises one or more cycloidal propeller units. A cycloidal propeller unit comprises a rotating wheel, and individually positionable blades extending from the wheel. The combined motion of the wheel and blades generates propulsion and steering forces simultaneously. For traditional propulsion systems, for example for the azimuthing propulsion system, there are automatic stopping procedures with steering capability during the stopping process. It would be beneficial to have such a process also with the cycloidal propulsion system.

SUMMARY

[0004] The invention relates to a method, an apparatus and a vessel, as defined in the independent claims. Further embodiments are disclosed in the dependent claims.

[0005] According to a first aspect there is provided a computer implemented method for stopping a vessel, which vessel comprises at least a first cycloidal propeller unit and a second cycloidal propeller unit, a cycloidal propeller unit comprising a rotatable main wheel equipped with two or more blades that are individually rotatable, the method comprising: starting, in response to receiving an input triggering an automatic stopping procedure, a stopping procedure comprising at least the following: obtaining at least information indicating a speed of the vessel; and adjusting, based on at least the speed indicated, motion control values of at least the first cycloidal propeller unit to cause, while maintaining a movement direction of the vessel to be according to a latest steering command, the first cycloidal propeller unit to brake in a first mode or in a second mode, wherein the first mode is a cycloidal propeller braking mode in which the main wheel is rotating and blades of the cycloidal propeller unit are rotated to change a thrust direction at the time the input is received towards to a reverse thrust direction, and the second mode is a rudder like braking mode in which either the main wheel is kept in a first position and the blades are positioned individually towards a corresponding predetermined angle to the movement direction or the blades are kept in first positions and the main wheel is rotated.

[0006] In embodiments, combinable with the first aspect and its other embodiments, the stopping procedure further comprises at least: reducing, before adjusting, the speed indicated to a first speed by changing propulsion of at least one of the first and second cycloidal propeller units; and starting the adjusting when the speed indicated is not exceeding the first speed.

[0007] In embodiments, combinable with the first aspect and its other embodiments, the stopping procedure further comprises at least a normal stopping operation mode and an emergency stopping operation mode, and the method further comprises: determining stopping operation mode based on the input; obtaining a set of operational parameter values predefined for the stopping operation mode determined, wherein the operational parameter values for the normal stopping operation mode are predefined for optimizing between a maximum stopping effect and a maximum component lifetime, and the operational parameter values for the emergency stopping operation mode are predefined for a maximum stopping effect; and performing the adjusting by applying the operational parameter values to determine the motion control values.
[0008] In embodiments, combinable with the first aspect and its other embodiments, the stopping procedure further comprises at least: performing the adjusting gradually in a step-wise manner, the step-wise manner comprising at least, per a step: obtaining, when the speed decreases to a maximum speed value of a step, a set of operational parameter values predefined for the step; and performing the adjusting by applying the operational parameter values to determine the motion control values.
[0009] In embodiments, combinable with the first aspect and its other embodiments, the operational parameter values in the first mode comprise values for a rotational speed, a pitch function parameter, and a steering parameter and in the second mode values for blade pitch angles.
[0010] In embodiments, combinable with the first aspect and its other embodiments, the method further comprises in the first mode: selecting, based on the speed, a pitch function amongst pitch functions comprising at least trochoidal and epicycloid pitch functions for stopping; inputting the set of operational parameter values obtained to the pitch function selected; and rotating the blades according to motion control values output by the pitch function selected.
[0011] In embodiments, combinable with the first aspect and its other embodiments, the method further comprises in the first mode at least: rotating, when the adjustment is started, the blades to cause thrust direction of the cycloidal propeller unit to change to be substantially perpendicular to the thrust direction at the time the input was received; and rotating, when the speed indicated is below a second speed, which is lower than the first speed, the blades to cause thrust direction of the cycloidal propeller unit to change to be the reverse thrust direction.
[0012] In embodiments, combinable with the first aspect and its other embodiments, in the second mode a value of a predetermined angle to the movement direction is up to ±90 degrees, and two or more of the two or more blades may have the same value or different values.
[0013] In embodiments, combinable with the first aspect and its other embodiments, the stopping procedure further comprises at least: adjusting the first and second cycloidal propeller units substantially symmetrically with respect to a longitudinal axis of the vessel using first motion control values; receiving, after the input, a steering command changing the movement direction of the vessel; determining second motion control values based at least on the speed and the steering command received; adjusting, after the steering command, one of the first and second cycloidal propeller units using the first motion control values and the other one using the second motion control values.
[0014] In embodiments, combinable with the first aspect and its other embodiments, when the first and second cycloidal propeller units are both adjusted using first motion control values they are both caused to brake either in the first mode or in the second mode; and when the first motion control values and the second motion control values are used in the adjusting, one of the first and second cycloidal propeller units is caused to brake in the first mode and the other one is caused to brake in the second mode.
[0015] In embodiments, combinable with the first aspect and its other embodiments, the method further comprising: receiving an input cancelling the automatic stopping procedure; stopping the stopping procedure; and entering a normal operation mode.
[0016] According to a second aspect there is provided an apparatus configured to implement a

method according to the first aspect or a method according to any combinations of the embodiments combinable with the first aspect.

[0017] According to a third aspect there is provided a vessel comprising: at least a first cycloidal propeller unit and a second cycloidal propeller unit, a cycloidal propeller unit comprising a rotatable main wheel equipped with two or more blades that are individually rotatable; a movement control arrangement comprising at least one apparatus configured to implement a method according to the first aspect or a method according to any combinations of the embodiments combinable with the first aspect; at least one first user interface element to change, in response to a user input to the first user interface element, status of the automatic stopping procedure, the user interface element being connected to the movement control arrangement; and at least one second user interface element to steer the vessel.

[0018] According to a fourth aspect there is provided an apparatus comprising: at least one processor; and at least one memory including computer program code, the at least one memory and computer program code configured to, with the at least one processor, cause the apparatus at least to perform: start, in response to receiving an input triggering an automatic stopping procedure for stopping a vessel, which vessel comprises at least a first cycloidal propeller unit and a second cycloidal propeller unit, a cycloidal propeller unit comprising a rotatable main wheel equipped with two or more blades that are individually rotatable, a stopping procedure comprising at least the following: obtaining at least information indicating a speed of the vessel; and adjusting, based on at least the speed indicated, motion control values of at least the first cycloidal propeller unit to cause, while maintaining a movement direction of the vessel to be according to a latest steering command, the first cycloidal propeller unit to brake in a first mode or in a second mode, wherein the first mode is a cycloidal propeller braking mode in which the main wheel is rotating and blades of the cycloidal propeller unit are rotated to change a thrust direction at the time the input is received towards to a reverse thrust direction, and the second mode is a rudder like braking mode in which either the main wheel is kept in a first position and the blades are positioned individually towards a corresponding predetermined angle to the movement direction or the blades are kept in first positions and the main wheel is rotated.

[0019] In embodiments, combinable with the fourth aspect and its other embodiments, the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to perform during the stopping procedure following: reducing, before adjusting, the speed indicated to a first speed by changing propulsion of at least one of the first and second cycloidal propeller units; starting the adjusting when the speed indicated is not exceeding the first speed. performing the adjusting gradually in a step-wise manner, the step-wise manner comprising at least, per a step: obtaining, when the speed decreases to a maximum speed value of a step, a set of operational parameter values predefined for the step; and performing the adjusting by applying the operational parameter values to determine the motion control values.

[0020] In embodiments, combinable with the fourth aspect and its other embodiments, the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to: determine stopping operation mode amongst at least a normal stopping operation mode and an emergency stopping operation mode based on the input; obtain a set of operational parameter values predefined for the stopping operation mode determined, wherein the operational parameter values for the normal stopping operation mode are predefined for optimizing between a maximum stopping effect and a maximum component lifetime, and the operational parameter values for the emergency stopping operation mode are predefined for a maximum stopping effect; and perform the adjusting by applying the operational parameter values to determine the motion control values.

[0021] In embodiments, combinable with the fourth aspect and its other embodiments, the operational parameter values in the first mode comprise values for a rotational speed, a pitch function parameter, and a steering parameter and in the second mode values for blade pitch angles.

[0022] In embodiments, combinable with the fourth aspect and its other embodiments, the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to perform in the first mode: selecting, based on the speed, a pitch function amongst pitch functions comprising at least trochoidal and epicycloid pitch functions for stopping; inputting the set of operational parameter values obtained to the pitch function selected; and rotating the blades according to motion control values output by the pitch function selected.
[0023] In embodiments, combinable with the fourth aspect and its other embodiments, the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to: rotate, in the first mode, when the adjustment is started, the blades to cause thrust direction of the cycloidal propeller unit to change to be substantially perpendicular to the thrust direction at the time the input was received; and rotate, in the first mode, when the speed indicated is below a second speed, which is lower than the first speed, the blades to cause thrust direction of the cycloidal propeller unit to change to be the reverse thrust direction.
[0024] In embodiments, combinable with the fourth aspect and its other embodiments, the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to: adjust the first and second cycloidal propeller units substantially symmetrically with respect to a longitudinal axis of the vessel using first motion control values; receive, after the input, a steering command changing the movement direction of the vessel; determine second motion control values based at least on the speed and the steering command received; and adjust, after the steering command, one of the first and second cycloidal propeller units using the first motion control values and the other one using the second motion control values.
[0025] In embodiments, combinable with the fourth aspect and its other embodiments, the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to: cause both the first and second cycloidal propeller units to brake either in the first mode or in the second mode when the first and second cycloidal propeller units are both adjusted using first motion control values; and cause one of the first and second cycloidal propeller units to brake in the first mode and the other one is caused to brake in the second mode when the first motion control values and the second motion control values are used in the adjusting.
[0026] According to a fifth aspect, there is provided a vessel comprising: at least a first cycloidal propeller unit and a second cycloidal propeller unit, a cycloidal propeller unit comprising a rotatable main wheel equipped with two or more blades that are individually rotatable; a movement control arrangement comprising at least one apparatus configured to start, in response to receiving an input triggering an automatic stopping procedure, a stopping procedure comprising at least the following: obtaining at least information indicating a speed of the vessel; and adjusting, based on at least the speed indicated, motion control values of at least the first cycloidal propeller unit to cause, while maintaining a movement direction of the vessel to be according to a latest steering command, the first cycloidal propeller unit to brake in a first mode or in a second mode, wherein the first mode is a cycloidal propeller braking mode in which the main wheel is rotating and blades of the cycloidal propeller unit are rotated to change a thrust direction at the time the input is received towards to a reverse thrust direction, and the second mode is a rudder like braking mode in which either the main wheel is kept in a first position and the blades are positioned individually towards a corresponding predetermined angle to the movement direction or the blades are kept in first positions and the main wheel is rotated; at least one first user interface element to change, in response to a user input to the first user interface element, status of the automatic stopping procedure, the user interface element being connected to the movement control arrangement; and at least one second user interface element to steer the vessel.
[0027] In an embodiment of the vessel, the at least one first user interface element comprises a plurality of user interface elements for a plurality of stopping operation modes comprising at least a normal stopping operation mode and an emergency stopping operation mode.

[0028] According to a sixth aspect there is provided a non-transitory computer-readable storage medium comprising computer-executable instructions that, when executed by a computer, causes the computer at least to perform: starting, in response to receiving an input triggering an automatic stopping procedure for stopping a vessel, which vessel comprises at least a first cycloidal propeller unit and a second cycloidal propeller unit, a cycloidal propeller unit comprising a rotatable main wheel equipped with two or more blades that are individually rotatable, a stopping procedure comprising at least the following: obtaining at least information indicating a speed of the vessel; and causing adjusting, based on at least the speed indicated, motion control values of at least the first cycloidal propeller unit to cause, while maintaining a movement direction of the vessel to be according to a latest steering command, the first cycloidal propeller unit to brake in a first mode or in a second mode, wherein the first mode is a cycloidal propeller braking mode in which the main wheel is rotating and blades of the cycloidal propeller unit are rotated to change a thrust direction at the time the input is received towards to a reverse thrust direction, and the second mode is a rudder like braking mode in which either the main wheel is kept in a first position and the blades are positioned individually towards a corresponding predetermined angle to the movement direction or the blades are kept in first positions and the main wheel is rotated.
[0029] Embodiments of the non-transitory computer-readable storage medium causes the computer to perform a method according to any combinations of the embodiments combinable with the first aspect.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0030] In the following, exemplary embodiments will be described in greater detail with reference to accompanying drawings, in which:
[0031] FIG. **1** illustrates an example of vessel equipment;
[0032] FIG. **2** illustrates placement examples of propulsion units;
[0033] FIG. **3** is a flow chart illustrating an example functionality;
[0034] FIG. **4** illustrates examples for a rudder like braking mode;
[0035] FIGS. **5** and **6** illustrate examples for a cycloidal propeller braking mode;
[0036] FIGS. **7**, **8** and **9** are flow charts illustrating example functionalities; and
[0037] FIG. **10** is an exemplified block diagram of an apparatus.
DETAILED DESCRIPTION
[0038] The following embodiments are exemplary. Although the specification may refer to “an”, “one”, or “some” embodiment(s) in several locations, this does not necessarily mean that each such reference is to the same embodiment(s), or that the feature only applies to a single embodiment. Single features of different embodiments may also be combined to provide other embodiments. Furthermore, words “comprising” and “including” should be understood as not limiting the described embodiments/examples to consist of only those features that have been mentioned, and such embodiments may contain also features/structures that have not been specifically mentioned. Further, although terms including ordinal numbers, such as “first”, “second”, etc., may be used for describing various elements, the structural elements are not restricted by the terms. The terms are used merely for the purpose of distinguishing an element from other elements. For example, a first cycloidal propeller unit could be termed a second cycloidal propeller unit, and similarly, a second cycloidal propeller unit could be also termed a first cycloidal propeller unit without departing from the scope of the present disclosure.
[0039] Embodiments and examples of the method described herein may be implemented in any cycloidal propulsion system comprising two or more cycloidal propeller units.
[0040] FIG. **1** is a schematic block diagram illustrating a highly simplified example of a vessel **110**

with a propulsion system, which comprises two or more cycloidal propeller units **120**, shortly propellers or propulsion sub-systems. The term vessel generally refers to any craft designed for water transportation, for example a marine vehicle is a vessel. Marine vehicles may include transport vessels and passenger ships, for example. The transport ships may include cargo vessels and containers, for example. Additionally, the vessel may refer to fishing vessels, service craft like tugboats and supply vessels, and warships. Furthermore, the vessel may be used as a ferry or a submarine. It is apparent to a person skilled in the art that the vessel comprises any number of shown elements, other equipment, other functions, and other structures that are not illustrated. They, as well as signalling and protocols used for carrying controlling information, for example, are well known by persons skilled in the art and are irrelevant to the actual invention. Therefore, they need not to be discussed in more detail here.

[0041] In the illustrated example of FIG. **1**, a cycloidal propeller unit **120** comprises a rotatable main wheel **121** equipped with five blades **122**, **123**, **124**, **125**, **126** that are individually rotatable to change, per a blade, an angle of attack, for example, and extend from the main wheel. It should be appreciated that there may be any number of blades. Different examples of such a cycloidal propeller unit, and controllability and rotatability of different parts of the cycloidal propeller unit, or cycloidal propeller units, and detailed description of a general movement control arrangement **140** controlling rotation of unit(s) or part(s) of unit(s) either individually or jointly are described in WO 2021/249645, assigned to the same applicant and hereby incorporated by a reference. Further, to enable an automatic stopping procedure with a steering capability, the movement control arrangement **140** comprises a stop tool **141**, for example an apparatus configured to implement an automatic stopping procedure, which will be described in more detail below.

[0042] The automatic stopping procedure is started when a corresponding input is received. The input may be a user input received via a user interface (UI) element **130** on a bridge, for example. The input may be an input generated by a pilot system, e.g. an automatic pilot system. The automatic stopping procedure may comprise one stopping operation mode, or a plurality of stopping operation modes, for example a normal stopping operation mode and an emergency stopping operation mode, depending on an implementation. A non-limiting list of examples of the user interface element **130** comprises a display comprising one or more software buttons for the automatic stopping procedure, or a joystick with one or more physical positions or buttons for the automatic stopping procedure, or a lever comprising one or more predefined positions for the automatic stopping procedure, or one or more dedicated levers or physical buttons for the automatic stopping procedure. The at least one user interface element **130** that is usable to change the status of the automatic stopping procedure, for example, is connected to the movement arrangement element **140**, to at least active the stop tool **141**. A further user interface element, not shown in FIG. **1**, is a user interface element to steer the vessel. For example, the joystick or the lever may be used to steer the vessel during the automatic stopping procedure. Correspondingly, even though not illustrated in FIG. **1**, a pilot system may be connected to the movement arrangement element **140**, or to the automatic stop tool **141**, or be part of the movement arrangement element **140**.

[0043] The automatic stop tool **141** may be configured to implement one or more different braking modes. The configuration may comprise sets of operational parameters to be used during the stopping. In one implementation, the automatic stopping procedure uses a cycloidal propeller braking mode. In another implementation, the automatic stopping procedure uses a rudder mode like braking mode. In further implementations, the automatic stopping procedure may use both the cycloidal propeller braking mode and the rudder mode like braking mode, for example successively and/or simultaneously and/or depending on a stopping operation mode.

[0044] FIG. **2** is a schematic block diagram that illustrates different examples of positioning at least a first cycloidal propeller unit and a second cycloidal propeller unit in vessels, which are configurable to implement the automatic stopping procedure that maintains a movement direction of the vessel to be according to a latest steering command. In the illustrated examples of FIG. **2** the cycloidal propeller units are positioned symmetrically with respect to a longitudinal axis of a hull of a vessel, the longitudinal axis being depicted by a dot-and-dash line. However, it should be appreciated that the cycloidal propeller units may be positioned asymmetrically, or some of them symmetrically and some asymmetrically.

[0045] Referring to FIG. **2**, the vessel **210** is a double ender, in which the first cycloidal propeller unit **211** and the second cycloidal propeller unit **212** are positioned along the longitudinal axis of the hull. In the vessel **220**, the first cycloidal propeller unit **221** and the second cycloidal propeller unit **222** are positioned at the end portion of the hull, at a same distance from the longitudinal axis of the hull. In the vessels **210** and **220** both propeller units may be used for stopping the vessel or one is used for stopping the vessel and the other one is used for maintaining the movement direction to be according to the latest steering command. The vessel **230** comprises three cycloidal propeller units **231**, **232**, **233** at the end portion of the hull, two cycloidal propeller unit **231**, **232** are positioned at a same distance from the longitudinal axis of the hull, i.e. similarly as in the vessel **220**, and one cycloidal propeller unit **233** is positioned along the longitudinal axis of the hull. In the vessel **230** all propeller units may be used for stopping the vessel or two propeller units may be used for stopping the vessel and one propeller unit is used for maintaining the movement direction to be according to the latest steering command, or one propeller unit is used for stopping the vessel and one or two propeller units may be used for maintaining the movement direction to be according to the latest steering command.

[0046] As is evident from the examples of FIG. **2**, the automatic stopping procedure does not limit the positioning of the propeller units, and propeller units may be controlled differently during the automatic stopping procedure with the steering capability.

[0047] FIG. **3** is a flow chart illustrating an example functionality of a movement control arrangement configured to implement the automatic stopping procedure for a vessel comprising at least a first cycloidal propeller unit and a second cycloidal propeller unit.

[0048] Referring to FIG. **3**, the propeller units are controlled (block **301**) to provide propulsion and to steer the vessel according to inputs received (block **302**: no), for example as described in WO 2021/249645. When an input triggering an automatic stopping procedure is received (block **302**: yes), a stopping procedure (an automatic stopping procedure) is started. The stopping procedure comprises at least following: obtaining (block **303**) at least information indicating a speed of the vessel and adjusting (block **304**), based on at least the speed indicated, motion control values of at least a first cycloidal propeller unit to cause, while maintaining a movement direction of the vessel to be according to a latest steering command, the first cycloidal propeller unit to brake in a first mode or in a second mode. The movement direction of the vessel is maintained to be according to the latest steering command by taking into account a possible movement direction change caused by braking, for example asymmetric braking, and compensate it in the steering.

[0049] Said obtaining (block **303**) and adjusting (block **304**) may be performed a plurality of times during the stopping procedure and they are performed automatically, without any further input than the input triggering the automatic stopping procedure.

[0050] The information indicating the speed may be a measured vessel speed, or information indicating indirectly the speed, or an estimate. The information indicating indirectly the speed may be torque values, power values, and/or revolutions per minute (RPM) values. The speed may be calculated using said values. The estimate may be calculated based on a model, for example based on total thrust of the vessel, i.e. thrust generated by the propeller units in use, and resistance curve of the vessel. The resistance, or the drag, of the vessel is constant, or almost constant (constant enough) with respect to the speed.

[0051] The first mode, in which the first cycloidal propeller unit may brake, may be a cycloidal propeller braking mode in which the main wheel is rotating, and blades of the cycloidal propeller unit are rotated to change a thrust direction at the time the input is received towards to a reverse thrust direction, for example as described with FIGS. **5** and **6**.

[0052] The second mode, in which the first cycloidal propeller unit may brake, may be a rudder like braking mode in which either the main wheel is kept in a first position and the blades are positioned individually towards a corresponding predetermined angle to the movement direction or the blades are kept in first positions and the main wheel is rotated, for example as described with FIG. **4**. The first position(s) may be position(s) the main wheel/blades had at the time the input triggering the automatic stopping procedure is received, or at a later time during the automatic stopping procedure.

[0053] Depending on an implementation, the adjusting may be performed gradually in a step-wise manner, i.e. sequentially. An example of the step-wise manner is described with FIG. **7**.

[0054] Further, depending on an implementation, when there are two or more automatic stopping operation modes, the adjusting may be performed based on an automatic stopping operation mode triggered by the input, the different automatic stopping operation modes providing different adjustment.

[0055] FIG. **4** is a block diagram illustrating operation principles in the rudder like braking mode, called herein the second mode. In the rudder like braking mode, the propeller unit does not generate propulsion and forward thrust, it generates only side force and braking force.

[0056] Referring to FIG. **4**, a main wheel **121** and blades of a propeller unit are controlled, including rotating, in a normal operation mode **410** as described above with block **301**, to move the vessel to movement direction **401** until the automatic stopping procedure is started.

[0057] In one implementation, during the automatic stopping procedure in the rudder like braking mode, the propeller unit may be configured to keep the main wheel **121** in a position (first position), for example a position the main wheel had when the input triggering the automatic stopping procedure is received, or when the adjusting is started, and the blades are positioned individually towards a corresponding predetermined angle to the movement direction. A value of a predetermined angle to the movement direction is up to ±90 degrees, preferably between ±10 to ±45 degrees. Two or more of the two or more blades may have the same value or different values of the predetermined angle. For example, all blades may be positioned inwards or outwards with the same angle, for example to generate steering power and/or to generate braking power and/or to compensate side force of another propeller unit. The blades may be positioned as symmetrically as possible, to form a braking formation, for example. For example, in an example **420** of a final braking mode position, the blades are positioned inwards with angles **421**, **422**, **423**, **424**, **425** having the same absolute value, for example 25 degrees. The blades may be gradually at different angles, for example the one(s) in the forward of the vessel having the smallest angle, the next ones having a bigger angle, etc., for example to intensify the steering effect. For example, in an example **430** of the final braking mode position of the blades, the angle **433** is the smallest one, the angles **432** and **434** are bigger than the angle **433** and have the same absolute value, and the angles **431** and **435** are bigger than the angles **432** and **434**. Any combination of the disclosed ways to position angles may be used, for example depending on a stopping operation mode, size of the vessel, number of propeller units in the vessel, number of propeller units used for the automatic stopping procedure, etc. Further, although in the examples **420** and **430** the angles are inwards, one or more of the angles may be outwards.

[0058] In another implementation, during the automatic stopping procedure in the rudder braking like mode, the propeller unit may be configured to keep the blades in positions (first positions), for example in positions the blades had when the input triggering the automatic stopping procedure is received, or when the adjusting is started, and the main wheel **121** is rotated towards a predetermined angle to the movement direction. A value of a predetermined angle to the movement direction is up to ±90 degrees. While the main wheel **121** rotates also the blades move accordingly, as illustrated in the example **440**.

[0059] It is also possible that in a vessel comprising two or more propeller units one or more propeller units in the vessel implement the rudder braking like mode keeping the wheel in the first position and one or more propeller units in the vessel implement the rudder braking like mode keeping the blades in the first positions. Further, it should be appreciated that a first position may be any predetermined fixed position.

[0060] FIGS. **5** and **6** are block diagrams illustrating operation principles in the cycloidal propeller braking mode, called herein the first mode, when two cycloidal propeller units are adjusted symmetrically with respect to the longitudinal axis and the movement direction. In the cycloidal propeller braking mode a propeller unit generates propulsion and thrust, and the thrust direction is changed, using predetermined control values for blades, for example, without changing the rotational direction of the wheel.

[0061] FIG. **5** illustrates operation principles for cycloidal propeller units positioned along the longitudinal axis.

[0062] Referring to FIG. **5**, in a normal operation mode **510** as described above with block **301**, to move the vessel to movement direction **501**, the blades generate thrust so that the thrust direction **511** is aligned with the movement direction until the automatic stopping procedure is started. When the automatic stopping procedure, or the adjusting, starts the blades are rotated to cause thrust directions of the cycloidal propeller units to change to be substantially perpendicular to the thrust direction at the time the input was received. In symmetrical adjustments the thrust direction of one of the propeller units is rotated outwards **521** and the thrust direction of the other one of the propeller units is rotated inwards **522**, as shown in the examples **520**A and **520**B. The blades are further rotated, for example when a speed indicated is below a predefined limit, to cause thrust direction of the cycloidal propeller unit to change to be the reverse thrust direction **531** as shown in the example **530**. The blades may be rotated by changing blade trajectory parameters.

[0063] FIG. **6** illustrates operation principles for cycloidal propeller units positioned symmetrically with respect to the longitudinal axis of the vessel, at a same, or substantially at the same, distance from the longitudinal axis.

[0064] Referring to FIG. **6**, in a normal operation mode **610** as described above with block **301**, to move the vessel to movement direction **601**, the blades generate thrust so that the thrust direction **611** is aligned with the movement direction until the automatic stopping procedure, or adjusting, is started. When the automatic stopping procedure, or the adjusting starts, the blades are rotated to cause thrust directions of the cycloidal propeller units to change to be substantially perpendicular to the thrust direction at the time the input was received. In symmetrical adjustments the thrust direction of the propeller units is rotated outwards **621** or inwards **622**, as shown in the examples **620**A and **620**B. In the illustrated example, the blades are further rotated, for example when a speed indicated, as explain with block **303**, is below a predefined limit, to cause thrust direction of the cycloidal propeller unit to change to be the reverse thrust direction **631** as shown in the example **630**. The blades may be rotated by changing blade trajectory parameters.

[0065] It is possible that during the automatic stopping procedure, the symmetrical adjustment is changed to asymmetric adjustment, possibly later changed back to the symmetrical adjustment. Further, it is also possible that in a vessel comprising two or more propeller units one or more propeller units in the vessel implement the rudder braking like mode and one or more propeller units in the vessel implement the cycloidal propeller braking mode.

[0066] In asymmetrical procedure the propellers may be adjusted to change the thrust direction so that one changes it inwards, the other one outwards, or they change the thrust directions at different phases, for example in such a way that when one has changed it about 90 degrees compared to the start position, the other one has changed it about 45 degrees.

[0067] FIG. **7** is a flow chart illustrating an example functionality of a movement control arrangement configured to implement the automatic stopping procedure in a step-wise manner and using one of a plurality of stopping operation modes available. In the illustrated example, it is assumed that the stopping operation modes are a normal stopping operation mode and an

emergency stopping operation mode.
[0068] Referring to FIG. **7**, the propeller units are controlled (block **701**) to provide propulsion and to steer the vessel according to steering inputs received (block **702**: no), for example according to user inputs as described in WO 2021/249645 and/or according to steering commands generated by a pilot system. When an input triggering an automatic stopping procedure is received (block **702**: yes), a stopping procedure (an automatic stopping procedure) is started. In the illustrated example, a stopping operation mode is determined (block **703**) based on the input. For example, a user input element selected by a user indicates whether the automatic stopping function is triggered for a normal stopping or for an emergency stopping. Correspondingly, a pilot system, for example an autopilot system, may generate different stopping commands, or stopping inputs, e.g. a normal stopping command and an emergency stopping command. Further, at least information indicating a speed v of the vessel is obtained (block **704**), said obtaining being performed a plurality of times during the stopping procedure, for example as an ongoing background process, even though not separately illustrated herein.
[0069] In the illustrated example of FIG. **7**, reducing, before adjusting, the speed v indicated is reduced to a first speed v1 by changing (block **706**) propulsion of at least one of the first and second cycloidal propeller units as long as (block **705**: yes) the speed v exceeds the first speed v1. For example, the speed may be reduced to be about 20 RPMs. In other words, the vessel has, when the stopping procedure is started, speed and inertia, and the speed is reduced by producing force that is against the movement direction.
[0070] When the speed has been reduced to the first speed (block **705**: no), i.e. the speed indicated is not exceeding the first speed, the adjusting of at least a first cycloidal propeller unit in a step-wise manner is started, meaning that the adjusting steps are performed repeatable, step by step. The number of steps may vary but in an implementation that uses the cycloidal propeller braking mode illustrated in FIG. **5** or **6**, at least two steps are required. Further, the number of steps in the normal operation mode may be different to the number of steps in the emergency mode.
[0071] In the illustrated example of FIG. **7**, a braking mode per a cycloidal propeller unit in the vessel is determined (block **707**), or per a cycloidal propeller unit used in the automatic stopping procedure. The braking modes comprise the first mode (cycloidal propeller braking mode) and the second mode (rudder like braking mode), and in an implementation the braking modes also comprise a steering only mode for one or more propeller units when at least one propeller unit is in a braking mode. It should be appreciated that determining the braking mode may be skipped, for example in implementations comprising only one braking mode.
[0072] Then the actual adjusting is performed per the cycloidal propeller unit for which the braking mode is determined. In the illustrated example, if the braking mode is the first mode (block **708**: yes), a pitch function amongst two or more pitch functions is selected (block **709**), based on the speed. For example, the selection may depend on the current step, which depends on the current speed. The pitch functions comprise at least trochoidal and epicycloid pitch functions, for example trochoidal and epicycloid pitch functions for stopping (for automatic stopping procedure). Depending on an implementation, the pitch functions may comprise other periodic pitch functions, or nonperiodic pitch functions, e.g. pod way stopping. Further, the pitch functions, or some of them may be same pitch functions used in the normal operation mode (block **701**) and/or dedicated pitch functions for the stopping operation mode.
[0073] Regardless of the braking mode, i.e. whether (block **708**: yes) or not (block **708**: no) a pitch function is selected, and a set of operational parameter values predefined for the stopping operation mode and for the step are obtained (block **710**). The pitch function may be selected based on the stopping operation mode and/or the speed. The operational parameter values for the normal stopping operation mode may be predefined for optimizing between a maximum stopping effect, or shortest stopping distance, and a maximum component lifetime, or they may be predefined for a soft stopping effect that takes into account component wear and a reasonable/pre-estimated

stopping distance. The operational parameter values for the emergency stopping operation mode may be predefined for a maximum stopping effect. In other words, they may be predefined for a shortest stopping distance, not taking into account what it means to even though the component lifetime. The set of operational parameter values for the first mode may comprise values for a rotational speed, a pitch function parameter, for example an eccentricity, and a steering parameter, for example a yaw angle. The set of operational parameter values for the second mode may comprise values for blade pitch angles, or a value to rotate the wheel. The values, or some of them, may be values to be applied as such, or values to be added or subtracted from a preceding value, for example a value for the operational parameter in a normal operation mode, to obtain a value to be applied at the step. As a general rule, values for the operational parameters may be predetermined to gain optimal performance and safety, for example to create required braking effect to stop the movement of the vessel while limiting blade stress level as much as possible to avoid damage to the propeller unit(s). The use of predetermined values ensures fast adjustment and requires less computational power during the automatic stopping procedure.

[0074] The operational parameter values are applied to determine (block **711**) the motion control values. For example, in the first mode the operational parameter values may be input to the pitch function outputting motion control values. In the second mode, the operational parameter values may be determined to be the motion control values, or the motion control values may be calculated using earlier motion control values and the obtained operational parameter values. The motion control values are then applied to rotate one or more blades and/or the wheel, and then it is monitored, whether the speed v decreases (block **713**) to a maximum speed value of a next step v-max-next, or decreases (block **714**) to zero or an input cancelling (block **715**) the automatic stopping procedure is received.

[0075] When the speed v decreases (block **713**: no) to a maximum speed value of a next step v-max-next, the process returns in the illustrated example to block **707** to determine braking mode for the step, and continues therefrom as described above.

[0076] When the speed v decreases (block **714**: yes) to zero, in the illustrated example a stopped mode is entered (block **716**).

[0077] If an input cancelling the automatic stopping procedure is received (block **715**: yes), the stopping procedure is stopped (block **717**) and, in the illustrated example the normal operation mode is entered (block **717**). Entering the normal operation mode means that the process returns to block **701** to control the propeller units to provide propulsion and to steer the vessel according to steering inputs received. The input triggering the automatic stopping procedure and the input cancelling the automatic stopping procedure may be both received as user inputs or be inputs generated by a pilot system, or one of them is a user input and another an input generated by the pilot system.

[0078] In one implementation, when the automatic stopping procedure triggered in block **702** is the normal stopping operation mode, an input of the emergency stopping operation mode received after that cancels the normal stopping operation mode, and the process returns to block **703** to redetermine the stopping operation mode.

[0079] FIGS. **8** and **9** are flow chart illustrating different examples example functionalities of the movement control arrangement, the functionalities providing different examples how a steering command received during the stopping procedure may be taken into account. The different functionalities may be combined. In the illustrated examples of FIGS. **8** and **9**, it is assumed that at the beginning of the stopping procedure, including beginning of the adjusting, a symmetric procedure maintaining the movement direction to be the direction the vessel had at the time the input triggering the automatic stopping procedure is applied. In other words, it is assumed that a steering command changing the movement direction of the vessel is received in the adjustment phase. Further, it is assumed for the sake of clarity of description that two cycloidal propeller units are used. It is a straightforward task to implement the functionality to more than two propeller units.

[0080] Referring to FIG. **8**, when the adjusting starts (block **800**), first motion control values are determined (block **801**) based on a speed and the two propeller units are adjusted (block **802**) substantially symmetrically with respect to a longitudinal axis of the vessel using the first motion control values until a steering command changing the movement direction of the vessel is received (block **803**: yes). After the steering command, in the illustrated example, first motion control values are determined (block **804**) based on the speed and second motion control values are determined (block **804**) based on the speed and the steering command, e.g. based on a change to a movement direction. Then one of the propeller units is adjusted (block **805**) using the first motion control values and the other one using the second motion control values. In other words, asymmetrical adjustment is applied.

[0081] Referring to FIG. **9**, when the adjusting starts (block **900**), the two propeller units are adjusted (block **901**) substantially symmetrically with respect to a longitudinal axis of the vessel to brake either in the first mode or in the second mode, i.e. in the same mode, until a steering command changing the movement direction of the vessel is received (block **902**: yes). Then, in the illustrated example, one of the propeller units is caused to brake in the first mode and the other one is caused to brake in the second mode. In other words, one of the propeller units is adjusted (block **903**) using the first mode and the other one using the second mode. In other words, asymmetrical adjustment is applied. One may say that the propeller unit whose braking mode remains the same, uses first motion control values, and the propeller unit whose braking mode is changes, uses at the beginning the first motion control values and after the steering command, second motion control values.

[0082] The blocks and related functions described above in FIGS. **1** to **9** are in no absolute chronological order, and some of the blocks may be performed simultaneously or in an order differing from the given one. Other functions can also be executed between the blocks or within the blocks. For example, when the stopping procedure is started, an open sea mode may be changed to be a maneuvering mode, and then the adjustment, or speed reduction may be started. Another example is harvesting electrical power from braking power generated during the automatic stopping procedure. Some of the blocks or part of the blocks can also be left out or replaced by a corresponding block or part of the block.

[0083] FIG. **10** is a simplified block diagram illustrating some units for an apparatus (device, equipment) **1000** configured to perform at least some functionality described above for automatic stopping procedure of a vessel, for example by means of FIGS. **1** to **7** and any combination thereof. In the illustrated example, the apparatus **1000** comprises one or more interface (IF) entities **1001**, such as one or more user interfaces, and one or more processing entities **1002** connected to various interface entities **1001** and to one or more memories **1003**.

[0084] The one or more interface entities **1001** are entities for receiving and transmitting information, such as communication interfaces comprising hardware and/or software for realising communication connectivity according to one or more communication protocols, or for realising data storing and fetching, or for providing user interaction via one or more user interfaces as described above in the explanation of the example illustrated by FIG. **1**.

[0085] A processing entity **1002** is capable to perform calculations and configured to implement at least part of functionalities/operations described above, for example by means of any of FIGS. **1** to **9** and any combination thereof, with corresponding algorithms **1004** stored in the memory **1003**. The functionalities and corresponding algorithms may include, in addition to functionalities and corresponding algorithms for one or more stopping procedures, one or more functionalities with corresponding algorithms for a pilot system. The entity **1002** may include one or more processors, controllers, control units, micro-controllers, etc. configurable to carry out embodiments/examples/implementations or operations described above, for example by means of any of FIGS. **1** to **9** and any combination thereof. Generally, a processor is a central processing unit, but the processor entity **1002** may be an additional operation processor or a multicore processor or a microprocessor.

[0086] A memory **1003** is usable for storing a computer program code required for one or more functionalities/operations described above, for example by means of any of FIGS. **1** to **9** and any combination thereof, that is, the algorithms **1004** for implementing the functionality/operations described above by means of any of FIGS. **1** to **9** and any combination thereof. The memory **1003** may be used for storing two or more sets of operational parameter values. The sets may be associated with corresponding speed value, when a step-wise manner adjusting (braking) is applied. The memory **1003** may also be usable for storing, at least temporarily, other possible information required for one or more functionalities/operations described above, for example by means of any of FIGS. **1** to **9** and any combination thereof. The memory **1003** may comprise a data buffer that may, at least temporarily, store for example measurement data and/or information received as input.

[0087] As a summary, the methods described herein, for example by means of any of FIGS. **1** to **9** and any combination thereof, may be configured as a computer or a processor, or a microprocessor, such as a single-chip computer element, or as a chipset, or one or more logic gates including at least a memory for providing storage area used for arithmetic operation and an operation processor for executing the arithmetic operation. Each or some or one of the algorithms for functions/operations described above, for example by means of any of FIGS. **1** to **7** and any combination thereof, may be comprised in one or more computer processors, application-specific integrated circuits (ASIC), digital signal processors (DSP), digital signal processing devices (DSPD), programmable logic devices (PLD), field-programmable gate arrays (FPGA), graphics processing units (GPU) and/or other hardware components that have been programmed and/or will be programmed by downloading computer program code (one or more algorithms) in such a way to carry out one or more functions of one or more embodiments/examples.

[0088] An embodiment provides a computer program embodied on any client-readable distribution/data storage medium or memory unit(s) or article(s) of manufacture, comprising program instructions executable by one or more processors/computers, which instructions, when loaded into an apparatus (device, equipment), constitute an entity providing corresponding functionality, or at least part of the corresponding functionality. Programs, also called program products, including software routines, program snippets constituting “program libraries”, applets, and macros, can be stored in any medium, including non-transitory computer readable storage medium, and may be downloaded into an apparatus. In other words, each or some or one of the algorithms for one or more functions/operations described above, for example by means of any of FIGS. **1** to **9** one or more arithmetic logic units, a number of special registers and control circuits.

[0089] It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. A method for stopping a vessel, which vessel comprises at least a first cycloidal propeller unit and a second cycloidal propeller unit, a cycloidal propeller unit including a rotatable main wheel equipped with two or more blades that are individually rotatable, the method comprising: starting, in response to receiving an input triggering an automatic stopping procedure, a stopping procedure including at least the following: obtaining at least information indicating a speed of the vessel; and adjusting, based on at least the speed indicated, motion control values of at least the first cycloidal propeller unit to cause, while maintaining a movement direction of the vessel to be according to a latest steering command, the first cycloidal propeller unit to brake in a first mode or in a second mode, wherein the first mode is a cycloidal propeller braking mode in which the main wheel is rotating and blades of the cycloidal propeller unit are rotated to change a thrust direction at the time

the input is received towards to a reverse thrust direction, and the second mode is a rudder like braking mode in which either the main wheel is kept in a first position and the blades are positioned individually towards a corresponding predetermined angle to the movement direction or the blades are kept in first positions and the main wheel is rotated.
2. The method of claim 1, wherein the stopping procedure further comprises at least: reducing, before adjusting, the speed indicated to a first speed by changing propulsion of at least one of the first and second cycloidal propeller units; and starting the adjusting when the speed indicated is not exceeding the first speed.
3. The method of claim 1, wherein the stopping procedure further comprises at least a normal stopping operation mode and an emergency stopping operation mode, the method further comprising: determining stopping operation mode based on the input; obtaining a set of operational parameter values predefined for the stopping operation mode determined, wherein the operational parameter values for the normal stopping operation mode are predefined for optimizing between a maximum stopping effect and a maximum component lifetime, and the operational parameter values for the emergency stopping operation mode are predefined for a maximum stopping effect; and performing the adjusting by applying the operational parameter values to determine the motion control values.
4. The method of claim 1, wherein the stopping procedure further comprises at least: performing the adjusting gradually in a step-wise manner, the step-wise manner including at least, per a step: obtaining, when the speed decreases to a maximum speed value of a step, a set of operational parameter values predefined for the step; and performing the adjusting by applying the operational parameter values to determine the motion control values.
5. The method of claim 4, the operational parameter values in the first mode comprise values for a rotational speed, a pitch function parameter, and a steering parameter and in the second mode values for blade pitch angles.
6. The method of claim 5, further comprising in the first mode: selecting, based on the speed, a pitch function amongst pitch functions including at least trochoidal and epicycloid pitch functions for stopping; inputting the set of operational parameter values obtained to the pitch function selected; and rotating the blades according to motion control values output by the pitch function selected.
7. The method of claim 2, further comprising in the first mode at least: rotating, when the adjustment is started, the blades to cause thrust direction of the cycloidal propeller unit to change to be substantially perpendicular to the thrust direction at the time the input was received; and rotating, when the speed indicated is below a second speed, which is lower than the first speed, the blades to cause thrust direction of the cycloidal propeller unit to change to be the reverse thrust direction.
8. The method of claim 1, wherein in the second mode a value of a predetermined angle to the movement direction is up to ±90 degrees, and two or more of the two or more blades may have the same value or different values.
9. The method of claim 1, wherein the stopping procedure further comprises at least: adjusting the first and second cycloidal propeller units substantially symmetrically with respect to a longitudinal axis of the vessel using first motion control values; receiving, after the input, a steering command changing the movement direction of the vessel; determining second motion control values based at least on the speed and the steering command received; adjusting, after the steering command, one of the first and second cycloidal propeller units using the first motion control values and the other one using the second motion control values.
10. The method of claim 9, wherein the first and second cycloidal propeller units are both adjusted using first motion control values, they are both caused to brake either in the first mode or in the second mode; and the first motion control values and the second motion control values are used in the adjusting, one of the first and second cycloidal propeller units is caused to brake in the first

mode and the other one is caused to brake in the second mode.
11. The method of claim 1, further comprising: receiving an input cancelling the automatic stopping procedure; stopping the stopping procedure; and entering a normal operation mode.
12. An apparatus comprising: at least one processor; and at least one memory including computer program code, the at least one memory and computer program code configured to, with the at least one processor, cause the apparatus at least to perform: start, in response to receiving an input triggering an automatic stopping procedure for stopping a vessel, which vessel comprises at least a first cycloidal propeller unit and a second cycloidal propeller unit, a cycloidal propeller unit including a rotatable main wheel equipped with two or more blades that are individually rotatable, a stopping procedure comprising at least the following: obtaining at least information indicating a speed of the vessel; and adjusting, based on at least the speed indicated, motion control values of at least the first cycloidal propeller unit to cause, while maintaining a movement direction of the vessel to be according to a latest steering command, the first cycloidal propeller unit to brake in a first mode or in a second mode, wherein the first mode is a cycloidal propeller braking mode in which the main wheel is rotating and blades of the cycloidal propeller unit are rotated to change a thrust direction at the time the input is received towards to a reverse thrust direction, and the second mode is a rudder like braking mode in which either the main wheel is kept in a first position and the blades are positioned individually towards a corresponding predetermined angle to the movement direction or the blades are kept in first positions and the main wheel is rotated.
13. The apparatus of claim 12, wherein the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to perform during the stopping procedure following: reducing, before adjusting, the speed indicated to a first speed by changing propulsion of at least one of the first and second cycloidal propeller units; starting the adjusting when the speed indicated is not exceeding the first speed. performing the adjusting gradually in a step-wise manner, the step-wise manner comprising at least, per a step: obtaining, when the speed decreases to a maximum speed value of a step, a set of operational parameter values predefined for the step; and performing the adjusting by applying the operational parameter values to determine the motion control values.
14. The apparatus of claim 12, wherein the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to: determine stopping operation mode amongst at least a normal stopping operation mode and an emergency stopping operation mode based on the input; obtain a set of operational parameter values predefined for the stopping operation mode determined, wherein the operational parameter values for the normal stopping operation mode are predefined for optimizing between a maximum stopping effect and a maximum component lifetime, and the operational parameter values for the emergency stopping operation mode are predefined for a maximum stopping effect; and perform the adjusting by applying the operational parameter values to determine the motion control values.
15. The apparatus of claim 13, wherein the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to perform in the first mode: selecting, based on the speed, a pitch function amongst pitch functions comprising at least trochoidal and epicycloid pitch functions for stopping; inputting the set of operational parameter values obtained to the pitch function selected; and rotating the blades according to motion control values output by the pitch function selected, wherein the operational parameter values in the first mode include values for a rotational speed, a pitch function parameter, and a steering parameter.
16. The apparatus of claim 13, wherein the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to: rotate, in the first mode, when the adjustment is started, the blades to cause thrust direction of the cycloidal propeller unit to change to be substantially perpendicular to the thrust direction at the time the input was received; and rotate, in the first mode, when the speed indicated is below a second speed,

which is lower than the first speed, the blades to cause thrust direction of the cycloidal propeller unit to change to be the reverse thrust direction.

17. The apparatus of claim 12, wherein the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to: adjust the first and second cycloidal propeller units substantially symmetrically with respect to a longitudinal axis of the vessel using first motion control values; receive, after the input, a steering command changing the movement direction of the vessel; determine second motion control values based at least on the speed and the steering command received; adjust, after the steering command, one of the first and second cycloidal propeller units using the first motion control values and the other one using the second motion control values.

18. The apparatus of claim 17, wherein the at least one memory and computer program code are configured to, with the at least one processor, further cause the apparatus at least to: cause both the first and second cycloidal propeller units to brake either in the first mode or in the second mode when the first and second cycloidal propeller units are both adjusted using first motion control values; and cause one of the first and second cycloidal propeller units to brake in the first mode and the other one is caused to brake in the second mode when the first motion control values and the second motion control values are used in the adjusting.

19. A vessel comprising: at least a first cycloidal propeller unit and a second cycloidal propeller unit, a cycloidal propeller unit comprising a rotatable main wheel equipped with two or more blades that are individually rotatable; a movement control arrangement including at least one apparatus configured to start, in response to receiving an input triggering an automatic stopping procedure, a stopping procedure including at least the following: obtaining at least information indicating a speed of the vessel; and adjusting, based on at least the speed indicated, motion control values of at least the first cycloidal propeller unit to cause, while maintaining a movement direction of the vessel to be according to a latest steering command, the first cycloidal propeller unit to brake in a first mode or in a second mode, wherein the first mode is a cycloidal propeller braking mode in which the main wheel is rotating and blades of the cycloidal propeller unit are rotated to change a thrust direction at the time the input is received towards to a reverse thrust direction, and the second mode is a rudder like braking mode in which either the main wheel is kept in a first position and the blades are positioned individually towards a corresponding predetermined angle to the movement direction or the blades are kept in first positions and the main wheel is rotated; at least one first user interface element to change, in response to a user input to the first user interface element, status of the automatic stopping procedure, the user interface element being connected to the movement control arrangement; and at least one second user interface element to steer the vessel.

20. The vessel of claim 19, wherein the at least one first user interface element comprises a plurality of user interface elements for a plurality of stopping operation modes including at least a normal stopping operation mode and an emergency stopping operation mode.