TUG APPROACH CONTROL

INTRODUCTION

The present invention relates to a tug comprising a tug controller unit controlling an approach of the tug towards a vessel to be towed.

BACKGROUND

A tug, or tugboat, is a powerful boat or ship that is used for towing and pushing marine vessels. By towing and pushing the vessel, one or more tugs may maneuver the vessel during difficult maneuvering operations, such as in a harbor, in a narrow canal or during rescue operations of vessels in distress. During pushing operations the tug maneuvers the vessel by transmitting force to one of the sides of the hull of the vessel. For this operation to be performed the tug must approach the vessel and come into contact with the hull. If this is done incorrectly then it can severely damage the tug or the vessel.

For this operation to be performed without damaging the tug or the vessel, tug captains must gradually approach the vessel and softly come into contact with the hull of the vessel. This may be challenging even for an experienced captain, in particular in difficult weather. A spotter standing on the bow of the tug may observe the distance between the tug and the vessel and report to the captain, however this would expose the spotter to risk of personal injury.

SUMMARY OF THE INVENTION

According to a first aspect, the invention provides a tug for maneuvering a vessel, including a propulsion controller for controlling a thrust, heading and speed of the tug, at least one proximity sensor in a contact area, the proximity sensor being configured to detect a distance between the contact area and the vessel, a tug controller unit controlling an approach of the tug towards the vessel based on the detected distance between the contact area and the vessel by instructing the propulsion controller, and at least one force sensor in the contact area, the force sensor being configured to measure an impact between the contact area and the vessel, and wherein the tug controller unit further instructs the propulsion controller to change at least the amount of thrust based on the measured impact between the contact area

and the vessel. The tug may be configured to detect a speed of approach of the tug towards the vessel, and the tug controller unit is further controlling the approach of the tug towards the vessel based on the detected speed of approach of the tug towards the vessel. The tug may further comprises at least one force sensor in the contact area, the force sensor being configured to measure an impact between the contact area and the vessel, and the tug controller unit is further controlling the approach of the tug towards the vessel based on the measured impact between the contact area and the vessel. The at least one force sensor may comprise an array of a plurality of force sensors. The at least one force sensor may be integrated in a tug fender. The tug controller unit may be configured to receive information of a speed and heading of the vessel from the vessel, and the tug controller unit is further controlling the approach of the tug towards the vessel based on the received information of the speed and heading of the vessel. The controlling the approach may be carried out autonomously by the tug controller unit. The tug controller unit may further comprise a dynamic positioning control system controlling the approach of the tug based on a plurality of input parameters, and the plurality of input parameters may comprise at least one of distance between the contact area and the vessel, speed of approach of the tug towards the vessel, impact between the contact area and the vessel, surface traffic, meteorological data, environmental data, movement of the vessel, location of the vessel, and electronic navigational charts. The proximity sensor may be one of a sonar, a radar, a lidar, a Doppler radar, an inductive proximity sensor and an ultrasonic sensor.

According to a second aspect, the invention provides a tug for maneuvering a vessel, including at least one force sensor for measuring an amount of force being transmitted to the vessel, wherein the at least one force sensor is arranged in a contact area between the tug and the vessel, a propulsion controller for controlling a thrust, heading and speed of the tug, and a tug control unit for instructing the propulsion controller to change at least the an amount of thrust based on the amount of force measured by the force sensor. The at least one force sensor may be integrated in a tug fender. The at least one force sensor may comprise an array of a plurality of force sensors. The controlling the amount of thrust may be carried out autonomously by the tug controller unit. The tug controller unit may further comprise a dynamic positioning control system controlling the amount of thrust provided by the tug on the vessel based on a plurality of input parameters, and the plurality of input

parameters may comprise at least one of force being transmitted to the vessel, surface traffic, meteorological data, environmental data, movement of the vessel, location of the vessel, and electronic navigational charts.

According to a third aspect, the invention provides a tug controller unit, wherein the tug controller unit is configured to receive data from at least one proximity sensor in a contact area between a tug and a vessel, the received data comprising information regarding a distance between the contact area and the vessel, the tug controller unit is further configured to receive data from at least one force sensor in the contact area between the tug and the vessel, the received data comprising information regarding an amount of force being transmitted to the vessel, and the tug controller unit is further configured to instruct a propulsion controller to change at least an amount of thrust based on the amount of force being transmitted to the vessel. The received data may further comprise a speed of approach of the tug towards the vessel. Further, the tug controller unit may be configured to receive data from at least one force sensor in the contact area, the received data comprising information regarding an impact between the contact area and the vessel. The at least one force sensor may comprise an array of a plurality of force sensors. The tug controller may further be configured to receive information of a speed and heading of the vessel from the vessel, and the tug controller unit is further controlling the approach of the tug towards the vessel based on the received information of the speed and heading of the vessel. The tug controller unit may carry out instructing the amount of thrust autonomously. The tug controller unit may further comprise a dynamic positioning control system controlling the amount of thrust provided by the tug on the vessel based on a plurality of input parameters, and the plurality of input parameters may comprise at least one of distance between the contact area and the vessel, speed of approach of the tug towards the vessel, impact between the contact area and the vessel, surface traffic, meteorological data, environmental data, movement of the vessel, location of the vessel, and electronic navigational charts. The proximity sensor may be one of a sonar, a radar, a lidar, a Doppler radar, an inductive proximity sensor and an ultrasonic sensor.

According to a fourth aspect, the invention provides a tug controller unit, wherein the tug controller unit is configured to receive data from at least one force sensor in a contact area between a tug and a marine vessel, the received data comprising

information regarding an amount of force being transmitted to the marine vessel, and the tug control unit is further configured to instruct a propulsion controller to change at least an amount of thrust provided by the tug on the vessel based on the information regarding the amount of force being transmitted to the marine vessel. The at least one force sensor may comprise an array of a plurality of force sensors. The controlling the amount of thrust may be carried out autonomously by the tug controller unit. The tug controller unit may further comprises a dynamic positioning control system controlling the amount of thrust provided by the tug on the vessel based on a plurality of input parameters, and the plurality of input parameters may comprise at least one of force being transmitted to the vessel, surface traffic, meteorological data, environmental data, movement of the vessel, location of the vessel, and electronic navigational charts.

BRIEF DESCRIPTION OF DRAWINGS

Embodiments of the invention will now be described with reference to the followings drawings, where:
Fig. 1 shows a top perspective view of a tug approaching a marine vessel.
Figs. 2a - 2b shows a top perspective view of a tug approaching a marine vessel.
Fig. 3 illustrates an exemplary tug controller unit.
Fig. 4 illustrates an exemplary dynamic positioning control system.

DETAILED DESCRIPTION

The present invention will be described with reference to the drawings. The same reference numerals are used for the same or similar features in all the drawings and throughout the description.

Tug

Fig. 1 shows a perspective view of a tug 100 approaching a marine vessel 105, hereinafter referred to as the vessel 105. The tug 100 is about to initiate a pushing operation on the vessel 105 to manoeuvre the vessel by pushing on a side 104 of the hull of the vessel. For this operation to be performed the tug 100 approaches the vessel 105 and a contact area 101 of the tug eventually comes into contact with the side 104 of the vessel. The contact area 101 is provided with resilient tug fenders that absorb energy during contact and protects both colliding surfaces. The tug 100 comprises at least one proximity sensor 102 in the contact area 101. The proximity sensor 102 is configured to detect a distance 106 between the contact area 101 and the vessel 105. The tug 100 is further provided with a tug controller unit 107 controlling the approach of the tug towards the vessel 105 based on the detected distance 106 between the contact area 101 and the marine vessel 105. In this manner may the approach be adjusted to allow a soft touch onto the side 104 of the hull. In example, the tug may move at a higher speed

CLAIMS

1. Tug for maneuvering a vessel, the tug comprising:
- a propulsion controller for controlling a thrust, heading and speed of the tug,
- at least one proximity sensor in a contact area, the proximity sensor being configured to detect a distance between the contact area and the vessel,
- a tug controller unit controlling an approach of the tug towards the vessel based on the detected distance between the contact area and the vessel by instructing the propulsion controller, and
- at least one force sensor in the contact area, the force sensor being configured to measure an impact between the contact area and the vessel, and wherein the tug controller unit further instructs the propulsion controller to change at least the amount of thrust based on the measured impact between the contact area and the vessel.

2. Tug according to claim 1, wherein the proximity sensor is further configured to detect a speed of approach of the tug towards the vessel, and the tug controller unit is further controlling the approach of the tug towards the vessel based on the detected speed of approach of the tug towards the vessel.

3. Tug according to claim 2, wherein the at least one force sensor is integrated in a tug fender.

4. Tug according to claim 2 or 3, wherein the at least one force sensor comprises an array of a plurality of force sensors.

5. Tug according to claim 1, wherein the tug controller unit is configured to receive information of a speed and heading of the vessel from the vessel, and the tug controller unit is further controlling the approach of the tug towards the vessel based on the received information of the speed and heading of the vessel.

6. Tug according to claim 1, wherein the controlling the approach is carried out autonomously by the tug controller unit.

7. Tug according to claim 1 or claim 2, wherein the tug controller unit further comprises a dynamic positioning control system controlling the approach of the tug based on a plurality of input parameters.

8. Tug according to claim 7, wherein the plurality of input parameters comprise at least one of
- distance between the contact area and the vessel,
- speed of approach of the tug towards the vessel,
- impact between the contact area and the vessel,
- surface traffic,
- meteorological data,
- environmental data,
- movement of the vessel,
- location of the vessel, and
- electronic navigational charts.

9. Tug according to claim 1, wherein the proximity sensor is one of a sonar, a radar, a lidar, a Doppler radar, an inductive proximity sensor and an ultrasonic sensor.

10. Tug for maneuvering a vessel, the tug comprising:
- at least one force sensor for measuring an amount of force being transmitted to the vessel, wherein the at least one force sensor is arranged in a contact area between the tug and the vessel,
- a propulsion controller for controlling a thrust, heading and speed of the tug, and
- a tug control unit for instructing the propulsion controller to change at least the amount of thrust based on the amount of force measured by the force sensor.

11. Tug according to claim 10, wherein the at least one force sensor is integrated in a tug fender.

12. Tug according to claim 10 or 11, wherein the at least one force sensor comprises an array of a plurality of force sensors.

13. Tug according to one of claims 10-12, wherein the controlling the amount of thrust is carried out autonomously by the tug controller unit.

14. Tug according to claim 10, wherein the tug controller unit further comprises a dynamic positioning control system controlling the amount of thrust provided by the tug on the vessel based on a plurality of input parameters.

15. Tug according to claim 14, wherein the plurality of input parameters comprise at least one of
- force being transmitted to the vessel,
- surface traffic,
- meteorological data,
- environmental data,
- movement of the vessel,
- location of the vessel, and
- electronic navigational charts.

16. Tug controller unit, wherein
- the tug controller unit is configured to receive data from at least one proximity sensor in a contact area between a tug and a vessel, the received data comprising information regarding a distance between the contact area and the vessel,
- the tug controller unit is further configured to receive data from at least one force sensor in the contact area between the tug and the vessel, the received data comprising information regarding an amount of force being transmitted to the vessel, and
- the tug controller unit is further configured to instruct a propulsion controller to change at least an amount of thrust based on the amount of force being transmitted to the vessel.

17. Tug controller unit according to claim 16, wherein the received data further comprises a speed of approach of the tug towards the vessel.

18. Tug controller unit according to claim 16 or 17, wherein the at least one force sensor comprises an array of a plurality of force sensors.

19. Tug controller unit according to any one of the claims 16 to 18, wherein the tug controller unit is configured to receive information of a speed and heading of the vessel from the vessel, and the tug controller unit is further controlling the approach of the tug towards the vessel based on the received information of the speed and heading of the vessel.

20. Tug controller unit according to claim 16, wherein instructing the amount of thrust is carried out autonomously by the tug controller unit.

21. Tug controller unit according to any of claims 16 – 20, wherein the tug controller unit further comprises a dynamic positioning control system controlling the amount of thrust provided by the tug on the vessel based on a plurality of input parameters.

22. Tug controller unit according to claim 21, wherein the plurality of input parameters comprise at least one of
- distance between the contact area and the vessel,
- speed of approach of the tug towards the vessel,
- impact between the contact area and the vessel,
- surface traffic,
- meteorological data,
- environmental data,
- movement of the vessel,
- location of the vessel, and
- electronic navigational charts.

23. Tug controller unit according to claim 16, wherein the proximity sensor is one of a sonar, a radar, a lidar, a Doppler radar, an inductive proximity sensor and an ultrasonic sensor.

24. Tug controller unit, wherein

- the tug controller unit is configured to receive data from at least one force sensor in a contact area between a tug and a marine vessel, the received data comprising information regarding an amount of force being transmitted to the marine vessel, and
- the tug control unit is further configured to instruct a propulsion controller to change at least an amount of thrust provided by the tug on the vessel based on the information regarding the amount of force being transmitted to the marine vessel.

25. Tug controller unit according to claim 24, wherein the at least one force sensor comprises an array of a plurality of force sensors.

26. Tug controller unit according to claim 24, wherein the controlling the amount of thrust is carried out autonomously by the tug controller unit.

27. Tug controller unit according to claim 25, wherein the tug controller unit further comprises a dynamic positioning control system controlling the amount of thrust provided by the tug on the vessel based on a plurality of input parameters.

28. Tug controller unit according to claim 26, wherein the plurality of input parameters comprise at least one of
- force being transmitted to the vessel,
- surface traffic,
- meteorological data,
- environmental data,
- movement of the vessel,
- location of the vessel, and
- electronic navigational charts.