

Maritime Vessel Stabilizer

Cross-Reference to Related Applications

[0001] The present application claims the benefit of U.S. provisional patent application 63/468,857, entitled “SEA TRUCK STABILIZERS,” filed on 25 May 2023, the entire disclosure of which is incorporated herein by reference.

Technical Field

[0002] The present disclosure generally relates to maritime vessels, and more particularly relates to stabilization systems for maritime vessels.

Background

[0003] Maritime vessels are, by nature, subject to the forces of nature, and particularly surface wave action, whether caused by currents, storms (far off or nearby), tides, etc. Such surface wave action can greatly impact the stability of the maritime vessels. For military maritime vessels, the lack of stability caused by surface wave action can present a number of challenges when employing defensive and/or offensive weapons. For example, the lack of stability may hamper the use of weapons completely, may require a greater amount of time to deploy the weapons, and may require more expensive weapons with more sophisticated navigation and targeting system to overcome the lack of stability in the maritime vessel.

Summary

[0004] According to an implementation, a stabilization system for a maritime vessel may include a stabilizer module including a stabilizer housing, and an extendable body. An extension feature may couple the extendable body with the stabilizer housing. The extension feature may be configured to allow movement of the extendable body between a first position adjacent to the stabilizer housing and a second position separated from the stabilizer housing below the maritime vessel. The stabilization module may include an actuator for moving the extendable body between the first position and the second position.

[0005] One or more of the following features may be included. The maritime vessel may include one or more of a sea truck, a barge, and a maritime platform. The

sea truck may include a bow module, a payload module, and a propulsion module. One or more of the bow module, payload module, and propulsion module may include a plurality ISO standard intermodal container three-faced twistlock connector features for coupling with at least another of the bow module, the payload module, and the propulsion module. The stabilization module may be one or more of integrated with and coupled to one or more of the bow module, the payload module, and the propulsion module. The payload module may include one or more of an ISO standard intermodal container and a support frame having ISO standard intermodal container dimensions.

[0006] The sea truck may include a first sea truck ensemble including a first bow module coupled with a first propulsion module, and a second sea truck ensemble including a second bow module couple with a second propulsion module. A central payload module may be coupled between the first sea truck ensemble and the second sea truck ensemble. The central payload module may be rotatable between a transit position generally parallel with the first sea truck ensemble and the second sea truck ensemble, and an active position angled relative to the first sea truck ensemble and the second sea truck ensemble. The stabilization module may be one of couple to and integrated with one or more of the first sea truck ensemble and the second sea truck ensemble.

[0007] The extension feature may be configured to transmit one or more of rotational and translational forces between the extendable body and the housing. The extension feature may include one or more of a scissor extension arrangement, and a telescoping arrangement. The extendable body may include one or more thrusters configured to provide dynamic stabilization of the maritime vessel.

[0008] The stabilization system may further include an extendible baffle configured to extend between at least a portion of the extendable body and at least a portion of the stabilizer housing when the extendable body is in the second position. The extendible baffle may at least partially surround the extension feature to define a captured mass of water between the stabilizer housing and the extendable body in the second position. The extendible baffle may have a cruciform configuration. The extendible baffle may have a lattice configuration. The extendible baffle may include one or more bypass flaps for controlling movement of water through the extendible baffle in at least one direction.

[0009] The stabilization system may also include a gyroscopic stabilizer. The

extendable body may include one or more power sources. The one or more power sources may be coupled for transmitting power to the maritime vessel.

[0010] According to another implementation, a stabilization system may include a sea truck including a bow module, a payload module having an ISO standard intermodal container form factor, and a propulsion module. The bow module may be coupled to a first end of the payload module and the propulsion module may be coupled to a second end of the payload module. The stabilization system may also include a stabilizer module including a stabilizer housing, an extendable body, and an extension feature coupling the extendable body with the stabilizer housing. The extension feature may be configured to allow movement of the extendable body between a first position adjacent to the stabilizer housing and a second position separated from the stabilizer housing below the maritime vessel. The stabilizer module may also include an actuator for moving the extendable body between the first position and the second position.

[0011] One or more of the following features may be included. The stabilizer module may be one or more of coupled to the sea truck and integrated with the payload module. The stabilization system may also include one or more thrusters associated with the extendable body and configured to provide dynamic stabilization of the sea truck. The stabilization system may also include an extendable baffle disposed between at least a portion of the stabilizer housing and the extendable body in the second position.

[0012] According to yet another implementation, a stabilization system may include a first sea truck ensemble including at least a first bow module and a first propulsion module, and a second sea truck ensemble including at least a second bow module and a second propulsion module. A payload module may be coupled between the first sea truck ensemble and the second sea truck ensemble. The payload module may be rotatable between a transit position generally parallel with the first sea truck ensemble and the second sea truck ensemble and an active position angled relative to the first sea truck ensemble and the second sea truck ensemble. A stabilizer module may be coupled to at least one of the first sea truck ensemble and the second sea truck ensemble. The stabilizer module may include a stabilizer housing, an extendable body, and an extension feature coupling the extendable body with the stabilizer housing. The extension feature may be configured to allow movement of the extendable body between a first position adjacent to the stabilizer housing and a

second position separated from the stabilizer housing below the maritime vessel. The stabilizer module may also include an actuator for moving the extendable body between the first position and the second position.

Brief Description of the Drawings

[0013] FIG. 1 is a schematic cross-section of a stabilization system in a non-deployed configuration, according to an example embodiment.

[0014] FIG. 2 diagrammatically depicts the stabilization system of FIG. 1 in a deployed configuration, according to an example embodiment.

[0015] FIGS. 3A and 3B schematically depict example extension features that may be used in connection with a stabilization system in some example embodiments.

[0016] FIG. 4 diagrammatically depicts an example sea truck configuration implementing a stabilization system, according to one example embodiment.

[0017] FIG. 5 diagrammatically depicts the example sea truck configuration of FIG. 4 with the stabilization system in a deployed configuration, according to one example embodiment.

[0018] FIG. 6 diagrammatically depicts the example sea truck configuration of FIG. 4 with the stabilization system in a deployed configuration, according to one example embodiment.

[0019] FIG. 7 diagrammatically depicts another example sea truck configuration implementing a stabilization system, according to one example embodiment.

[0020] FIG. 8 diagrammatically depicts the example sea truck configuration of FIG. 7 with the stabilization system, according to one example embodiment.

[0021] FIG. 9 diagrammatically depicts the example sea truck configuration of FIG. 7 with the stabilization system in a deployed configuration, according to one example embodiment.

[0022] FIG. 10 diagrammatically depicts another example sea truck configuration implementing a stabilization system, according to one example embodiment.

[0023] FIG. 11 diagrammatically depicts the example sea truck configuration of FIG. 10 with the stabilization system in a deployed configuration, according to one example embodiment.

[0024] Like reference symbols in the various drawings indicate like elements.

Detailed Description of the Example Embodiments

[0025] In general, some aspects of the present disclosure may relate to systems and methods for providing stabilization of maritime vessels. In some implementations, the present disclosure may utilize passive stabilization systems that may mitigate the effects of surface waves on a maritime vessel. For example, stabilization systems consistent with some aspects of the present disclosure may reduce rolling and/or pitching motions imparted on a maritime vessel by surface waves. For example, some embodiments consistent with the present disclosure may include systems that may allow a center of mass associated with the maritime vessel to be lowered relative to the center of buoyancy of the maritime vessel. As such, the effects of surface waves on the maritime vessel may be reduced, resulting in increased roll and/or pitch stability of the maritime vessel. Further, in some implementations, passive stabilization, as through the lowering of the center of mass relative to the center of buoyancy (and/or other passive stabilization) may be utilized in combination with various active stabilization systems and/or methods. For example, active stabilization systems and/or methods may include, but are not limited to, the use of dynamically controllable thrusters and/or gyroscopic stabilizing systems.

[0026] Consistent with some implementations of the present disclosure, increasing the stability of a maritime vessel may facilitate various maritime operations. For example, in conjunction with military operations, increased stability may facilitate the use of a maritime vessel as a weapons platform by increasing the accuracy of deployed weapons systems, and/or allowing the acceptable use of weapons systems requiring less expensive, less power intensive, and/or less complicated targeting systems, fire control systems, and/or launch systems. Further, in some implementations, increasing the stability of a maritime vessel may facilitate other operations, such as the use of electronic and/or visual surveillance or tracking systems. Still further, whether in military or civilian contexts, increasing the stability of a maritime vessel may facilitate, e.g., cargo handling (such as loading and unloading), performance of manual tasks on the maritime vessel, coordinated operations of multiple maritime vessels, as well as various additional and/or alternative tasks and/or operations.

[0027] Referring to FIGS. 1 and 2, an example stabilization system 100 consistent with one example embodiment is generally depicted. In some embodiments, the

stabilization system 100 for a maritime vessel may include a stabilizer module 102. The stabilizer module 102, may generally include a stabilizer housing 104, and an extendable body 106. An extension feature (e.g., extension features 108) may couple the extendable body 106 with the stabilizer housing 104. The extension feature 108 may be configured to allow movement of the extendable body 106 between a first position adjacent the stabilizer housing 104 (e.g., as generally shown in FIG. 1) and a second position separated from the stabilizer housing 104 (e.g., as generally shown in FIG. 2) below the maritime vessel. The stabilization module 102 may include an actuator (e.g., actuator 110) for moving the extendable body 106 between the first position and the second position.

[0028] With continued reference to the illustrated example embodiments, as generally discussed above, the stabilizer module 102 may include the stabilizer housing 104. Consistent with various embodiments, the stabilizer housing 104 may include a standalone feature that may be attached to the maritime vessel. Additionally/alternatively, in some embodiments the stabilizer housing 104 may be integrated into the maritime vessel. For example, in the example embodiment depicted in FIG. 1, the stabilizer housing 104 may be integrated with a cargo feature 112 of a maritime vessel. In the particular illustrated embodiment of FIG. 1, the stabilizer housing may be separated from the cargo feature 112 of the maritime vessel by a divider 114. In some embodiments, the divider 114 may provide a waterproof barrier between the stabilizer housing 102 and the cargo feature 112, although other embodiments may also be implemented (e.g., which may include the divider 114 and/or in which the divider 114 does not provide a watertight barrier). Consistent with some implementations, the stabilizer housing 104, alone and/or in combination with the cargo feature 112, may have an ISO standard intermodal container form factor. That is, for example, the stabilizing housing (alone and/or in combination with the cargo feature) may be sized according to an ISO standard intermodal container (e.g., a standardized shipping container).

[0029] As is generally known, the specifications may be set by the International Organization for Standardization (also known as the “ISO”). These ISO specifications may include standards for dimensions, forms, strength, water-tightness, mobility, and security. The size of such ISO standard intermodal containers is typically forty feet long, eight feet wide and eight feet six inches high (i.e., 40’x8’x8’-6”) and can weigh over thirty-four tons fully loaded with a capacity of over 2,720 cubic feet. Other ISO

standard containers can measure 20'x8'x8'-6", 45'x8'x8'-6", or 45'x8'x9'-6".

Additionally, in some example embodiments, the stabilizer housing may include a half-height form factor, e.g., in which the stabilizer housing may be half the height of an ISO standard container, with the remaining dimensions corresponding to an ISO standard container. In some such implementations, the cargo feature 112 may also be a half-height ISO standard form factor. In some such implementations, when the stabilizer housing is attached to and/or integrated with the cargo feature, the stabilizing housing and the cargo feature may together define an ISO standard container form factor. According to various implementations contemplated consistent with the present disclosure, the design, the overall lengths, widths and heights of the stabilizer housing and/or the cargo feature may vary to meet the operational task/components. Consistent with some implementations, the stabilizer housing and/or the cargo feature may include ISO standard three-face twistlock connectors (e.g., connectors 116). As is generally known, ISO standard twist lock connectors may be located at, at least, each corner of the ISO standard container form factor. As set forth by the ISO standard, the three-face twistlock connectors may allow connection to adjacent containers, components, and/or features at each of the three planes of the corner (e.g., an X-Y plane, an X-Z plane, and a Y-Z plane, representing each of the three faces of a container corner). In some implementations, the ISO standard twistlock connectors may be used to couple the stabilizer housing with the cargo feature, and/or may allow the stabilizer housing/cargo feature arrangement to be coupled with adjacent containers, modules, components, and/or features having cooperating ISO standard twistlock connectors. It should be noted that, herein, the reference to ISO standard twistlock connectors may include the three-faced casting for receiving a twistlock connector and/or may include the twistlock connector feature (e.g., which may be coupled to the three-faced casting). In addition to the standard ISO connectors located at each corner of the stabilizer housing, cargo feature, and/or combined stabilizer housing/cargo feature assembly or unit, additional ISO connectors may be located at other points on the stabilizer housing and/or cargo feature to facilitate connection with other components and/or modules.

[0030] Consistent with the present disclosure, the stabilizer module may include the extendable body 106 that may be coupled to the stabilizer housing 104 by an extension feature 108. Consistent with various embodiments, extension feature 108 may include a single extension feature and/or may include multiple extension

features. For example, as shown in FIG. 2, two extension features 108 may be implemented, e.g., at either end of stabilizer housing 104 and extendable body 106. Such an arrangement may facilitate uniform lowering and raising of the extendable body 106 relative to the stabilizer housing 104. It will be appreciated that additional extension features may be utilized.

[0031] As generally discussed above, the one or more extension features 108 may couple the extendable body 106 with the stabilizer housing 108. Additionally, the extension feature 108 may be configured to allow movement of the extendable body 106 between a first position adjacent the stabilizer housing (e.g., as shown in FIG. 1) and a second position separated from the stabilizer housing 104 below the maritime vessel. In some implementations, when the extendable body 106 is in the first position the extendable body may be positioned adjacent to the stabilizer housing 104 and/or may be partially and/or fully disposed within the stabilizer housing. For example, in some embodiments, the extendable body 106 may be completely disposed within the stabilizer housing in the first position, which may, e.g., reduce drag during transit of the maritime vessel. When the extendable body 106 is in the second position, separated from the stabilizer housing 104 below the maritime vessel, the extendable body may act to lower the center of mass of the stabilizer system 100 (and therein the center of mass of the maritime vessel) relative to the center of buoyancy of the maritime vessel. Accordingly, the extendable body may provide passive stabilization of the maritime vessel to mitigate the effects of surface waves on the stability of the maritime vessel. Consistent with some such embodiments, the roll and/or pitch stability of the maritime vessel may be improved.

[0032] The stabilization system 100 may further include one or more actuators (e.g., actuator 110) for moving the extendable body 106 between the first position and the second position. The configuration of the actuators 110 may vary depending upon the configuration of the extension feature 108 (as discussed in greater detail below), as well as other design criteria. For example, in some implementations consistent with the present disclosure, the actuator may include a jackscrew actuator, e.g., in which a screw, or other threaded feature, and a nut, or other feature interacting with the screw, may be rotated relative to one another to advance the nut along the axis of the screw. In the illustrated embodiment of FIG. 2, the actuator is shown associated with (e.g., coupled to and/or at least partially housed within) the extendable body 106. However, it will be appreciated that the actuator may additionally and/or alternatively be

associated with (e.g., coupled to and/or at least partially housed within) the stabilizer housing 104. In still further implementations, the actuator may at least partially extend between the stabilizer housing 104 and the extendable body 106. For example, a first component of the actuator may be associated with (e.g., coupled to and/or at least partially housed within) the stabilizer housing and at least a second component of the actuator may be associated with (e.g., coupled to and/or at least partially housed within) the extendable body. In still a further implementation, the actuator may be coupled with the extension feature itself. While the foregoing illustrative example references a jackscrew arrangement, it will be appreciated that various additional and/or alternative actuators may be implemented, including, but not limited to, a hydraulic piston actuator, a pneumatic actuator, a sector gear actuator, a linear motor, etc.

[0033] Consistent with some implementations of the present disclosure, the extension feature 108 may be configured to transmit one or more of rotational and translational forces between the extendable body 106 and the stabilizer housing 104. For example, as noted above, when the extendable body 106 is in the second position, the stabilizer body 106 may serve to lower the center of mass of the stabilizer system, and/or the maritime vessel as a whole, relative to the center of buoyancy of the maritime vessel, which may provide passive stabilization of the maritime vessel. Accordingly, in some implementations, the extension feature may provide an at least generally rigid connection between the extendable body 106 and the stabilizer housing. In some implementations, the extension feature 108 may include a scissor extension arrangement, as generally shown in FIG. 2. In such an implementation, the extension feature may include a plurality of pivoting features that may be expanded and contracted (e.g., by the actuator 110) to move the extendable body between the first position on the second position. It will be appreciated that the extension feature may include various additional and/or alternative configurations. For example, the extension feature may include a telescoping arrangement, as shown in FIG. 3A. As schematically depicted, the telescoping arrangement may include two or more tubular members 110a, 110b (and/or a tubular member and a complementary solid member) that may slide relative to one another, via any suitable actuator means (e.g., hydraulic piston, pneumatic piston, etc.). Consistent with some such implementations, the tubular members may have any suitable cross-sectional shape, including, but not limited to, circular, oval, square, rectangular, etc. Additionally, while the

implementation in FIG. 3A is shown including two extension features, it will be appreciated that a greater or fewer number of extension features may be utilized. Further, as generally shown in FIG. 3B, in another implementation the extension features may include a jackscrew, or similar arrangement. As shown, the extension features may include a first threaded feature (e.g., externally threaded feature 110c) and an interacting second threaded feature (e.g., internally threaded feature 110d). Consistent with such an implementation, the first and second threaded features may be rotated relative to each other to raise and lower the extendable body 106 relative to the stabilizer housing.

[0034] As generally described above, consistent with some embodiments, the extendable body 106 may be moved between the first position and the second position to provide passive stabilization of the maritime vessel (e.g., based upon, at least in part, lowering the center of mass relative to the center of buoyancy). Further, according to some implementations the stabilizer system may additionally and/or alternatively provide active stabilization for the maritime vessel. For example, according to one embodiment the extendable body 106 may include one or more thrusters 118 (e.g., as shown in FIG. 2). The one or more thrusters 118 may be configured to provide dynamic stabilization of the maritime vessel. Consistent with the illustrated example embodiment, the extendable body 106 may include both a longitudinal thruster and a lateral thruster at each corner. According to such an implementation, the various thrusters may be actuated to provide lateral thrust, longitudinal thrust, and combinations thereof. As such, the thrusters may be utilized for providing dynamic roll stabilization, dynamic pitch stabilization, and dynamic yaw stabilization, as well as providing maneuvering propulsion for the maritime vessel. Any suitable thrusters may be utilized, including, but not limited to, exposed props, ducted props, pumped water thrusters, pneumatic thrusters, etc. In some implementations, the position of the thrusters 118 on the extendable body may take advantage of the lever arm provided by the extension features (e.g., when the extendable body is in the second position) to provide enhanced thruster force (e.g., a relatively smaller thruster force acting through the lever arm of the extension feature may provide mechanical advantage for controlling movement of the maritime vessel about the center of buoyancy).

[0035] Consistent with some implementations, the stabilization system may also include a gyroscopic stabilizer. Examples of such gyroscopic stabilizers may include

the SeaKeeper™ available from Seakeeper Inc., as well as various similar commercially available gyroscopic stabilizers. As is known, gyroscopic stabilizers may typically function by converting rolling motion of a vessel into a more controllable pitch motion. Consistent with some implementations, the gyroscopic stabilizer may be disposed within the extendable body, within the stabilizer housing, and/or within the maritime vessel. Further, in some implementations, the stabilization system may provide dynamic stabilization for the maritime vessel, at least in part, by dynamically raising and lowering the extendable body. For example, the depth to which the extendable body is lowered in the second position may vary depending upon detected sea-state and/or detected motion of the maritime vessel. In addition to controlling the depth to which the extendable body is lowered, the depth of the extendable body may be adjusted to provide additional dynamic stabilization.

[0036] Additionally, in some embodiments the extendable body 106 may include one or more power sources 120. Examples of such power sources may include, but are not limited to, batteries, gasoline and/or diesel engines or generators, fuel cells, nuclear reactors, and the like. In some implementations, the one or more power sources may be coupled for transmitting power to the maritime vessel (e.g., to power one or more functions of the maritime vessel, such as propulsion systems, navigation systems, communication systems, armament systems, and the like). Additionally, in some implementations, the one or more power sources may be utilized, at least in part, for powering the actuator(s) for moving the extendable body between the first position and the second position (however, in other embodiments, the actuators may be powered by power sources associated with the maritime vessel). Consistent with various embodiments, the one or more power sources may be coupled for transmitting power to the maritime vessel via any suitable means, such as an extendable electrical cable, which may be configured to extend and contract with the extension feature and/or with the movement of the extendable body. It will be appreciated that various additional and/or alternative power connections may also be utilized.

[0037] In some implementations, one or more power sources may additionally serve to increase the mass of the extendable body. As generally discussed above, in some implementations, the stabilization system may provide passive stabilization for the maritime vessel by lowering the center of mass of the maritime vessel relative to the center of buoyancy. Accordingly, the greater the mass associated with the extendable body, the greater the center of mass can be lowered when the extendable

body is in the second position. Accordingly, housing, e.g., a battery bank, within the extendable body may increase the mass of the extendable body and achieve a greater lowering of the center of mass of the maritime vessel relative to the center of buoyance when the extendable body is in the second position. In addition/as an alternative to housing the power source within the extendable body, the extendable body may include various other ballast to aid in achieving the lowering of the center of mass of the maritime vessel relative to the center of buoyancy.

[0038] Consistent with the present disclosure, the stabilization system herein may be implemented in connection with various maritime vessels. For example, the maritime vessel may include one or more of a sea truck, a barge, a maritime vessel, and a maritime platform. Consistent with some implementations, a sea truck may include a modular maritime vessel, which may be rapidly assembled, configured, and/or repaired by virtue of the modular nature of the sea truck. A sea truck may be configured for a variety of civilian and/or military applications. For example, a sea truck may provide an economical platform for comparatively small volume cargo transport, easily configurable research platform, or the like. Additionally, a sea truck may be configured for various offensive and/or defensive military applications.

[0039] For example, consistent with some embodiments of the present disclosure, sea trucks may allow offensive or defensive missile systems to be transported, stowed, and launched from an extremely small vessel-ISO container sized. Further, in some embodiments, sea trucks may be utilized to deploy radars/radar jammers or other sensor arrays. Such applicants may greatly expand military capabilities in a dispersed, controlled, and very cost-effective manner. Additionally, through the use of remote command and control (e.g., which may include satellites and aircraft) deployed sea trucks can be monitored, controlled, and surveilled (for detecting adversary intervention forces/elements). In some implementations, this may allow an entire deployed “fleet” of stabilized sea trucks to respond to changing operations as a coordinated “swarm” in a highly effective manner. Examples of some of the capabilities that sea trucks may utilize may include, but are not limited to onboard missile(s), missile launcher(s), radar(s), laser gun(s), other direct/indirect high-energy gun(s)/weapon(s), torpedo launcher(s), manned/unmanned vehicles/vessels/platforms (air, surface, amphibious, ground and/or submerged), other existing or new defensive/offensive weapon(s), radar/laser jammers/deception devices, cyber/anti-cyber warfare system(s), radar/other decoys, satellite/tele-communication system(s),

reconnaissance/surveillance/intelligence system(s), and/or other apparatus that may or may not require elevation from the water surface for increased functioning.

[0040] Further, as generally suggested, sea trucks may be used individually and/or as a collective of sea trucks that may be launched from a ship, a water-based platform, and/or a shore-based platform. Control of the sea trucks (to include activation, launching, retrieval, partial/complete destruction, or sinking) may be pre-programmed, fully autonomous utilizing GPS, internal Inertia Navigation or “dead reckoning” and/or controlled by ship, aircraft, land station, or satellite.

[0041] Continuing with the foregoing, FIGS. 4 through 6 illustrate an example embodiment of a sea truck 200 implementing aspects of the current disclosure. Consistent with the illustrated example embodiment, sea truck 200 may generally include a bow module 202, a payload module 204, and a propulsion module 206. As generally described above, one or more of the bow module 202, payload module 204, and propulsion module 206 may include a plurality ISO standard intermodal container three-face twistlock connector features for coupling with at least another of the bow module, the payload module, and the propulsion module. For example, each of the bow module and the propulsion module may include an interface that may conform to end form factor of an ISO standard container. Further, in the illustrated example embodiment, the payload module 204 may be configured as a half-height ISO standard container form factor. Additionally, the stabilizer housing 104 may also be configured as a half-height ISO standard container form factor. As such, with the payload module 204 stacked on the stabilizer housing 104 the combination may provide an ISO standard full-height container form factor, which may be coupled to each of the bow module 202 and the propulsion module 206. As discussed above, in some implementations, rather than being stacked on top of each other (e.g., which may also include coupling via ISO standard twistlocks), the payload module 204 and the stabilizer housing 104 may be integrated as a single structure (e.g., which may, in some embodiments, include a divider therebetween, e.g., to maintain the payload module in a watertight configuration).

[0042] Consistent with some implementations, the bow module 202 may serve multiple purposes. For example, the bow module 202 may provide streamlining for the sea truck, increasing speed and range capabilities, and may also provide forward buoyancy to allow the sea truck to maintain an even keel in the water. In some embodiments of the design, the bow module may provide a forward mounting for

potential radar and anti-collision lighting, and/or may provide a mounting for forward athwartship thrusters for increased heading control powered by an internal battery pack or other power source(s).

[0043] Consistent with some implementations, the propulsion module 206 may include a propulsion unit and controller subsystem (with associated propulsion system having steering capability). The propulsion system may be powered by a selection of stored energy systems, which may include, but are not limited to, gasoline, diesel, battery, hydrogen, fuel cell, other chemical, or even nuclear energy. The propulsion system may be fabricated for efficiency (streamlined), and agility (responsive to autonomous steering inputs integrating propulsors/propellers with thrusters to control the sea truck) having associated navigation systems, antenna, navigation lighting, communication systems and processors/software to support control commands, inventory specifics and stored/communicated commands to support the operations intended for payload module and/or any equipment associated therewith. Consistent with some embodiments, the sea truck 200 may be capable of operating individually or swarming together with other sea trucks or other maritime vessels/vehicles as a fleet or squadron. Further consistent with various embodiments, the sea truck 200 may be manned, unmanned but remotely controlled, semi-autonomous, and/or fully autonomous. Further, consistent with various embodiments, the sea truck (and/or one or more portions thereof, including, but not limited to, the bow module, the payload module, and the propulsion module) may include the addition of Radar Absorbent Materials (RAM) of the top and sides of the sea truck and/or the ability of adjusting the “freeboard” above the water surface, which may enhance the covert deployment and use of the sea truck.

[0044] Consistent with some embodiments, and as generally depicted in FIGS. 4 through 6, the payload module 204 may include a half-height ISO standard container, which may house a fully encapsulated, deployable missile launcher assembly 208. This payload module 204 may further connect to the stabilizer housing 104 of the stabilization module, as well as the sea truck bow module 202 and stern propulsion module 206. The configuration shown in FIG. 4 depicts an example sea truck 200 in a navigation state, wherein the extendable body 106 is retracted and thereby contained fully within the bounds of the stabilizer housing 104. This state for the sea truck may be held throughout the duration of transit to its desired launch location. Once that location has been reached and launch is desired, the sea truck may, as a first step

towards enhancing stability, utilize the bow module 202 and propulsion module 206 to maneuver the sea truck into the waves. By placing the sea truck either bow-on or stern-on to the waves, the ship would “cut” through wave crests and lower the impulses transmitted to the hull of the sea truck while maintaining that location on the surface of the sea. This orientation may be maintained through the remainder of the launch process. The integrated thrusters 118 may be utilized to assist in maintaining an optimal orientation. FIGS. 5 and 6 depict the sea truck 200 in a launch state of the system, wherein the extendable body 106 has emerged (e.g., been moved to the second position away from the stabilizer housing) and the missile launcher component 208 has been deployed by way of an actuation mechanism 210. This missile elevation may act to clear the missile launch trajectory above the hull of the sea truck and would itself provide active pitch control of the launch tube to further stabilize the missile(s) within elevated sea states. The embodiment shown within FIGS. 5 and 6 may utilize a hydraulic actuator, but alternative embodiments could realize a combination of actuation schemes. For instance, one actuator could be used to provide the majority of the lifting motion of the extendable body 106, while another, faster method could be used to exert higher control over the instantaneous state of the sea truck by making adjustments to the depth of the extendable body 106. According to various embodiments, the systems could be powered by way of a separate on-board power system or by routing the stabilization module power from the batteries 120 within the extendable body 106 back to the payload container for increased powered levels or increased activation time.

[0045] Referring also to FIGS. 7 through 9, according to another implementation, a sea truck 300 may include a combination of sea truck ensembles. Consistent with the illustrated example embodiment, the sea truck 300 may include a first sea truck ensemble including a first bow module 202 coupled with a first propulsion module 206, and a second sea truck ensemble including a second bow module 202 couple with a second propulsion module 206. Consistent with the illustrated example embodiment, the first bow module may be coupled to the first propulsion module via a first stabilizer housing 104, and the second bow module may be coupled to the second propulsion module via a second stabilizer housing. Consistent with some embodiments, one of the first stabilizer housing and the second stabilizer housing may be replaced with an ISO standard container (e.g., which may have a similar length as the stabilizer housing).

[0046] With continued reference to FIGS. 7 through 9, according to an example embodiment, a central payload module 302 may be coupled between the first sea truck ensemble and the second sea truck ensemble. Further, the central payload module 302 may be rotatable between a transit position generally parallel with the first sea truck ensemble and the second sea truck ensemble (e.g., as generally depicted in FIGS. 7 and 8), and an active position angled relative to the first sea truck ensemble and the second sea truck ensemble (e.g., as shown in FIG. 9). Consistent with some implementations, the central payload module 302, and/or one or more of the stabilizer housings 104, may include a pivot 306 configured to enable the central payload module 302 to rotate between the transit position and the active position.

[0047] Consistent with some implementations of the example embodiment depicted in FIGS. 7 through 9, the sea truck 300 may harness two or more Sea Truck units, each of which is driven by separate propulsion modules 206. In some embodiments, the propulsion modules 206 may be connected to the respective bow module 202 through the stabilizer housings 104. The central module 302 may incorporate a larger missile launcher unit configured to elevate the missile(s) for launch. In some embodiments, the sea truck may include pivot 306 (e.g., such as a large robust rotating hinge component) that may connect to a central payload module 302. The hinge component may be integral to the center missile tube with one side permanently attached to the missile tube and the other side of the hinge attached to an interface bracket. The interface bracket may be sized and equipped with ISO connectors at the corners thereof to allow attachment to an ISO container (e.g., on either and/or both sides of the missile tube). The pivot 306 may include a variety of mechanisms and/or arrangements that may enable sufficient rotation of the central payload module 302 to support a missile launch. Examples of such pivots may include, but are not limited to, ball joints, robust axles, gear boxes/joints, or other rigid hinges. The central payload module 302 may not be limited in size, which may permit higher payload flexibility. In this illustrated example embodiment, the central payload module 302 houses a missile launcher assembly 308, which may be sealed off by a pivoting bow module 304, e.g., which may prevent water from damaging the components of the missile launcher assembly and/or missiles therein during navigation and serves to streamline the sea truck 300. Consistent with some embodiments, the sea truck 300 may be configured to jettison or explosively remove the pivoting bow module 304 (e.g., to permit launching of missiles from the missile

launcher assembly 308). The pivoting nature of the center payload module may create fewer size restrictions for the launcher assembly 308 and may further enable the capability for vertical launches, which have a variety of benefits over the angled launches, as may be implemented in other design embodiments. For instance, angled launches may necessitate the addition of thermal shielding/ablative coating to prevent launch-induced damage to its container during launch. Alternatively, if thermal shielding is not implemented, the missile may burn through the hull of its housing, and a deployable air bag may be required to patch the hull/provide sufficient buoyancy to allow for further transiting. In the case of vertical launch, any launches conducted from within the central payload module 302 may have the rear end of the missile container submerged underwater, which could mitigate launch-induced damage to the rest of the Sea Truck system.

[0048] Consistent with the illustrated example embodiment, and as described above, during transit the extendable body 106 of the stabilization system may be in the first position (e.g., including fully and/or partially contained within the stabilizer housing 104), as shown in FIG. 7. This state for the sea truck may be held throughout the duration of transit to its desired launch location. Once that location has been reached and launch is desired, the sea truck may, as a first step towards enhancing stability, utilize the bow modules 202 and propulsion modules 206 to maneuver the sea truck into the waves. By placing the sea truck either bow-on or stern-on to the waves, the ship would “cut” through wave crests and lower the impulses transmitted to the hull of the sea truck while maintaining that location on the surface of the sea. This orientation may be maintained through the remainder of the launch process. The integrated thrusters 118 may be utilized to assist in maintaining an optimal orientation. FIG. 9 depicts the sea truck 300 in a launch state of the system, wherein the extendable body 106 has emerged (e.g., been moved to the second position away from the stabilizer housing) and the central payload module 302 may be rotated to an angled orientation relative to the first and second sea truck ensembles (e.g., to a vertical position in the depicted embodiment, however other angled orientations may also be utilized). Further, the pivoting bow module 304 may be pivoted (and/or jettisoned or otherwise removed) to expose the missile launcher component 308 for launching one or more missiles.

[0049] Referring also to FIGS. 10 and 11, another illustrative example embodiment of a sea truck 400 is shown. Consistent with the depicted example

embodiment, stabilization housing 104 may be connected to a central payload module 402, which may not be restricted in size and thereby can house a diverse array of payloads. Similar to previous embodiments, the central payload module 402 may include an ISO standard container form factor, and/or may include a differently sized payload module. Consistent with the illustrated embodiment, each of the central payload module 402 and the stabilizer housing 104 may include bow modules 404, e.g., which increase the maneuverability of the sea truck 400 during navigation. Because the container size of the central payload module 402 may not be restricted, a missile launcher 406 included with the central payload module 402 may have fewer imposed restrictions as well, which may increase the versatility of the system. In the illustrated example embodiment, the central payload module 402 may be connected (directly, as depicted, and/or indirectly, as will be appreciated) to adjacent bow modules 202 and propulsion modules 206, which may be offset from the plane of deployment of the launcher 406. Consistent with such an implementation, the configuration may mitigate some and/or all launch-induced damage to the propulsion components while still ensuring maximal degrees of maneuverability. To ensure the stability of the system during launches, this configuration utilizes a bottom mount for the stabilizer housing **104**, which may still provide the benefits of the expendable body 104, as discussed previously. To maintain the stability of the sea truck 400, the stabilizer housing 104 may, in some implementations, be flooded with water at all times.

[0050] Consistent with the present disclosure, in some implementations the stabilization system may further include an extendible baffle configured to extend between at least a portion of the extendable body and at least a portion of the stabilizer housing when the extendable body is in the second position. Consistent with some such implementations, the extendible baffle may form a water blocking/drag inducing structure, e.g., which may aid in mitigating the effects of surface waves on the stabilization system and/or a marine vessel utilizing the stabilization system. For example, the passive stabilization torque provided by the extendable body 106 may be enhanced further by introducing the baffle around and/or within the extension features, and adding water drag to mitigate and/or control induced displacements from a vertical orientation.

[0051] Consistent with the present disclosure, the extendible baffle may be implemented having a variety of configurations. For example, as generally depicted in

the example embodiment of FIGS. 5 and 6, the extendible baffle 212a may at least partially surround the extension feature 108. Consistent with such an implementation the baffle 212a may provide a generally uniform structure surrounding the extension features and extending between the stabilizer housing 104 and the extendable body 106. Further, in some implementations, the extendible baffle 212a may define a captured mass of water between the stabilizer housing and the extendable body in the second position. This captured mass of water may further aid in stabilizing the marine vessel and mitigating the effects of surface waves.

[0052] According to another implementation, e.g., as generally depicted in FIG. 9, the extendible baffle 212b may have a cruciform configuration. For example, the cruciform configured baffle 212b may be disposed between the extension features and may facilitate extension and retraction of the extendible baffle 212b. Still further, in some implementations, as depicted in FIG. 11, the extendible baffle 212c may have a lattice configuration. In some implementations, the lattice configuration of the extendible baffle 212c may surround the extension features, and/or may otherwise be disposed between the extendable body 106 and the stabilizer housing 104 when the extendable body is in the second position. It will be appreciated that while specific example extendible baffles have been illustrated in connection with specific sea truck and/or stabilizer system configurations, this is simply for the purpose of illustrating the various example sea truck configurations, stabilizer system configurations, and extendible baffle configuration. It will be appreciated that any of the extendible baffle configurations (as well as various additional and/or alternative extendible baffle configurations) may be utilized in connection with any of the sea truck configurations and/or any of the stabilizer system configurations. Additionally, consistent with some implementations, the extendible baffle may include one or more bypass flaps for controlling movement of water through the extendible baffle in at least one direction. For example, the bypass flaps may be passively or actively controlled to increase resistance in a selected direction (e.g., by opening or closing the flaps to allow or prevent/control water movement through the extendible baffle).

[0053] Consistent with the foregoing, in some embodiments, a stabilization system may include a sea truck including a bow module, a payload module having an ISO standard intermodal container form factor, and a propulsion module. The bow module may be coupled to a first end of the payload module and the propulsion module may be coupled to a second end of the payload module. The stabilization

system may also include a stabilizer module including a stabilizer housing, an extendable body, and an extension feature coupling the extendable body with the stabilizer housing. The extension feature may be configured to allow movement of the extendable body between a first position adjacent the stabilizer housing (including being partially and/or fully disposed within the stabilizer housing) and a second position separated from the stabilizer housing below the maritime vessel. In the second position, the stabilization system may provide stabilization of the sea truck, e.g., by lowering a center of mass relative to a center of buoyancy of the sea truck. Such a configuration may enhance pitch and/or roll stability of the entire sea truck. The stabilizer module may also include an actuator for moving the extendable body between the first position and the second position.

[0054] Consistent with some implementations, the stabilizer module may be one or more of coupled to the sea truck and integrated with the payload module. The stabilization system may also include one or more thrusters associated with the extendable body and configured to provide dynamic stabilization of the sea truck. The stabilization system may also include an extendable baffle disposed between at least a portion of the stabilizer housing and the extendable body in the second position.

[0055] Consistent with yet another implementation, a stabilization system may include a first sea truck ensemble including at least a first bow module and a first propulsion module, and a second sea truck ensemble including at least a second bow module and a second propulsion module. A payload module may be coupled between the first sea truck ensemble and the second sea truck ensemble. The payload module may be rotatable between a transit position generally parallel with the first sea truck ensemble and the second sea truck ensemble and an active position angled relative to the first sea truck ensemble and the second sea truck ensemble. A stabilizer module may be coupled to at least one of the first sea truck ensemble and the second sea truck ensemble. The stabilizer module may include a stabilizer housing, an extendable body, and an extension feature coupling the extendable body with the stabilizer housing. The extension feature may be configured to allow movement of the extendable body between a first position adjacent the stabilizer housing and a second position separated from the stabilizer housing below the maritime vessel. The stabilizer module may also include an actuator for moving the extendable body between the first position and the second position.

[0056] Consistent with some implementations of the present disclosure, a

stabilization system may be provided for mitigating the effects of surface waves on the stability of marine vessels through passive means. This enhanced stability may demand lower control performance from, e.g., a missile being launched from the marine vessel, which in turn may reduce the cost of the design, increase range by reducing the energy input for initial stabilization, and/or increase operational availability through a greater successful launch rate during elevated sea states.

[0057] Consistent with some embodiments, the stabilization system may include an extendable body that may be extended from a maritime vessel. In some implementations, the extendable body may contain sufficient weight to serve as a counterbalance against the effects of surface waves on the maritime vessel, which may be attainable through attachment of devices like batteries, ballasting, and/or external/internal weighting, which may be contained within the extendable body to allow it to be retracted fully and/or partially within a stabilizer housing. In some embodiments, through this extension of the extendable body, the stabilization module may act to lower the center of mass beneath and/or relative to the center of buoyancy of the maritime vessel, thereby enhancing pitch and roll stability of the entire maritime vessel in a stabilization configuration.

[0058] Consistent with some implementations, additional modes of providing stability may be integrated in tandem with the extendable body. One method is the addition of active powered thrusters that may be included with the extendable body. For example, there may be at least one thruster on each side of the extendable body to provide 360-degree stabilization capability by coordinating power to each of the thrusters individually. Additional thrusters (e.g., one at each fore and aft end of the port and starboard sides) may allow enhanced control of yaw forces. The inclusion of thrusters may provide dynamic stabilization in all directions, and the amount and direction of thrust may be controlled by one or more missile launch components to match the degree of stability required by the specific missile(s) being launched.

[0059] As discussed above, consistent with some embodiments, the present disclosure may provide a means to maintain the necessary stability to conduct a remote missile launch through a sea truck system. This launch modality may provide numerous cost benefits over a conventional launch system that requires a ship and crew. In some implementations, the systems may also be unmanned, and due to the reduced cost and size of the sea trucks, they may provide the capability for dispersed, yet coordinated and concentrated launches. In some embodiments, the sea truck

systems may provide the capability to navigate close to shore to reduce engagement time and/or may operate far from shore to extend Area Denial coverage. Further, in some implementations, sea truck systems may demonstrate swarm-like behavior that may enable individual or group maneuvering and targeting; and may significantly increase the difficulty of countering the launch efforts.

[0060] A number of implementations have been described. Having thus described the disclosure of the present application in detail and by reference to embodiments thereof, it will be apparent that modifications and variations are possible without departing from the scope of the disclosure defined in the appended claims.

What is claimed is:

1. A stabilization system for a maritime vessel comprising:
a stabilizer module including:
a stabilizer housing;
an extendable body;
an extension feature coupling the extendable body with the stabilizer housing, the extension feature configured to allow movement of the extendable body between a first position adjacent the stabilizer housing and a second position separated from the stabilizer housing below the maritime vessel; and
an actuator for moving the extendable body between the first position and the second position.
2. The stabilization system according to claim 1, wherein the maritime vessel comprises one of more of:
a sea truck;
a barge; and
a maritime platform.
3. The stabilization system according to claim 2, wherein the sea truck comprises:
a bow module;
a payload module; and
a propulsion module;
wherein one or more of the bow module, payload module, and propulsion module includes a plurality ISO standard intermodal container three-face twistlock connector features for coupling with at least another of the bow module, the payload module, and the propulsion module.
4. The stabilization system according to claim 3, wherein the stabilization module is one or more of integrated with and coupled to one or more of the bow module, the payload module, and the propulsion module.

5. The stabilization system according to claim 3, wherein the payload module comprises one or more of:
- an ISO standard intermodal container; and
 - a support frame having ISO standard intermodal container dimensions.
6. The stabilization system according to claim 3, wherein the sea truck comprises:
- a first sea truck ensemble comprising a first bow module coupled with a first propulsion module;
 - a second sea truck ensemble comprising a second bow module couple with a second propulsion module; and
 - a central payload module coupled between the first sea truck ensemble and the second sea truck ensemble, the central payload module being rotatable between a transit position generally parallel with the first sea truck ensemble and the second sea truck ensemble, and an active position angled relative to the first sea truck ensemble and the second sea truck ensemble;
- wherein the stabilization module is one of couple to and integrated with one or more of the first sea truck ensemble and the second sea truck ensemble.
7. The stabilization system according to claim 1, wherein the extension feature is configured to transmit one or more of rotational and translational forces between the extendable body and the housing.
8. The stabilization system according to claim 7, wherein the extension feature includes one or more of:
- a scissor extension arrangement; and
 - a telescoping arrangement.
9. The stabilization system according to claim 1, wherein the extendable body includes one or more thrusters configured to provide dynamic stabilization of the maritime vessel.

10. The stabilization system according to claim 1, further comprising:
an extendible baffle configured to extend between at least a portion of the extendable body and at least a portion of the stabilizer housing when the extendable body is in the second position.
11. The stabilization system according to claim 10, wherein the extendible baffle at least partially surrounds the extension feature to define a captured mass of water between the stabilizer housing and the extendable body in the second position.
12. The stabilization system according to claim 10, wherein the extendible baffle has a cruciform configuration.
13. The stabilization system according to claim 10, wherein the extendible baffle has a lattice configuration.
14. The stabilization system according to claim 10, wherein the extendible baffle includes one or more bypass flaps for controlling movement of water through the extendible baffle in at least one direction.
15. The stabilization system according to claim 1, further comprising:
a gyroscopic stabilizer.
16. The stabilization system according to claim 1, wherein the extendable body includes one or more power sources, and wherein the one or more power sources are coupled for transmitting power to the maritime vessel.
17. A stabilization system comprising:
a sea truck comprising:
a bow module;
a payload module having an ISO standard intermodal container form factor; and
a propulsion module, wherein the bow module is coupled to a first end of the payload module and the propulsion module is coupled to a second end of the payload module;

a stabilizer module including:
a stabilizer housing;
an extendable body;
an extension feature coupling the extendable body with the stabilizer housing, the extension feature configured to allow movement of the extendable body between a first position adjacent the stabilizer housing and a second position separated from the stabilizer housing below the maritime vessel; and
an actuator for moving the extendable body between the first position and the second position.

18. The stabilization system according to claim 17, wherein the stabilizer module is one or more of:
coupled to the sea truck; and
integrated with the payload module.

19. The stabilization system according to claim 17, further comprising:
one or more thrusters associated with the extendable body and configured to provide dynamic stabilization of the sea truck; and
an extendable baffle disposed between at least a portion of the stabilizer housing and the extendable body in the second position.

20. A stabilization system comprising:
a first sea truck ensemble including at least a first bow module and a first propulsion module;
a second sea truck ensemble including at least a second bow module and a second propulsion module;
a payload module coupled between the first sea truck ensemble and the second sea truck ensemble, the payload module being rotatable between a transit position generally parallel with the first sea truck ensemble and the second sea truck ensemble and an active position angled relative to the first sea truck ensemble and the second sea truck ensemble; and
a stabilizer module coupled to at least one of the first sea truck ensemble and the second sea truck ensemble, the stabilizer module including:

a stabilizer housing;
an extendable body;
an extension feature coupling the extendable body with the stabilizer housing, the extension feature configured to allow movement of the extendable body between a first position adjacent the stabilizer housing and a second position separated from the stabilizer housing below the maritime vessel; and
an actuator for moving the extendable body between the first position and the second position.