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Tool-less Modular Payload Bay for a Transmedium Drone Accepting Interchangeable Flotation, Sampling, and Authority-Limited Tow Modules

Marginal · 63.9/100

12 claims

TECHNICAL FIELD

Interchangeable payload systems for transmedium unmanned vehicles, with module identification and safety-scoped operating envelopes.

ABSTRACT

A tool-less modular payload bay for a transmedium drone receives interchangeable mission modules through a keyed mechanical interface and an electrical and data connector, without hand tools. An identification feature reports the inserted module to a flight controller, which loads a corresponding operating envelope. Disclosed modules include a search-and-rescue flotation-aid dispenser that releases a buoyant aid to a person in the water, a sampling and baited-line servo-reel module for aquaculture support and small-catch sampling, and a tow-line or net module. The tow-line or net module is constrained in the claims so that it is enabled only for engagement with unoccupied craft or objects, or with craft for which an explicit authority clearance has been received, and is inhibited for occupied or crewed craft. The controller enforces these limits as a function of the identified module and an authority-clearance input, so that the safety and legal boundary on towing is encoded in the system rather than left to operator discretion.

BACKGROUND

A transmedium drone is more useful if a single airframe can carry different payloads for flotation delivery, environmental and aquaculture sampling, or light line and net handling. Modular payload bays and quick-release payloads are known on drones generally, often using rails, latches, or magnetic mounts and a data connector. However, known modular bays do not combine a tool-less keyed interface with automatic module identification that loads a module-specific operating envelope, and crucially they do not encode legal and safety constraints into the payload control for sensitive functions such as towing. A tow-line or net function is hazardous and legally sensitive: towing or snaring an occupied or crewed craft can endanger life and breach maritime law. Leaving such a limit to operator discretion is unsafe. There remains a need for a tool-less modular payload bay whose controller recognises the inserted module, applies a module-specific operating envelope, and for a tow-line or net module enforces in the system itself that engagement is permitted only for unoccupied craft or objects, or for craft expressly cleared by a competent authority, and is inhibited otherwise.

SUMMARY OF THE INVENTION

The invention provides a tool-less modular payload bay and a control method that encode safety limits per module. The bay receives interchangeable modules through a keyed mechanical interface and a blind-mate electrical and data connector that can be engaged and released by hand. A module identification feature, such as a resistor key, a memory device, or a digital identifier, reports the inserted module to a flight controller, which loads a corresponding operating envelope and user interface. A flotation-aid dispenser module, a sampling and baited-line servo-reel module, and a tow-line or net module are disclosed. For the tow-line or net module, the controller enables tow or net engagement only when an occupancy condition indicates an unoccupied craft or object, or when an explicit authority-clearance input has been received for the target, and otherwise inhibits engagement. The legal and safety boundary on towing crewed craft is thereby enforced by the system, improving safety and supporting lawful operation.

DETAILED DESCRIPTION

FIG. 1 is a perspective view of the transmedium drone with a tool-less payload bay (60) and an interchangeable module (62). FIG. 2 is a section view of the keyed mechanical interface (64) and a blind-mate electrical and data connector (66). FIG. 3 shows a flotation-aid dispenser module (62a). FIG. 4 shows a sampling and baited-line servo-reel module (62b). FIG. 5 shows a tow-line or net module (62c). FIG. 6 is a block diagram of module identification (68) and a flight controller (70). FIG. 7 is a flowchart of the module-keyed operating-envelope and tow-authorisation logic. Referring to FIG. 1 and FIG. 2, the module (62) is inserted into the bay (60) and retained by the keyed mechanical interface (64), which is shaped so that only correctly oriented modules seat, and is secured by a hand-operated latch requiring no tools. The blind-mate connector (66) carries power and data and engages as the module seats. The identification feature (68) may be a coding resistor, a one-wire memory, or a digital identifier read over the data connector. Referring to FIG. 3 to FIG. 5, the flotation-aid dispenser module (62a) holds one or more buoyant aids and a release mechanism to drop an aid near a person in the water during search and rescue support. The sampling and baited-line servo-reel module (62b) carries a servo-driven reel with a line and optional bait or sampler for aquaculture support and small-catch or water-sample collection, paying out and retrieving the line under controller command. The tow-line or net module (62c) carries a line or net and an actuated coupling for towing or capturing an object on or in the water. Referring to FIG. 6 and FIG. 7, on insertion the controller (70) reads the identification feature (68) and loads the module-specific operating envelope, control interface, and limits. For the tow-line or net module (62c) the controller applies a gating rule: tow or net engagement is permitted only when an occupancy assessment indicates the target is an unoccupied craft or object, or when an authority-clearance input for the specific target has been received from a competent authority; otherwise engagement is inhibited and the operator is prevented from commanding a tow of an occupied or crewed craft. The occupancy assessment may use onboard sensing, operator confirmation, or an authority data feed. In an embodiment the controller logs the authorisation basis for each tow engagement.

DRAWINGS

FIG. 1 is a perspective view of the transmedium drone with the tool-less payload bay and an interchangeable module; FIG. 2 is a section view of the keyed mechanical interface and blind-mate connector; FIG. 3 shows the flotation-aid dispenser module; FIG. 4 shows the sampling and baited-line servo-reel module; FIG. 5 shows the tow-line or net module; FIG. 6 is a block diagram of module identification and the flight controller; FIG. 7 is a flowchart of the module-keyed operating-envelope and tow-authorisation logic.

CLAIMS

1. A method of operating a transmedium unmanned vehicle having a tool-less modular payload bay, the method comprising: receiving an interchangeable module in the payload bay through a keyed mechanical interface and a data connector engageable by hand; identifying the received module by an identification feature and loading a corresponding operating envelope at a controller; and where the identified module is a tow-line or net module, enabling a tow or net engagement only when one of an occupancy condition indicating an unoccupied craft or object is satisfied and an authority-clearance input for a target is received, and otherwise inhibiting the tow or net engagement.
2. A modular payload system for a transmedium unmanned vehicle, the system comprising: a tool-less payload bay having a keyed mechanical interface and a hand-engageable electrical and data connector; a set of interchangeable modules including a flotation-aid dispenser module, a sampling and baited-line servo-reel module, and a tow-line or net module; a module identification feature; and a controller configured to load a module-specific operating envelope upon identifying an inserted module and, for the tow-line or net module, to enable a tow or net engagement only for an unoccupied craft or object or upon an authority-clearance input and to inhibit the engagement otherwise.
3. The method of claim 1, wherein the identification feature comprises one of a coding resistor, a one-wire memory device, and a digital identifier read over the data connector.
4. The method of claim 1, wherein the flotation-aid dispenser module releases a buoyant aid toward a person in the water during a search-and-rescue support task.
5. The method of claim 1, wherein the sampling and baited-line servo-reel module pays out and retrieves a line under controller command for at least one of aquaculture support, small-catch sampling, and water sampling.
6. The method of claim 1, wherein the occupancy condition is assessed from at least one of onboard sensing, an operator confirmation, and an authority data feed.
7. The method of claim 1, further comprising logging an authorisation basis for each tow or net engagement performed by the tow-line or net module.

8. The method of claim 1, wherein inhibiting the tow or net engagement comprises preventing an operator command to tow a craft assessed or indicated to be occupied or crewed.
9. The system of claim 2, wherein the keyed mechanical interface admits only a correctly oriented module and is secured by a hand-operated latch requiring no tools.
10. The system of claim 2, wherein the controller is configured to load, with the module-specific operating envelope, a corresponding operator control interface for the identified module.
11. The system of claim 2, wherein for the tow-line or net module the controller is configured to require an authority-clearance input bound to a specific target before enabling the tow or net engagement.
12. The system of claim 2, wherein the controller is configured to record, for each tow or net engagement, the occupancy assessment or authority-clearance input on which the engagement was permitted.

PATENTABILITY SELF-ASSESSMENT (30-FACTOR)

Patentability	72.0%
Prior-art position	52.0%
Technical merit	64.0%
Commercial	62.0%
Composite genius score	63.9/100 (Marginal)

FILING ROUTES

United Kingdom (UK IPO)

GB national application at UK IPO with combined search and examination; the tow-authorisation interlock is the distinguishing feature and should anchor the independent claims over generic modular-bay art.

Ireland (IPOI / Irish PATO)

IE 10-year short-term patent suits the incremental modular subject matter; consider EPO or PCT only for the authority-gated tow interlock if it searches cleanly.

PRIOR-ART VERIFICATION (LIVE SEARCHES)

UK IPO patent search (Ipsu)

UK national register and file inspection
<https://www.search-for-intellectual-property.service.gov.uk/SearchByNumber>

Espacenet (EPO)

European/worldwide prior-art search
<https://worldwide.espacenet.com/patent/search?q=toolless%20modular%20payload%20bay%20drone%20l>

Google Patents

Full-text + family view
[https://patents.google.com/?q=\(toolless%20modular%20payload%20bay%20drone%20UAV%20transmedium\)&type=PATENT](https://patents.google.com/?q=(toolless%20modular%20payload%20bay%20drone%20UAV%20transmedium)&type=PATENT)

IPOI (Irish Patents Office)

Irish national filing route (short-term + full-term)
<https://www.ipoi.gov.ie/en/types-of-ip/patents/>

EPO CPC B64U (UAS)

Unmanned-aircraft classification
<https://worldwide.espacenet.com/patent/search?q=cpc%3DB64U>

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