# UNMANNED UNDERWATER VEHICLE HAVING MONOCOQUE BODY

## CROSS-REFERENCES TO RELATED APPLICATIONS

**[0001]** This application claims the benefit of priority to U.S. Patent Application No. 17/589,055, filed on January 31, 2022, the entire contents of which are herein incorporated by reference.

## FIELD

**[0002]** The present disclosure generally relates to unmanned underwater or submersible vehicles.

## BACKGROUND

**[0003]** Unmanned underwater vehicle ("UUV") have many useful applications in a variety of industries to explore underwater areas, collect data, conduct inspections, monitor specific underwater zones, etc. For example, UUV's can be used to conduct underwater explorations for mining or oil drilling, inspect underwater cables, monitor areas for national defense purposes, and collect data in previously unexplored areas, all without the need for a human driver present on the vehicle. Known UUVs have deficiencies or can be benefit from improvements to their performance. For example, conventional UUV's may not be suitable for deep underwater missions that can cause UUV's to experience high pressures and other adverse conditions. Such missions can require a strong but light UUV. Conventional heavy UUV's can be limited in the amount of payload they can carry, which may limit the types and lengths of missions that they can conduct. It is therefore desirable to have a stronger and lighter UUV capable of handling more payload to extend the range of the UUV, conduct deep underwater missions, and obtain other advantages.

## SUMMARY

[0003a] In an aspect, the present disclosure refers to a monocoque body for an unmanned underwater vehicle (UV) comprising:

a nose portion,

a tail portion,

a body interior surface,

a body exterior surface, and

wherein the monocoque body comprises an underbody that is a one-piece structural shell made of fiber reinforced sheet,

wherein the underbody is configured to receive a removable cover.

[0003b] In an aspect, the present disclosure refers to an unmanned underwater vehicle (UUV) comprising:

a monocoque underbody providing structural support for the UUV and adapted to receive a payload, comprising:

a nose portion,

a tail portion,

a body interior surface forming a cavity,

a body exterior surface, and

a plurality of transverse structural members integrally formed into underbody.

**[0004]** In one example, the disclosed technology relates to a monocoque body for an unmanned underwater vehicle ("UUV") including a nose portion, a tail portion, a body interior surface, and a body exterior surface. The monocoque body may be a one-piece structural shell made of fiber reinforced sheet.

**[0005]** In some examples, the fiber reinforced sheet can be a polymer reinforced by carbon fiber. The monocoque body can form a portion of a UUV that is free-flooding. The monocoque body may further include an acoustically transparent window. The acoustically transparent window can be integrally formed out of the fiber reinforced sheet and is configured to permit acoustic signals to travel through the monocoque body.

**[0006]** The body interior surface may form a cavity and the monocoque body may further include a plurality of transverse structural members integrally formed into monocoque body. The transverse structural members may separate the cavity into a plurality of payload area(s) that can be configured to receive a payload for attachment to the monocoque body. The payload can be at least one of: a battery, a motor, a pressure vessel, or a sensor. The monocoque body can further include one or more longitudinal supports extending axially along the underbody between the tail portion and the nose portion. The longitudinal supports can form an attachment rail. The attachment rail can be configured to receive a payload. The monocoque body can further include an aperture extending through the body exterior surface, the aperture being configured to receive a face of a sensor connected to the monocoque body.

**[0007]** In another example, disclosed embodiments provide an unmanned underwater vehicle ("UUV") including a monocoque underbody providing structural support for the UUV and adapted to receive a payload, the monocoque underbody comprising: a nose portion, a tail portion, a body interior surface forming a cavity, a body exterior surface, and a plurality of transverse structural members integrally formed into underbody. The underbody can be constructed of a polymer reinforced by carbon fiber. The UUV can be free-flooding. The UUV can further include a cover extending from the nose portion to the tail portion. The cover can include a cover interior surface; and a cover exterior surface. The cover can attach to the underbody such that the cover interior surface faces the body interior surface, and the cover exterior surface and the body exterior surface together form an exterior surface of the UUV. The cover may be removably attached to permit access to the cavity.

**[0008]** In some examplez, the body exterior surface may form 30% to 70% of a total exterior surface of the UUV. The underbody can be constructed of a first material and the cover can be constructed of a second material. The second material can have a relatively lower material strength or weight than that of the first material. The underbody can further include one or more

longitudinal supports extending axially along the underbody between the tail portion and the nose portion and forming an attachment rail(s).

**[0009]** In another example, disclosed embodiments provide an unmanned underwater vehicle ("UUV") comprising a monocoque underbody that preferably spans from nose to tail of the UUV and can be made of fiber reinforced multilayer epoxy bound sheet wherein the sheet is adapted (a) to provide a shape of an exterior hydrodynamic shell of the UUV and (b) be the UUV payload support frame that carries desired payloads in the UUV during operation; and is adapted to receive a top removeable UUV cover adapted to be positioned over the underbody.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0010]** The accompanying drawings, which are incorporated herein and constitute part of this specification, are illustrative of particular embodiments of the present disclosure and do not limit the scope of the present disclosure. The drawings are not to scale and are intended for use in conjunction with the explanations in the following detailed description.

**[0011]** FIG. 1 is a perspective view of an exemplary unmanned underwater vehicle, in accordance with one or more embodiments of the present invention(s).

**[0012]** FIG. 2A is a top view of an exemplary unmanned underwater vehicle, in accordance with one or more embodiments of the present invention(s).

**[0013]** FIG. 2B is a side view of an exemplary unmanned underwater vehicle, in accordance with one or more embodiments of the present invention(s).

**[0014]** FIG. 3A is a bottom view of an exemplary unmanned underwater vehicle, in accordance with one or more embodiments of the present invention(s).

**[0015]** FIG. 3B is a front view of an exemplary unmanned underwater vehicle, in accordance with one or more embodiments of the present invention(s).

**[0016]** FIG. 3C is a back sectional view of an exemplary unmanned underwater vehicle, in accordance with one or more embodiments of the present invention(s).

**[0017]** FIG. 4 is a perspective view of an exemplary unmanned underwater vehicle, in accordance with one or more embodiments of the present invention(s).