UAV WITH FRANGIBLE AIRFRAME STRUCTURES

TECHNICAL FIELD

[0001] This disclosure relates generally to unmanned aerial vehicles, and in particular but not exclusively, relates to airframes of unmanned aerial vehicles.

BACKGROUND INFORMATION

[0002] An unmanned vehicle, which may also be referred to as an autonomous vehicle, is a vehicle capable of travel without a physically-present human operator. An unmanned vehicle may operate in a remote-control mode, in an autonomous mode, or in a partially autonomous mode.

[0003] When an unmanned vehicle operates in a remote-control mode, a pilot or driver that is at a remote location can control the unmanned vehicle via commands that are sent to the unmanned vehicle via a wireless link. When the unmanned vehicle operates in autonomous mode, the unmanned vehicle typically moves based on pre-programmed navigation waypoints, dynamic automation systems, or a combination of these. Further, some unmanned vehicles can operate in both a remote-control mode and an autonomous mode, and in some instances may do so simultaneously. For instance, a remote pilot or driver may wish to leave navigation to an autonomous system while manually performing another task, such as operating a mechanical system for picking up objects, as an example.

[0004] Various types of unmanned vehicles exist for various different environments. For instance, unmanned vehicles exist for operation in the air, on the ground, underwater, and in space. Unmanned aerial vehicles (UAVs) are becoming more popular in general. Their use over populated areas, such as suburban and urban localities, means that designed in safety measures and components are increasingly important.

SUMMARY OF INVENTION

[0004a] According to a first aspect of the present invention, there is provided a mechanical joiner for an airframe, comprising:

a joiner core having a first side with a first cradle shaped to hold a first structural member and a second side with a second cradle shaped to hold a second structural member;

a first cap shaped to mate to the first side of the joiner core and clamp the first structural member into the first cradle, wherein the joiner core includes a first hole for a first mechanical fastener to extend through and across the first cradle to secure the first cap to the joiner core; and

a second cap shaped to mate to the second side of the joiner core and clamp the second structural member into the second cradle, wherein the second cap includes second holes for second mechanical fasteners, distinct from the first mechanical fastener, to secure the second cap to the joiner core.

[0004b] According to a second aspect of the present invention, there is provided an unmanned aerial vehicle (UAV), comprising:

a wing assembly including a wing spar;

a boom assembly including a boom and a plurality of motor mounts secured to the boom; and

a spar-boom joiner for mechanically securing the wing spar to the boom, the spar-boom joiner including:

a joiner core having a first side with a spar cradle shaped to hold the wing spar and a second side with a boom cradle shaped to hold the boom;

a spar cap shaped to mate to the first side of the joiner core and clamp the wing spar into the spar cradle, wherein a spar fastener extends through the wing spar and secures the spar cap to the joiner core; and

a boom cap shaped to mate to the second side of the joiner core and clamp the boom into the boom cradle, wherein second mechanical fasteners, distinct from the spar fastener, secure the boom cap to the joiner core.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Non-limiting and non-exhaustive embodiments of the invention are described with reference to the following figures, wherein like reference numerals refer to like parts throughout the various views unless otherwise specified. Not all instances of an element are necessarily labeled so as not to clutter the drawings where appropriate. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles being described.

CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A mechanical joiner for an airframe, comprising:

a joiner core having a first side with a first cradle shaped to hold a first structural member and a second side with a second cradle shaped to hold a second structural member;

a first cap shaped to mate to the first side of the joiner core and clamp the first structural member into the first cradle, wherein the joiner core includes a first hole for a first mechanical fastener to extend through and across the first cradle to secure the first cap to the joiner core; and

a second cap shaped to mate to the second side of the joiner core and clamp the second structural member into the second cradle, wherein the second cap includes second holes for second mechanical fasteners, distinct from the first mechanical fastener, to secure the second cap to the joiner core.

2. The mechanical joiner of claim 1, wherein the first mechanical fastener does not extend through the second cap.

3. The mechanical joiner of claim 2, wherein a head of the first mechanical fastener is recessed into the second cradle of the joiner core so as not to physically interfere with seating the second structural member into the second cradle.

4. The mechanical joiner of claim 1, wherein the second mechanical fasteners that secure the second cap each have less shear or tensile strength than the first mechanical fastener that passes through and across the first cradle.

5. The mechanical joiner of claim 4, wherein the second mechanical fasteners comprise four plastic screws that thread into the second side of the joiner core.

6. The mechanical joiner of claim 4, wherein the first mechanical fastener comprises a metal mechanical fastener and the metal mechanical fastener comprises a nut and a bolt.

7. The mechanical joiner of claim 1, further comprising:

an anti-rotation pin that extends through the second cap into the second structural member to prevent rotation of the second structural member within the second cradle.

8. The mechanical joiner of claim 7, wherein the anti-rotation pin comprises a nylon screw.

9. The mechanical joiner of claim 7, further comprising:

a layer of adhesive applied to an inside surface of the second cap that conforms with and mates to the second structural member to adhere the second structural member to the second cap.

10. The mechanical joiner of claim 1, wherein the joiner core, the first cap, and the second cap are fabricated of glass filled nylon and the first structural member and the second structural member each comprise a hollow tubular rod.

11. An unmanned aerial vehicle (UAV), comprising:

a wing assembly including a wing spar;

a boom assembly including a boom and a plurality of motor mounts secured to the boom; and

a spar-boom joiner for mechanically securing the wing spar to the boom, the spar-boom joiner including:

a joiner core having a first side with a spar cradle shaped to hold the wing spar and a second side with a boom cradle shaped to hold the boom;

a spar cap shaped to mate to the first side of the joiner core and clamp the wing spar into the spar cradle, wherein a spar fastener extends through the wing spar and secures the spar cap to the joiner core; and

a boom cap shaped to mate to the second side of the joiner core and clamp the boom into the boom cradle, wherein second mechanical fasteners, distinct from the spar fastener, secure the boom cap to the joiner core.

12. The UAV of claim 11, wherein the spar fastener is a mechanical fastener that does not extend through the boom cap.

13. The UAV of claim 12, wherein a head of the spar fastener is recessed into the boom cradle of the joiner core so as not to physically interfere with seating the boom into the boom cradle.

14. The UAV of claim 11, wherein the second mechanical fasteners each have less shear or tensile strength than the spar fastener.

15. The UAV of claim 14, wherein the second mechanical fasteners comprise four plastic screws that thread into the second side of the joiner core.

16. The UAV of claim 14, wherein the spar fastener comprises a metal mechanical fastener and the metal mechanical fastener comprises a nut and a bolt.

17. The UAV of claim 11, further comprising:

an anti-rotation pin extending through the boom cap into the boom to prevent rotation of the boom within the boom cradle.

18. The UAV of claim 17, wherein the anti-rotation pin comprises a nylon screw.

19. The UAV of claim 17, further comprising:

a layer of adhesive applied to an inside surface of the boom cap that conforms with and mates to the boom to adhere the boom to the boom cap.

20. The UAV of claim 11, wherein the joiner core, the spar cap, and the boom cap are fabricated of glass filled nylon and the wing spar and the boom each comprise a hollow tubular rod.

21. The UAV of claim 11, further comprising a modular fuselage secured to the wing spar, the modular fuselage including:

a first section secured to the wing spar with a second joiner that clamps onto the wing spar, wherein the second joiner is clamped with first plastic screws selected to fail upon a collision impact of the modular fuselage; and

one or more other sections connected to the first section, wherein the one or more other sections are secured to the first section at connection points secured together with second plastic screws selected to fail upon the collision impact of the modular fuselage.