SUMMARY

[0005a] According to a first aspect of the present invention, there is provided a payload loading system comprising:

an unmanned aerial vehicle (UAV) that comprises a retractable tether, wherein a distal end of the tether is coupled to a payload coupling apparatus, and a proximate end of the tether is coupled to the UAV; and

a loading structure comprising:

a landing platform for the UAV;

a tether guide coupled to the landing platform, wherein the tether guide directs the retractable tether of the UAV as the UAV approaches the landing platform such that the payload coupling apparatus arrives at a target location, and further wherein a payload is loaded to or unloaded from the payload coupling apparatus while the payload coupling apparatus is within the target location; and

an opening, wherein the tether guide directs the retractable tether such that the payload coupling apparatus passes through the opening of the loading structure.

[0005b] According to a second aspect of the present invention, there is provided a payload loading structure comprising:

a landing platform for an unmanned aerial vehicle (UAV), where the UAV comprises a retractable tether coupleable to a payload at a payload coupling apparatus coupled to the retractable tether; and

a tether guide coupled to the landing platform, wherein the tether guide contacts and directs the retractable tether as the UAV approaches the landing platform such that the payload coupling apparatus passes through an opening of the payload loading structure and arrives a target location, and further wherein the payload is loaded to or unloaded from the payload coupling apparatus at the target location.

[0005c] According to a third aspect of the present invention, there is provided a method comprising:

traveling, by an unmanned aerial vehicle (UAV), across at least a portion of a landing platform coupled to a loading structure;

guiding and contacting, by a tether guide coupled to the loading structure, a retractable tether such that a payload coupling apparatus coupled to a distal end of the tether passes through an opening of the loading structure and arrives at a target location, wherein the retractable tether is extended from and coupled to the UAV at a proximate end of the tether; and

loading a payload to the UAV by coupling the payload to the payload coupling apparatus while the payload coupling apparatus is within the target location.

[0006] The present application discloses unmanned aerial vehicle (UAV) payload loading systems, structures, and methods relating thereto. UAVs are increasingly utilized for a wide array of delivery services and as such, dedicated structures that increase the ease of use, efficiency, and safety of such delivery services is necessary. For example, a payload loading system designed to interact with an approaching or departing UAV associated with a delivery service may facilitate better access to loading a payload to, or unloading a payload from, the UAV. Moreover, additional components may be included as part of the payload loading system to further support the UAV delivery service.

[0007] Example payload loading systems described herein may be installed on freestanding support structures, may be installed on or within existing structures such as building walls, rooftops, trucks, lamp posts, cell towers, warehouses, etc., or may be installed by modifying an existing structure with aspects described herein. Beneficially, the payload loading systems described herein may be installed in a variety of locations without impeding everyday life of merchants, customers, or other people, while increasing the efficiency of access to UAV delivery service to the same merchants, customers, or other people.

[0008] In one embodiment, a payload loading system is described. The payload loading system includes a UAV and a loading structure, among other potential components. The UAV includes a retractable tether. A payload coupling apparatus is coupled to a distal end of the tether and the UAV is coupled to a proximate end of the tether. The tether may be extended or retracted by a winch system of the UAV such that the payload coupling apparatus is lowered down away from the UAV or raised up towards the UAV. A payload is loaded to, unloaded from, or both unloaded from and then another payload is loaded to the UAV by coupling the payload to the payload coupling apparatus. The loading structure of the payload loading system includes a landing platform and a tether guide. The tether guide is coupled to the landing platform and directs the tether as the UAV approaches and travels across at least a portion of the landing platform such that the payload coupling apparatus arrives at a target location. Moreover, the UAV may land on and move across or hover over the landing platform as the UAV travels across at least a portion of the landing platform. The payload is loaded to and/or unloaded from the payload coupling apparatus while the payload coupling apparatus is within the target location. The landing platform may include a channel that also guides the tether such that the payload coupling apparatus arrives at the target location. In some embodiments, the channel may be attached to or a component of the tether guide.

[0009] In another embodiment, a payload loading structure is provided. The payload loading

CLAIMS

~~We claim:~~

~~1. A payload loading system comprising:~~

~~an unmanned aerial vehicle (UAV) that comprises a retractable tether, wherein a distal end of the tether is coupled to a payload coupling apparatus, and a proximate end of the tether is coupled to the UAV; and~~

~~a loading structure comprising:~~

~~a landing platform for the UAV; and~~

~~a tether guide coupled to the landing platform, wherein the tether guide directs the retractable tether of the UAV as the UAV approaches the landing platform such that the payload coupling apparatus arrives at a target location, and further wherein a payload is loaded to or unloaded from the payload coupling apparatus while the payload coupling apparatus is within the target location.~~

~~2. The payload loading system of claim 1, wherein the landing platform further comprises a channel and the retractable tether passes through at least a portion of the channel such that the payload coupling apparatus arrives at the target location.~~

~~3. The payload loading system of claim 1, wherein the tether guide comprises at least one edge of at least a portion of the loading structure, wherein the at least one edge is at an angle relative to a heading of the UAV as the UAV approaches the landing platform.~~

~~4. The payload loading system of claim 3, wherein the edge of the tether guide directs the retractable tether along a directional heading different than the heading of the UAV.~~

~~5. The payload loading system of claim 1, wherein the loading structure further comprises an opening, and further wherein the tether guide directs the retractable tether such that the payload coupling apparatus passes through the opening of the loading structure.~~

~~6. The payload loading system of claim 5, wherein the opening of the loading structure is located in a wall of a merchant module.~~

~~7. The payload loading system of claim 1, wherein the tether guide defines a plurality of tether paths, wherein the retractable tether follows one of the tether paths as the UAV travels across the landing platform, wherein each of the plurality of tether paths direct the retractable tether such that the payload coupling apparatus arrives at the target location.~~

~~8. The payload loading system of claim 7, wherein the landing platform comprises a plurality of platform portions and at least one channel, wherein each channel is between two of the platform portions.~~

9. The payload loading system of claim 7, wherein a heading of the UAV as the UAV travels across the landing platform is different than a direction the retractable tether travels within at least a portion of the tether path.

10. The payload loading system of claim 1, wherein the tether guide is conical, and further wherein during loading or unloading of the payload, the retractable tether is extended through the conical tether guide.

11. The payload loading system of claim 10, wherein the landing platform is circular and the landing platform and the conical tether guide are concentric.

12. The payload loading system of claim 10, wherein the conical tether guide comprises:

a first tapered portion, coupled to the landing platform at a proximate end of the first tapered portion, wherein the first tapered portion extends down from the landing platform towards the target location, wherein a diameter of the first tapered portion at the proximate end of the first tapered portion is greater than a diameter of the first tapered portion at a distal end of the first tapered portion; and

a second tapered portion, concentric with the first tapered portion, wherein a proximate end of the second tapered portion is coupled to the distal end of the first tapered portion, wherein a diameter of the proximate end of the second tapered portion is the same as the diameter of the distal end of the first tapered portion, and further wherein a diameter of a distal end of the second tapered portion is greater than the diameter of the proximate end of the second tapered portion.

13. The payload loading system of claim 1, wherein the landing platform comprises a plurality of hinged doors, and further wherein the hinged doors open when the UAV departs the loading structure with the payload.

14. The payload loading system of claim 1, wherein the tether guide is configured to receive more than one tether of more than one UAV at a single time.

15. The payload loading system of claim 1, wherein the landing platform comprises a plurality of landing pads, wherein the UAV charges when in contact with one of the plurality of landing pads.

16. The payload loading system of claim 1, wherein the target location is at an ergonomic position for a user to load or unload a payload.

17. A payload loading structure comprising:

a landing platform for an unmanned aerial vehicle (UAV), where the UAV comprises a retractable tether coupleable to a payload at a payload coupling apparatus coupled to the retractable tether; and

~~a tether guide coupled to the landing platform, wherein the tether guide directs the retractable tether as the UAV approaches the landing platform such that the payload coupling apparatus arrives a target location, and further wherein the payload is loaded to or unloaded from the payload coupling apparatus at the target location.~~

~~18. A method comprising:~~

~~traveling, by an unmanned aerial vehicle (UAV), across at least a portion of a landing platform coupled to a loading structure;~~

~~guiding, by a tether guide coupled to the loading structure, a retractable tether such that a payload coupling apparatus coupled to a distal end of the tether arrives at a target location, wherein the retractable tether is extended from and coupled to the UAV at a proximate end of the tether; and~~

~~loading a payload to the UAV by coupling the payload to the payload coupling apparatus while the payload coupling apparatus is within the target location.~~

~~19. The method of claim 18, further comprising:~~

~~locating, by the UAV, the payload coupling apparatus within an opening of the loading structure as the UAV approaches the loading structure.~~

~~20. The method of claim 18, further comprising:~~

~~extending, by the UAV, the retractable tether a length such that the payload coupling apparatus is below the tether guide as the UAV approaches the landing platform.~~

1. A payload loading system comprising:

an unmanned aerial vehicle (UAV) that comprises a retractable tether, wherein a distal end of the tether is coupled to a payload coupling apparatus, and a proximate end of the tether is coupled to the UAV; and

a loading structure comprising:

a landing platform for the UAV;

a tether guide coupled to the landing platform, wherein the tether guide directs the retractable tether of the UAV as the UAV approaches the landing platform such that the payload coupling apparatus arrives at a target location, and further wherein a payload is loaded to or unloaded from the payload coupling apparatus while the payload coupling apparatus is within the target location; and

an opening, wherein the tether guide directs the retractable tether such that the payload coupling apparatus passes through the opening of the loading structure.

2. The payload loading system of claim 1, wherein the landing platform further comprises a channel and the retractable tether passes through at least a portion of the channel such that the payload coupling apparatus arrives at the target location.

3. The payload loading system of claim 1, wherein the tether guide comprises at least one edge of at least a portion of the loading structure, wherein the at least one edge is at an angle relative to a heading of the UAV as the UAV approaches the landing platform.

4. The payload loading system of claim 3, wherein the edge of the tether guide directs the retractable tether along a directional heading different than the heading of the UAV.

5. The payload loading system of claim 1, wherein the opening of the loading structure is located in a wall of a merchant module.

6. The payload loading system of claim 1, wherein the tether guide defines a plurality of tether paths, wherein the retractable tether follows one of the tether paths as the UAV travels across the landing platform, wherein each of the plurality of tether paths direct the retractable tether such that the payload coupling apparatus arrives at the target location.

7. The payload loading system of claim 6, wherein the landing platform comprises a plurality of platform portions and at least one channel, wherein each channel is between two of the platform portions.

8. The payload loading system of claim 6, wherein a heading of the UAV as the UAV travels across the landing platform is different than a direction the retractable tether travels within at least a portion of the tether path.

9. The payload loading system of claim 1, wherein the tether guide is conical, and further wherein during loading or unloading of the payload, the retractable tether is extended through the conical tether guide.

10. The payload loading system of claim 9, wherein the landing platform is circular and the landing platform and the conical tether guide are concentric.

11. The payload loading system of claim 9, wherein the conical tether guide comprises:

a first tapered portion, coupled to the landing platform at a proximate end of the first tapered portion, wherein the first tapered portion extends down from the landing platform towards the target location, wherein a diameter of the first tapered portion at the proximate end of the first tapered portion is greater than a diameter of the first tapered portion at a distal end of the first tapered portion; and

a second tapered portion, concentric with the first tapered portion, wherein a proximate end of the second tapered portion is coupled to the distal end of the first tapered portion, wherein a diameter of the proximate end of the second tapered portion is the same as the diameter of the distal end of the first tapered portion, and further wherein a diameter of a distal end of the second tapered portion is greater than the diameter of the proximate end of the second tapered portion.

12. The payload loading system of claim 1, wherein the landing platform comprises a plurality of hinged doors, and further wherein the hinged doors open when the UAV departs the loading structure with the payload.

13. The payload loading system of claim 1, wherein the tether guide is configured to receive more than one tether of more than one UAV at a single time.

14. The payload loading system of claim 1, wherein the landing platform comprises a plurality of landing pads, wherein the UAV charges when in contact with one of the plurality of landing pads.

15. A payload loading structure comprising:

a landing platform for an unmanned aerial vehicle (UAV), where the UAV comprises a retractable tether coupleable to a payload at a payload coupling apparatus coupled to the retractable tether; and

a tether guide coupled to the landing platform, wherein the tether guide contacts and directs the retractable tether as the UAV approaches the landing platform such that the payload coupling apparatus passes through an opening of the payload loading structure and arrives a target location, and further wherein the payload is loaded to or unloaded from the payload coupling apparatus at the target location.

16. The payload loading structure of claim 15, wherein the tether guide is configured such that movement of the UAV across the landing platform causes the retractable tether to pass through the landing platform.

17. The payload loading structure of claim 15, wherein the opening of the payload loading structure is located in a wall of a merchant module.

18. A method comprising:

traveling, by an unmanned aerial vehicle (UAV), across at least a portion of a landing platform coupled to a loading structure;

guiding and contacting, by a tether guide coupled to the loading structure, a retractable tether such that a payload coupling apparatus coupled to a distal end of the tether passes through an opening of the loading structure and arrives at a target location, wherein the retractable tether is extended from and coupled to the UAV at a proximate end of the tether; and

loading a payload to the UAV by coupling the payload to the payload coupling apparatus while the payload coupling apparatus is within the target location.

19. The method of claim 18, further comprising:

locating, by the UAV, the payload coupling apparatus within the opening of the loading structure as the UAV approaches the loading structure.

20. The method of claim 18, further comprising:

extending, by the UAV, the retractable tether a length such that the payload coupling apparatus is below the tether guide as the UAV approaches the landing platform.