CLAIMS

What is claimed is:

1. A conical-shaped articulated member, comprising:

a conical- shaped structure including an inner surface and an outer surface wherein the conical-shaped structure comprises at least a skin, an air bag, or a textile; and

a plurality of rotary actuation units disposed along a length of the conical-shaped structure, wherein at least two rotary actuation units of the plurality of rotary actuation units are coupled together, and wherein the plurality of rotary actuation units are configured to perform one or more motions,

wherein each rotary actuation unit of the plurality of rotary actuation units includes a plurality of support rods fixed thereto, each support rod of the plurality of support rods including a first end and a second end, wherein the first end is fixed to the inner surface of the skin, the air bag, or the textile.

2. The conical-shaped articulated member of claim 1, wherein each rotary actuation unit of the plurality of rotary actuation units includes a rotary actuator and a shaft, wherein the shaft is coupled to the rotary actuator.

3. The conical-shaped articulated member of claim 1, wherein the second end is coupled to:

a rotating component of a rotary actuator of a rotary actuation unit, or

a shaft of the rotary actuation unit.

4. The conical- shaped articulated member of claim 3, wherein at least two support rods of the plurality of support rods have different lengths.

5. The conical-shaped articulated member of claim 1, wherein a first rotary actuation unit of the at least two rotary actuation units has a first orientation, and a second rotary actuation unit of the at least two rotary actuation units has a second orientation.

6. The conical-shaped articulated member of claim 5, wherein the second orientation is offset by approximately 90 degrees relative to the first orientation.

7. The conical-shaped articulated member of claim 1, wherein the plurality of rotary actuation units decrease in weight along the length of the conical-shaped structure.

8. The conical-shaped articulated member of claim 1, wherein the conical- shaped structure further comprises at least a shell.

9. The conical-shaped articulated member of claim 1, wherein

a first rotary actuation unit of the plurality of rotary actuation units includes a first rotary actuator and a first shaft, the first shaft coupled to a first rotating component of the first rotary actuator, the first rotating component having a first axis of rotation,

a second rotary actuation unit of the plurality of rotary actuation units includes a second rotary actuator and a second shaft, the second shaft coupled to a second rotating component of the second rotary actuator, the second rotating component having a second axis of rotation, and

the first rotating component is coupled to the second rotary actuator via the first shaft extending along the first axis of rotation, the first axis of rotation being approximately perpendicular to the second axis of rotation.

10. The conical-shaped articulated member of claim 9, wherein

a third rotary actuation unit of the plurality of rotary actuation units includes a third rotary actuator and a third shaft, the third shaft coupled to a third rotating component of the third rotary actuator, the third rotating component having a third axis of rotation, and

the second rotating component is coupled to the third rotary actuator via the second shaft extending along the third axis of rotation, the third axis of rotation being approximately perpendicular to the second axis of rotation.

11. The conical-shaped articulated member of claim 10, wherein

a fourth rotary actuation unit of the plurality of rotary actuation units includes a fourth rotary actuator and a fourth shaft, the fourth shaft coupled to a fourth rotating component of the fourth rotary actuator, the fourth rotating component having a fourth axis of rotation, and

the third rotating component is coupled to the fourth rotary actuator via the third shaft extending along the third axis of rotation, wherein the third axis of rotation and the fourth axis of rotation form an obtuse angle.

12. The conical-shaped articulated member of claim 11, wherein a longitudinal axis of the fourth shaft is approximately perpendicular to the fourth axis of rotation.

13. The conical-shaped articulated member of claim 1, wherein the one or more motions includes at least a roll motion and a pitch motion, and wherein:

at least a first rotary actuation unit of the at least two rotary actuation units provides the roll motion for the conical-shaped articulated member, and

at least a second rotary actuation unit of the at least two rotary actuation units provides the pitch motion for the conical-shaped articulated member.

14. The conical-shaped articulated member of claim 1, wherein the plurality of rotary actuation units provide multiple degrees of freedom for the conical-shaped articulated member.

15. A method for constructing a conical-shaped articulated member, the method comprising:

forming a conical-shaped structure including an inner surface and an outer surface, wherein the conical-shaped structure comprises at least a skin, an air bag, or a textile;

coupling a plurality of rotary actuation units to one another, the plurality of rotary actuation units configured to perform one or more motions,

wherein each rotary actuation unit of the plurality of rotary actuation units includes a plurality of support rods fixed thereto, each support rod of the plurality of support rods including a first end and a second end;

disposing the plurality of rotary actuation units along a length of the conical-shaped structure; and

fixing the first end of each support rod of the plurality of support rods to the inner surface of the skin, the air bag, or the textile.

16. The method of claim 15, wherein the coupling the plurality of rotary actuation units comprises:

coupling a first rotary actuation unit of the plurality of rotary actuation units to a second rotary actuation unit of the plurality of rotary actuation units, wherein the first rotary actuation unit of the plurality of rotary actuation units includes a first rotary actuator and a first shaft, the first shaft being coupled to a first rotating component of the first rotary actuator, the first rotating component having a first axis of rotation,

wherein the second rotary actuation unit of the plurality of rotary actuation units includes a second rotary actuator and a second shaft, the second shaft being coupled to a second

rotating component of the second rotary actuator, the second rotating component having a second axis of rotation, and

wherein the first rotating component is coupled to the second rotary actuator via the first shaft extending along the first axis of rotation, the first axis of rotation being approximately perpendicular to the second axis of rotation.

17. The method of claim 16, wherein the coupling the plurality of rotary actuation units further comprises:

coupling the second rotary actuation unit to a third rotary actuation unit,

wherein the third rotary actuation unit includes a third rotary actuator and a third shaft, the third shaft coupled to a third rotating component of the third rotary actuator, the third rotating component having a third axis of rotation, and

wherein the second rotating component is coupled to the third rotary actuator via the second shaft extending along the third axis of rotation, the third axis of rotation being approximately perpendicular to the second axis of rotation.

18. The method of claim 17, wherein the coupling the plurality of rotary actuation units further comprises:

coupling the third rotary actuation unit to a fourth rotary actuation unit, the fourth rotary actuation unit including a fourth rotary actuator and a fourth shaft, the fourth shaft coupled to a fourth rotating component of the fourth rotary actuator, the fourth rotating component having a fourth axis of rotation, and

wherein the third rotating component is coupled to the fourth rotary actuator via the third shaft extending along the third axis of rotation, wherein the third axis of rotation and the fourth axis of rotation form an obtuse angle.

19. The method of claim 18, further comprising:

coupling the second end of each support rod of the plurality of support rods to:

a rotating component of a rotary actuator of a rotary actuation unit, or a shaft of the rotary actuation unit.

20. The method of claim 19, wherein the one or more motions includes at least a roll motion and a pitch motion, and wherein:

at least the first rotary actuation unit of the plurality of rotary actuation units provides the roll motion for the conical-shaped articulated member, and

at least the second rotary actuation unit of the plurality of rotary actuation units provides the pitch motion for the conical-shaped articulated member.