Claims

WHAT IS CLAIMED IS:

1. A deployable antenna system for deployment in an extraterrestrial environment, the deployable antenna system comprising:

a deployment mechanism including one or more extendable support structures comprising at least one axial support structure adapted to increase in length substantially along a z-direction parallel to a z-axis in the deployable antenna system; and

a deployable antenna attached to the one or more extendable support structures and adapted to be stowed in an undeployed state and to be unfurled into a deployed state by the deployment mechanism, the deployable antenna being further adapted to extend and unfurl during deployment from the deployment mechanism in the z-direction responsive to the increase in length substantially along the z-direction of the at least one axial support structure, the deployable antenna including one or more flexible membranes coupled to the at least one axial support structure and extending from the z-axis in the deployed state.

2. The deployable antenna system of claim 1, wherein the one or more flexible membranes extend radially from the z-axis orthogonally to each other.

3. The deployable antenna system of claim 1, wherein the one or more flexible membranes include a first flexible membrane and a second flexible membrane extending orthogonally to each other from the z-axis and interleaved with each other.

4. The deployable antenna system of claim 1, wherein at least two of the one or more flexible membranes include two or more parallel sub-membranes, the at least two of the one or more flexible membranes being substantially perpendicular to one another.

5. The deployable antenna system of claim 1, wherein the one or more flexible membranes include a plurality of antenna elements and wherein a spacing between the plurality of antenna elements along the z-direction on at least one of the one or more flexible membranes is non-uniform.

6. The deployable antenna system of claim 5, wherein at least one of the plurality of antenna elements includes a conductive trace inlaid in the one or more flexible membranes.

7. The deployable antenna system of claim 1, further comprising:

electromagnetic radiation (EMR) control circuitry; and

an EMR circuitry coupler,

wherein a flexible membrane of the one or more flexible membranes includes a plurality of antenna elements, a first sub-membrane, and a second sub-membrane, and

wherein a first conductive element of the EMR circuitry coupler is coupled at a distal portion to a distal-most antenna element of the first sub-membrane and a second conductive element of the EMR circuitry coupler is coupled to a distal-most antenna element of the second sub-membrane.

8. The deployable antenna system of claim 1, further comprising:

electromagnetic radiation (EMR) control circuitry; and

an EMR circuitry coupler,

wherein a flexible membrane of the one or more flexible membranes includes a plurality of antenna elements, a first sub-membrane, and a second sub-membrane, and wherein a flexible membrane of the one or more flexible membranes includes a first sub-membrane coupled to a second sub-membrane and antenna elements of the first sub-membrane are arranged with mirror symmetry about a central membrane axis relative to antenna elements of the second sub-membrane.

9. The deployable antenna system of claim 1, wherein the one or more extendable support structures includes at least one radial support structure that is substantially orthogonal to the at least one axial support structure and is configured to increase in length substantially along a radial direction orthogonal to the at least one axial support structure, the at least one radial support structure coupled to the one or more flexible membranes and adapted to extend the one or more flexible membranes radially from the z-axis.

10. The deployable antenna system of claim 9, wherein the at least one axial support structure is configured to increase in length substantially along the z-axis responsively to the at least one radial support structure increasing in length substantially radially from the z-axis.

11. A method for deploying a deployable antenna in an extraterrestrial environment from an undeployed state to a deployed state, the method comprising:

increasing in length one or more axial support structures substantially along a z-direction parallel to a z-axis, the one or more axial support structures coupled at a first end to the deployable antenna and at a second end to a deployment base from which the deployable antenna deploys; and

unfurling one or more flexible membranes of the deployable antenna by the operation of increasing in length the one or more axial support structures substantially along the z-direction, wherein the unfurling extends the one or more flexible membranes axially, wherein the one or more flexible membranes extend from the z-axis.

12. The method of claim 11, comprising:

increasing in length one or more radial support structures in a radial direction substantially orthogonal to the z-axis, each of the one or more radial support structures coupled on a first end to the deployable antenna and on a second end to the deployment base from which the deployable antenna deploys, wherein the operation of increasing in length the one or more radial support structures in a radial direction substantially orthogonal to the z-axis causes the one or more flexible membranes to unfurl and extend in the radial direction.

13. The method of claim 12, wherein the operation of increasing in length the one or more axial support structures is conducted responsively to the operation of increasing in length the one or more radial support structures.

14. The method of claim 11, further comprising:

unfurling the one or more flexible membranes to extend radially from the z-axis orthogonally to each other.

15. The method of claim 11, wherein at least two of the one or more flexible membranes include two or more parallel sub-membranes, the two or more parallel sub-membranes coupled to one another to maintain a space between the two or more parallel sub-membranes of a predefined width.

16. The method of claim 11, wherein the one or more flexible membranes include a plurality of antenna elements.

17. The method of claim 16, wherein at least one of the plurality of antenna elements includes a conductive trace inlaid in the one or more flexible membranes.

18. The method of claim 16, wherein the one or more flexible membranes further comprise:

one or more furling discontinuities in the one or more flexible membranes resulting from a furling of the one or more flexible membranes in the undeployed state, wherein at least one of the plurality of antenna elements intersects at least one of the one or more furling discontinuities; and

at least one furl resilience element at the intersection.

19. The method of claim 11, further comprising:

extending an EMR circuitry coupler electrically coupled at a proximal portion to electromagnetic radiation (EMR) control circuitry, wherein a first conductive element of the EMR circuitry coupler is coupled at a distal portion to a distal-most antenna element of a first sub-membrane of a flexible membrane of the one or more flexible membranes and a second conductive element of the EMR circuitry coupler is coupled to a distal-most antenna element of a second sub-membrane of the flexible membrane.

20. The method of claim 11, further comprising:

extending an EMR circuitry coupler electrically coupled at a proximal portion to electromagnetic radiation (EMR) control circuitry, wherein a flexible membrane of the one or more flexible membranes includes a first sub-membrane coupled to a second sub-membrane and antenna elements of the first sub-membrane are arranged with mirror symmetry about a central membrane axis relative to antenna elements of the second sub-membrane.