CLAIMS

What is claimed is:

1. A flight control apparatus for a fixed-wing aircraft, comprising:

a first port wing and a first starboard wing;

a first port swash plate coupled between a first port rotor and a first port electric motor, the first port electric motor coupled to the first port wing; and

a first starboard swash plate coupled between a first starboard rotor and a first starboard electric motor, the first starboard electric motor coupled to the first starboard wing; wherein the fixed-wing aircraft is configured to rotate from an at least generally vertical to an at least generally horizontal orientation without the benefit of control surfaces.

2. The apparatus of claim 1, further comprising:

a second port wing and second starboard wing;

a second port swash plate coupled between a second port rotor and second port electric motor, the second port electric motor coupled to the second port wing; and

a second starboard swash plate coupled between a second starboard rotor and second starboard electric motor, the second starboard electric motor coupled to the second starboard wing.

3. The apparatus of claim 2, further comprising:

a horizontal stabilizer coupled to a fuselage and an elevator rotatably coupled to the horizontal stabilizer, the fuselage coupled between the first port wing and second starboard wing.

4. The apparatus of claim 3, further comprising:

a port aileron rotatably disposed on a trailing edge of the first port wing; and

a starboard aileron rotatably disposed on a trailing edge of the first starboard wing.

5. The apparatus of claim 1, further comprising:

first and second landing gear attached to the first port wing and first starboard wing, respectively.

6. The apparatus of claim 5, further comprising:

a third landing gear attached to the horizontal stabilizer.

7. A method of flight control for fixed-wing aircraft, comprising:

inducing a left roll of a fuselage coupled between a first port wing and a first starboard wing, in response to:

generating in a first port rotor a negative rotational moment in response to actuation of a first port swash plate, the first port rotor rotatably coupled to the first port wing; and

generating in a first starboard rotor a positive rotational moment in response to actuation of a first starboard swash plate, the first starboard rotor rotatably coupled to the first starboard wing.

8. The method of claim 7, further comprising:

inducing a yaw moment about the fuselage, in response to:

generating asymmetric collective control between the first port rotor and the first starboard rotor.

9. The method of claim 8, wherein the generating an asymmetric collective control, the generating in the first port rotor the positive rotational moment and the generating in the first starboard rotor the negative rotational moment collectively accomplish a coordinated turn of the port and starboard wings.

10. The method of claim 7, further comprising:

inducing a right roll of the fuselage in response to:

generating in the first port rotor a positive rotational moment in response to actuation of the first port swash plate; and

generating in the first starboard rotor a negative rotational moment in response to actuation of the first starboard swash plate.

11. The method of claim 7, further comprising:

providing pitch control of the fuselage in response to:

providing asymmetric collective control between at least the first port rotor and a second port rotor that is rotatably coupled to a second port wing, the second port wing coupled to the fuselage.

12. The method of claim 7, further comprising:

providing pitch control of the fuselage in response to:

providing differential motor RPM control between at least the first port rotor and a second port rotor rotatably coupled to a second port wing, the second port wing coupled to the fuselage.

13. The method of claim 12, further comprising:

providing pitch control of the fuselage in response to:

providing differential motor RPM control between the first starboard rotor and a second starboard rotor rotatably coupled to a second starboard wing.

14. The method of claim 13, further comprising:

providing elevator control complementary to the providing pitch control to supplement the pitching moment with an additional pitching moment.

15. The method of claim 7, further comprising:

providing pitch control of the fuselage in response to actuating an elevator.

16. The method of claim 7, further comprising:

inducing a right roll of the fuselage in response to:

generating in a second port rotor a negative rotational moment in response to actuation of a second port swash plate, the second port rotor rotatably coupled to a second port wing; and

generating in a second starboard rotor a positive rotational moment in response to actuation of a second starboard swash plate, the second starboard rotor rotatably coupled to a second starboard wing;

wherein the positive and negative moments of force generated in the second port rotor and second starboard rotor induce a right roll of the second port and second starboard wings.

17. The method of claim 16, further comprising:

supplementing the right roll of the fuselage in response to actuating port and starboard ailerons rotatably coupled to the second port wing and second starboard wing, respectively.

18. The method of claim 7, further comprising:

providing pitch-up control of the fuselage in response to:

generating in the first starboard rotor a positive rotational moment in response to actuation of a first starboard swash plate; and

generating in the first port rotor a positive rotational moment in response to actuation of the first starboard swash plate.

19. A method of vertical take-off and horizontal flight of a fixed-wing aircraft, comprising:

generating thrust in a first port rotor driven by a first port electric motor on a first port wing and a first starboard rotor driven by a first starboard motor on a first starboard wing to induce vertical takeoff of a fuselage coupled between the first port wing and a first starboard wing.

20. The method of claim 19, further comprising:

generating a negative rotational moment in the first port rotor and first starboard rotor using cyclic rotor blade control to accomplish transition of the first port and first starboard wings from vertical takeoff to horizontal flight.

21. The method of claim 19, further comprising:

generating thrust in a second port rotor driven by a second port electric motor on a second port wing and a second starboard rotor driven by a second starboard motor on a second starboard wing.

22. The method of claim 21, further comprising:

transitioning the fuselage from vertical takeoff to horizontal flight in response to asymmetric collective control as between the first port rotor and first starboard rotor on the one hand and the second port rotor and the second starboard rotor on the other hand.

23. The method of claim 21, further comprising:

transitioning the fuselage from vertical takeoff to horizontal flight in response to differential rotor angular velocity (RPM) control as between the first port rotor and first starboard rotor on the one hand and the second port rotor and the second starboard rotor on the other.

~~24. The method of claim 21, further comprising:~~

~~providing horizontal thrust in response to generating symmetric cyclic control of the first port rotor, first starboard rotor, second port rotor, and second starboard rotor.~~

~~25. The method of claim 21, further comprising:~~

~~providing horizontal thrust in response to generating asymmetric collective thrust of at least one pair of rotors selected from the group consisting of: i) first and second port rotors on the one hand and first and second starboard rotors on the other hand, ii) first port rotor and first starboard rotor on the one hand and second port rotor and second starboard rotor on the other hand.~~

~~26. The method of claim 21, further comprising:~~

~~providing pitch and roll station-keeping control of the fuselage in response to:~~

~~generating symmetric cyclic control of the first port rotor, first starboard rotor, second port rotor, and second starboard rotor to provide horizontal thrust; and~~

~~generating asymmetric collective control of at least one pair of rotors selected from the group consisting of: i) first and second port rotors on the one hand and first and second starboard rotors on the other hand, ii) first port rotor and first starboard rotor on the one hand and second port rotor and second starboard rotor on the other hand.~~

~~wherein the generating asymmetric collective control in combination with the generating symmetric cyclic control induce the fuselage to remain stationary and at a pitch or roll angle with respect to horizontal.~~

~~27. A method of fixed-wing aircraft control, comprising:~~

~~providing rotor blade pitch control to a first port rotor coupled to a first port wing, the rotor blade pitch control for the first port rotor selected from the group consisting of longitudinal cyclic control, lateral cyclic control and collective pitch control to induce pitch, roll and yaw moments, respectively;~~

~~providing rotor blade pitch control to a first starboard rotor coupled to a first starboard wing, the rotor blade pitch control for the first starboard rotor selected from the group consisting of longitudinal cyclic control, lateral cyclic control and collective pitch control to induce pitch, roll and yaw moments, respectively;~~

~~wherein fixed-wing aircraft pitch, yaw and roll moments are accomplished without the benefit of control surfaces on a wing.~~

28. The method of claim 27, further comprising:

providing rotor blade pitch control to a second port rotor coupled to a second port wing, the rotor blade pitch control selected from the group consisting of longitudinal cyclic control, lateral cyclic control and collective pitch control; and

providing rotor blade pitch control to a second starboard rotor coupled to a second starboard wing, the cyclic control selected from the group consisting of longitudinal cyclic control, lateral cyclic control and collective pitch control.

29. The method of claim 27, wherein providing rotor blade pitch control affects symmetric cyclic control of the first port rotor, first starboard rotor, second port rotor, and second starboard rotor so that the first port wing, first starboard wing, second port wing and second starboard wing are induced to translate horizontally.

30. A fixed-wing aircraft, comprising:

a fuselage;

a first port wing and a first starboard wing extending from opposite sides of the fuselage, the first port wing and first starboard wing lacking in-flight controllable surfaces;

a first port rotor coupled to the first port wing, the first port rotor driven by a first electric motor and having a first swash plate; and

a first starboard rotor coupled to the first starboard wing, the first starboard rotor driven by a second electric motor and having a second swash plate;

wherein the first and second swash plates enable first port rotor blade pitch control and first starboard rotor blade pitch control each independently selected from the group consisting of longitudinal cyclic control, lateral cyclic control and collective pitch control.

31. The fixed-wing aircraft of claim 30, further comprising:

a second port wing and second starboard wing extending from opposite sides of the fuselage;

a second port rotor coupled to the second port wing, the second port rotor driven by a third electric motor and having a third swash plate; and

a second starboard rotor coupled to the second starboard wing, the second starboard rotor driven by a fourth electric motor having a fourth swash plate.