CLAIMS

1. A motor or generator, comprising:

a rotor having an axis of rotation and configured to generate first magnetic flux parallel to the axis of rotation; and

a stator configured to generate second magnetic flux parallel to the axis of rotation;

wherein at least one of the rotor or the stator is configured to generate a magnetic flux profile that is non-uniformly distributed about the axis of rotation.

2. The motor or generator of claim 1, wherein the rotor is configured to generate a first magnetic flux profile that is non-uniformly distributed about the axis of rotation.

3. The motor or generator of claim 2, wherein the rotor comprises one or more magnet segments non-uniformly distributed about the axis of rotation.

4. The motor or generator of claim 3, wherein each of the one or more magnet segments has a respective surface location at which the first magnetic flux has a maximum density, and the respective surface locations are non-uniformly distributed about the axis of rotation.

5. The motor or generator of claim 2, wherein the rotor is configured such that, as the rotor rotates though a range of angles with respect to the stator at a substantially constant speed, a periodicity of torque produced due to interaction of the first magnetic flux and the second magnetic flux is irregular.

6. The motor or generator of claim 2, wherein the stator is configured to generate a second magnetic flux profile that is non-uniformly distributed about the axis of rotation.

7. The motor or generator of claim 1, wherein the stator is configured to generate a magnetic flux profile that is non-uniformly distributed about the axis of rotation.

8 The motor or generator of claim 7, wherein the stator comprises one or more printed circuit board segments non-uniformly distributed about the axis of rotation.

9. The motor or generator of claim 1, wherein the stator comprises conductive traces arranged on at least one dielectric layer to generate the second magnetic flux when energized with current.

10. The motor or generator of claim 9, wherein the stator is configured such that, at any given time when the conductive traces are energized with current, one or more locations of maximum density of the second magnetic flux are non-uniformly distributed about the axis of rotation.

11. The motor or generator of claim 10, wherein the conductive traces are arranged on the at least one dielectric layer and coupled to a power source to generate three phases of the second magnetic flux corresponding to three phases of current output by the power source.

12. The motor or generator of claim 10, wherein the stator comprises one or more printed circuit board segments non-uniformly distributed about the axis of rotation.

13. The motor or generator of claim 1, wherein at least one of the rotor or the stator is configured such that, as the rotor rotates though a range of angles with respect to the stator at a constant speed, a periodicity of torque produced due to interaction of the first magnetic flux and the second magnetic flux is irregular.

14. A method, comprising:

arranging one or more magnetic flux producing windings of a stator non-uniformly about an axis of rotation of a rotor of an axial flux motor or generator.

15. The method of claim 14, wherein arranging the one or more magnetic flux producing windings comprises:

arranging one or more printed circuit board segments including the windings non-uniformly about the axis of rotation.

16. The method of claim 15, wherein the rotor comprises magnets arranged non-uniformly about the axis of rotation.

17. The method of claim 15, wherein arranging the one or more printed circuit board segments further comprises:

arranging the one or more printed circuit board segments such that, at any given time when the windings are energized with current, one or more locations of maximum density of the second magnetic flux are non-uniformly distributed about the axis of rotation.

18. The method of claim 14, wherein arranging the one or more magnetic flux producing windings comprises:

arranging the one or more magnetic flux producing windings such that, as the rotor rotates though a range of angles with respect to the stator at a constant speed, a periodicity of torque produced due to interaction of magnetic flux generated by the rotor and the stator is irregular.

19. A rotor for use in a motor or generator, comprising:

a support structure; and

one or more magnet segments that are supported by the support structure and that generate first magnetic flux parallel to an axis of rotation about which the support structure rotates when assembled with a stator that generates second magnetic flux parallel to the axis of rotation, wherein the one or more magnet

segments are configured and arranged to generate a magnetic flux profile that is non-uniformly distributed about the axis of rotation.

20. The rotor of claim 19, wherein the one or more magnet segments include at least a first magnet segment and a second magnet segment spaced apart from the first magnet segment, the first magnet segment including a larger number of adjacent magnets than the second magnet segment.

CLAIMS

1. A motor or generator, comprising:

a rotor having an axis of rotation and configured to generate a first magnetic flux parallel to the axis of rotation, wherein a first profile of the first magnetic flux is non-uniformly distributed about the axis of rotation; and

a stator configured to generate a second magnetic flux, different than the first magnetic flux, parallel to the axis of rotation, wherein a second profile of the second magnetic flux is non-uniformly distributed about the axis of rotation.

2. The motor or generator of claim 1, wherein the rotor comprises one or more magnet segments non-uniformly distributed about the axis of rotation, each of the one or more magnet segments generating a respective portion of the first magnetic flux.

3. The motor or generator of claim 2, wherein each of the one or more magnet segments has a respective surface location at which the respective portion of the first magnetic flux generated by that magnetic segment has a maximum density, and the respective surface locations are non-uniformly distributed about the axis of rotation.

4. The motor or generator of claim 1, wherein the stator comprises one or more printed circuit board segments non-uniformly distributed about the axis of rotation.

5. The motor or generator of claim 1, wherein the stator comprises conductive traces arranged on at least one dielectric layer to generate one or more respective portions of the second magnetic flux when energized with current.

6. The motor or generator of claim 5, wherein the stator is configured such that, at any given time when the conductive traces are energized with current, one or more locations of maximum density of the one or more respective portions of the second magnetic flux are non-uniformly distributed about the axis of rotation.

7. The motor or generator of claim 6, wherein the conductive traces are arranged on the at least one dielectric layer and coupled to a power source to generate a rotating magnetic flux corresponding to a poly-phase set of currents output by the power source.

8. The motor or generator of claim 1, wherein the rotor and the stator are configured such that, as the rotor rotates through a range of angles with respect to the stator at a constant speed, a periodicity of torque produced due to interaction of the first magnetic flux and the second magnetic flux is irregular.

9. The motor or generator of claim 1, wherein:

the rotor and the stator are configured to provide a torque capability between the rotor and the stator that varies aperiodically as a function of an angular position of the rotor relative to the stator as the rotor rotates through a full mechanical rotation about the axis of rotation.

10. The motor or generator of claim 1, wherein:

the rotor comprises at least first, second, and third magnets oriented to generate respective portions of the first magnetic flux in a first direction parallel to the axis of rotation;

no other magnets that are oriented to generate magnetic flux in the first direction are positioned angularly between the first magnet and the second magnet;

no other magnets that are oriented to generate magnetic flux in the first direction are positioned angularly between the second magnet and the third magnet; and

a first angular distance between the first magnet and the second magnet is at least two times a second angular distance between the second magnet and the third magnet.

11. The motor or generator of claim 10, wherein:

the stator comprises at least first, second, and third windings oriented to generate respective portions of the second magnetic flux in a second direction parallel to the axis of rotation when energized with current of a first polarity;

no other windings that are oriented to generate magnetic flux in the second direction when energized with current of the first polarity are positioned angularly between the first winding and the second winding;

no other windings that are oriented to generate magnetic flux in the second direction when energized with current of the first polarity are positioned angularly between the second winding and the third winding; and

a third angular distance between the first winding and the second winding is at least two times a fourth angular distance between the second winding and the third winding.

12. The motor or generator of claim 1, wherein:

a first portion of the rotor is configured to generate a first peak magnetic flux density, parallel to the axis of rotation, at a first location relative to the rotor;

a second portion of the rotor is configured to generate a second peak magnetic flux density, parallel to the axis of rotation, at a second location relative to the rotor;

a first portion of the stator is configured to generate a third peak magnetic flux density, parallel to the axis of rotation, at a third location relative to the stator; and

the rotor and the stator are configured such that a first torque capability between the rotor and the stator when the first location is angularly aligned with the third location is greater than a second torque capability between the rotor and the stator when the second location is angularly aligned with the third location.

13. The motor or generator of claim 12, wherein:

the rotor and the stator are configured such that the first torque capability when the first location is angularly aligned with the third location is at least twenty five percent greater than the second torque capability when the second location is angularly aligned with the third location.

14. The motor or generator of claim 12, wherein:

the rotor and the stator are configured such that the first torque capability when the first location is angularly aligned with the third location is at least two times the second torque capability when the second location is angularly aligned with the third location.

15. The motor or generator of claim 1, wherein:

a first portion of the stator is configured to generate a first peak magnetic flux density, parallel to the axis of rotation, at a first location relative to the stator;

a second portion of the stator is configured to generate a second peak magnetic flux density, parallel to the axis of rotation, at a second location relative to the stator;

a first portion of the rotor is configured to generate a third peak magnetic flux density, parallel to the axis of rotation, at a third location relative to the rotor; and

the rotor and the stator are configured such that a first torque capability between the rotor and the stator when the first location is angularly aligned with the third location is greater than a second torque capability between the rotor and the stator when the second

location is angularly aligned with the third location.

16. The motor or generator of claim 15, wherein:

the rotor and the stator are configured such that the first torque capability when the first location is angularly aligned with the third location is at least twenty five percent greater than the second torque capability when the second location is angularly aligned with the third location.

17. The motor or generator of claim 15, wherein:

the rotor and the stator are configured such that the first torque capability when the first location is angularly aligned with the third location is at least two times the second torque capability when the second location is angularly aligned with the third location.

18. The motor or generator of claim 1, wherein:

the rotor comprises a plurality of magnets configured and arranged to generate the first magnetic flux, wherein the plurality of magnets are arranged such that a first angular half of the rotor generates a first portion of the first magnetic flux and a second angular half of the rotor generates a second portion of the first magnetic flux that is substantially greater than the first portion.

19. The motor or generator of claim 1, wherein:

magnets that generate the first magnetic flux are arranged with 1-fold angular symmetry with respect to the rotor.

20. The motor or generator of claim 1, wherein:

one or more portions of the rotor are configured to generate peak magnetic flux densities in a first direction parallel to the axis of rotation at one or more first angular locations of a first angular half of the rotor and at zero or more second angular locations of a second angular half of the rotor, wherein a quantity of the one or more first angular locations is greater than a quantity of the zero or more second angular locations.

21. The motor or generator of claim 20, wherein:

one or more portions of the stator are configured to generate peak magnetic flux

densities in a second direction parallel to the axis of rotation at one or more third angular locations of a first angular half of the stator and at zero or more fourth angular locations of a second angular half of the stator, wherein a quantity of the one or more third angular locations is greater than a quantity of the zero or more fourth angular locations.

22. The motor or generator of claim 1, wherein:

a first angular half of the rotor includes a first quantity of magnets oriented to generate respective first portions of the first magnetic flux in a first direction parallel to the axis of rotation;

a second angular half of the rotor includes a second quantity of magnets oriented to generate respective second portions of the first magnetic flux in the first direction; and

the first quantity is greater than the second quantity.

23. The motor or generator of claim 22, wherein:

a first angular half of the stator includes a third quantity of windings oriented to generate respective first portions of the second magnetic flux in a second direction parallel to the axis of rotation when energized with current of a first polarity;

a second angular half of the stator includes a fourth quantity of windings oriented to generate respective second portions of the second magnetic flux in the second direction when energized with current of the first polarity; and

the third quantity is greater than the fourth quantity.

24. The motor or generator of claim 1, wherein:

the rotor comprises one or more magnets configured to generate the first magnetic flux, wherein the one or more magnets are non-uniformly distributed about the axis of rotation; and

the stator comprises one or more windings that, when energized with current, generate the second magnetic flux, wherein the one or more windings are non-uniformly distributed about the axis of rotation.