CLAIMS

We Claim:

1. An aerial vehicle comprising:

a plurality of rotor units connected to the aerial vehicle, wherein at least one rotor unit of the plurality of rotor units comprises:

two or more rotor blades, wherein each rotor blade of the two or more rotor blades comprises a surface area, and wherein an asymmetric parameter is defined, at least in part, by the relationship between the surface areas of the two or more rotor blades; and

a control system configured to operate the at least one rotor unit, wherein the value of the asymmetric parameter is such that the operation of the at least one rotor unit: (i) moves the two or more rotor blades such that each rotor blade produces a respective vortex and (ii) the respective vortices produced by the two or more rotor blades cause the rotor unit to produce a sound output having an energy distribution defined, at least in part, by a set of frequencies, wherein the set of frequencies comprises a fundamental frequency, one or more harmonic frequencies of the fundamental frequency, and one or more non-harmonic frequencies of the fundamental frequency, wherein each frequency of the set of frequencies has a respective strength greater than a threshold strength of 5 dB (A).

2. The aerial vehicle of claim 1, wherein the one or more harmonic frequencies of the fundamental frequency comprise five harmonic frequencies of the fundamental frequency, and wherein the one or more non-harmonic frequencies of the fundamental frequency comprise three non-harmonic frequencies of the fundamental frequency.

3. The aerial vehicle of claim 1, wherein the one or more harmonic frequencies of the fundamental frequency comprise three harmonic frequencies of the fundamental frequency, and wherein the one or more non-harmonic frequencies of the fundamental frequency comprise three-non harmonic frequencies of the fundamental frequency.

4. The aerial vehicle of claim 1, wherein the fundamental frequency comprises the blade passing frequency of the at least one rotor unit of the plurality of rotor units.

5. The aerial vehicle of claim 1, wherein the two or more rotor blades comprise:

a first rotor blade comprising a first span, and

a second rotor blade comprising a second span that is different than the first span, and wherein the asymmetric parameter is defined, at least in part, by the difference between the first span and the second span.

6. The aerial vehicle of claim 1, wherein the two or more rotor blades comprise:
a first rotor blade comprising a first chord distribution, and
a second rotor blade comprising a second chord distribution that is different than the first chord distribution, and wherein the asymmetric parameter is defined, at least in part, by the difference between the first chord distribution and the second chord distribution.

7. The aerial vehicle of claim 1, wherein the two or more rotor blades comprise:
a first rotor blade comprising a first width at a specific distance from a root of the first rotor blade, and
a second rotor blade comprising a second width at a corresponding specific distance from a root of the second rotor blade, wherein the second width is different than the first width, and wherein the asymmetric parameter is defined, at least in part, by the difference between the first width and the second width.

8. The aerial vehicle of claim 1, wherein the two or more rotor blades comprise:
a first rotor blade, and
a second rotor blade that is different than the first rotor blade, wherein the first rotor blade and the second rotor blade provide substantially the same lift along an axis of rotation of the at least one unit of the plurality of rotor units.

9. A rotor unit comprising:
a motor;
a hub coupled to the motor; and
two or more rotor blades coupled to the hub, wherein each rotor blade of the two or more rotor blades comprises a surface area, wherein an asymmetric parameter is defined, at least in part, by the relationship between the surface areas of the two or more rotor blades, and wherein the value of the asymmetric parameter is such that operation of the rotor unit: (i) moves the two or more rotor blades such that each rotor blade produces a respective vortex and (ii) the respective vortices produced by the two or more rotor blades cause the rotor unit to produce a sound output having an energy distribution defined, at least in part, by a set of frequencies,

wherein the set of frequencies comprises a fundamental frequency, one or more harmonic frequencies of the fundamental frequency, and one or more non-harmonic frequencies of the fundamental frequency, wherein each frequency of the set of frequencies has a respective strength greater than a threshold strength of 5 dB (A).

10. The rotor unit of claim 9, wherein the one or more harmonic frequencies of the fundamental frequency comprise five harmonic frequencies of the fundamental frequency, and wherein the one or more non-harmonic frequencies of the fundamental frequency comprise three non-harmonic frequencies of the fundamental frequency.

11. The rotor unit of claim 9, wherein the one or more harmonic frequencies of the fundamental frequency comprise three harmonic frequencies of the fundamental frequency, and wherein the one or more non-harmonic frequencies of the fundamental frequency comprise three-non harmonic frequencies of the fundamental frequency.

12. The rotor unit of claim 9, wherein the two or more rotor blades comprise:
a first rotor blade comprising a first span, and
a second rotor blade comprising a second span that is different than the first span, and wherein the asymmetric parameter is defined, at least in part, by the difference between the first span and the second span.

13. The rotor unit of claim 9, wherein the two or more rotor blades comprise:
a first rotor blade comprising a first chord distribution, and
a second rotor blade comprising a second chord distribution that is different than the first chord distribution, and wherein the asymmetric parameter is defined, at least in part, by the difference between the first chord distribution and the second chord distribution.

14. The rotor unit of claim 9, wherein the two or more rotor blades comprise:
a first rotor blade comprising a first width at a specific distance from a root of the first rotor blade, and
a second rotor blade comprising a second width at a corresponding specific distance from a root of the second rotor blade, wherein the second width is different than the first width, and wherein the asymmetric parameter is defined, at least in part, by the difference between the first width and the second width.

15. A method comprising:

using a plurality of rotor units, wherein at least one rotor unit of the plurality of rotor units comprises two or more rotor blades, wherein each rotor blade of the two or more rotor blades comprises a surface area, wherein an asymmetric parameter is defined, at least in part, by the relationship between the surface areas of the two or more rotor blades, and wherein the value of the asymmetric parameter is such that operation of the at least one rotor unit: (i) moves the two or more rotor blades such that each rotor blade produces a respective vortex and (ii) the respective vortices produced by the two or more rotor blades cause the rotor unit to produce a sound output having an energy distribution defined, at least in part, by a set of frequencies, wherein the set of frequencies comprises a fundamental frequency, one or more harmonic frequencies of the fundamental frequency, and one or more non-harmonic frequencies of the fundamental frequency, and wherein each frequency of the set of frequencies has a respective strength greater than a threshold strength of 5 dB (A).

16. The method of claim 15, wherein the one or more harmonic frequencies of the fundamental frequency comprise five harmonic frequencies of the fundamental frequency, and wherein the one or more non-harmonic frequencies of the fundamental frequency comprise three non-harmonic frequencies of the fundamental frequency.

17. The method of claim 15, wherein the one or more harmonic frequencies of the fundamental frequency comprise three harmonic frequencies of the fundamental frequency, and wherein the one or more non-harmonic frequencies of the fundamental frequency comprise three-non harmonic frequencies of the fundamental frequency.

18. The method of claim 15, wherein the two or more rotor blades comprise:
a first rotor blade comprising a first span, and
a second rotor blade comprising a second span that is different than the first span, and wherein the asymmetric parameter is defined, at least in part, by the difference between the first span and the second span.

19. The method of claim 15, wherein the two or more rotor blades comprise:
a first rotor blade comprising a first chord distribution, and

a second rotor blade comprising a second chord distribution that is different than the first chord distribution, and wherein the asymmetric parameter is defined, at least in part, by the difference between the first chord distribution and the second chord distribution.