CLAIMS

What is claimed is:

1. A mono-wing aerial device comprising:

a housing member having disposed thereon electronic components and a power source, including a controller configured to control a thrust unit;

a wing member coupled to the housing member, the wing member configured to produce aerodynamic forces for autorotation of the aerial device, the wing member comprising a first edge portion proximal to the housing member and a second edge portion distal to the housing member, wherein the wing member is coupled to the housing member at the first edge portion; and

the thrust unit coupled to the wing member at the second edge portion, wherein the thrust unit is configured to generate thrust in a direction substantially tangential to a rotational plane of the wing member, wherein

the wing member comprises a leading portion and a trailing portion, each of the leading portion and the trailing portion being a flat plate airfoil, the wing member having an inner wing region with the first edge portion and an outer wing region with the second edge portion, and the trailing portion being arranged along a length of the leading portion in the outer wing region, and

the controller is configured to control the thrust unit to generate the thrust for flight control, including directional control, of the mono-wing aerial device based on a square cyclic control.

2. The mono-wing aerial device of claim 1, wherein the second edge portion comprises a first side of the leading portion distal to the housing member and a first side of the trailing portion distal to the housing member, and the thrust unit is connected to the first side of the leading portion distal to the housing member.

3. The mono-wing aerial device of claim 1 or 2, wherein the leading portion comprises a second side proximal to the housing member, and the trailing portion comprises a second side proximal to the housing member, and the second side of the trailing portion being offset from the second side of the leading portion by a predetermined distance.

4. The mono-wing aerial device of any one of claims 1 to 3, wherein the leading portion is formed of a different material from the trailing portion.

5. The mono-wing aerial device of claim 4, wherein the leading portion is formed of wood and the trailing portion is formed of a solid foam material.

6. The mono-wing aerial device of any one of claims 1 to 5, wherein the square cyclic control comprises a first parameter relating to an offset thrust and a second parameter relating to an amplitude of a square wave.

7. The mono-wing aerial device of any one of claims 1 to 6, wherein the thrust unit comprises a motor and a propeller.

8. The mono-wing aerial device of any one of claims 1 to 7, wherein the housing member is a printed circuit board.

9. The mono-wing aerial device of any one of claims 1 to 8, wherein the housing member has a memory disposed thereon, and the controller is communicatively coupled to the memory and configured to control the thrust unit to generate the thrust in the direction substantially tangential to the rotational plane of the wing member.

10. A method of forming a mono-wing aerial device, the method comprising:

providing a housing member having disposed thereon electronic components and a power source, including a controller configured to control a thrust unit;

coupling a wing member to the housing member, the wing member configured to produce aerodynamic forces for autorotation of the aerial device, the wing member comprising a first edge portion proximal to the housing member and a second edge portion distal to the housing member, wherein the wing member is coupled to the housing member at the first edge portion; and

coupling the thrust unit to the wing member at the second edge portion, wherein the thrust unit is configured to generate thrust in a direction substantially tangential to a rotational plane of the wing member, wherein

the wing member comprises a leading portion and a trailing portion, each of the leading portion and the trailing portion being a flat plate airfoil, the wing member having an inner wing region with the first edge portion and an outer wing region with the second edge portion, and the trailing portion being arranged along a length of the leading portion in the outer wing region, and

the controller is configured to control the thrust unit to generate the thrust for flight control, including directional control, of the mono-wing aerial device based on a square cyclic control.

11. The method of claim 10, wherein a planform of the wing member and a location and orientation of the thrust unit at the second edge portion of the wing member is configured based on a first multi-component objective optimization function including a plurality of components for minimum thrust and minimum undesired oscillations at hover state using a genetic algorithm.

12. The method of claim 11, wherein the plurality of components of the first multi-component objective optimization function comprise a first component relating to an average thrust at hover, a second component relating to an average rotation speed, a third component relating to oscillations in a hover state, and a fourth component relating to a penalty function for undesired oscillations.

13. The method of claim 11, wherein the planform of the wing member and the location and orientation of the thrust unit at the second edge portion of the wing member is configured based on a second multi-component objective optimization function including a plurality of components relating to the square cyclic control using the genetic algorithm.

14. The method of claim 13, wherein the plurality of components of the second multi-component objective optimization function comprise a fifth component relating to a distance travelled under a square cyclic command, a sixth component relating to a fluctuating height of the mono-wing aerial device under the square cyclic command, and a seventh component relating to a penalty function for undesired oscillations.

15. The method of any one of claims 10 to 14, wherein the second edge portion comprises a first side of the leading portion distal to the housing member and a first side of the trailing portion distal to the housing member, and the thrust unit is connected to the first side of the leading portion distal to the housing member.

16. The method of any one of claims 10 to 15, wherein the trailing portion comprises a second side proximal to the housing member, the second side being offset from the housing member by a predetermined distance.