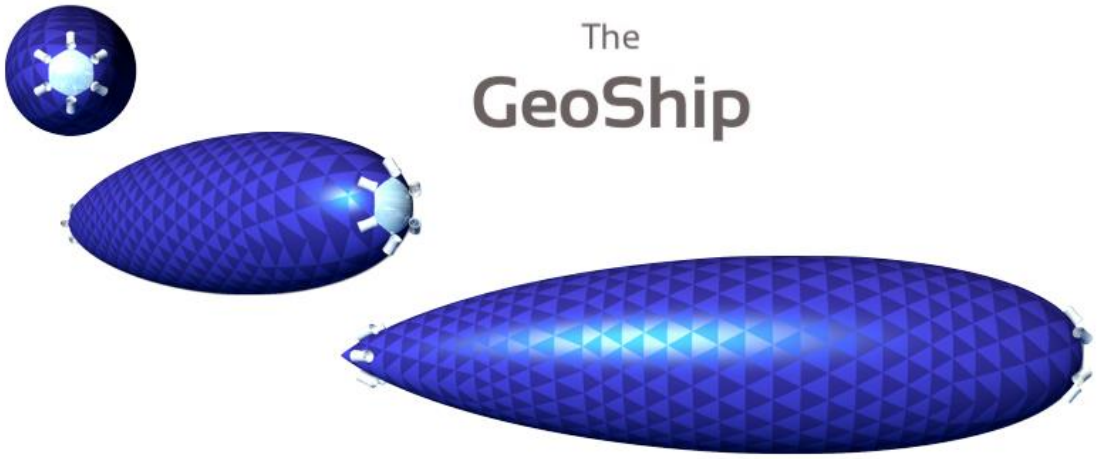
Skylite Aeronautics - GeoShip

Peter Lobner, 3 April 2021

1. Introduction

Skylite Aeronautics (originally Quantum Aerostatics) was founded by Michael Voorhees in Albuquerque, NM in 2004. The firm is performing the design, engineering, market analysis, and business development of a sustainable, environmentally friendly, global transportation airship known as the GeoShip, which is expected to be able to deliver cargo and passengers using 90% less energy than conventional jet planes. Michael Voorhees also is the inventor responsible for the key patents that are incorporated into the design of the GeoShip.



The GeoShip airship. Source: Skylite Aeronautics

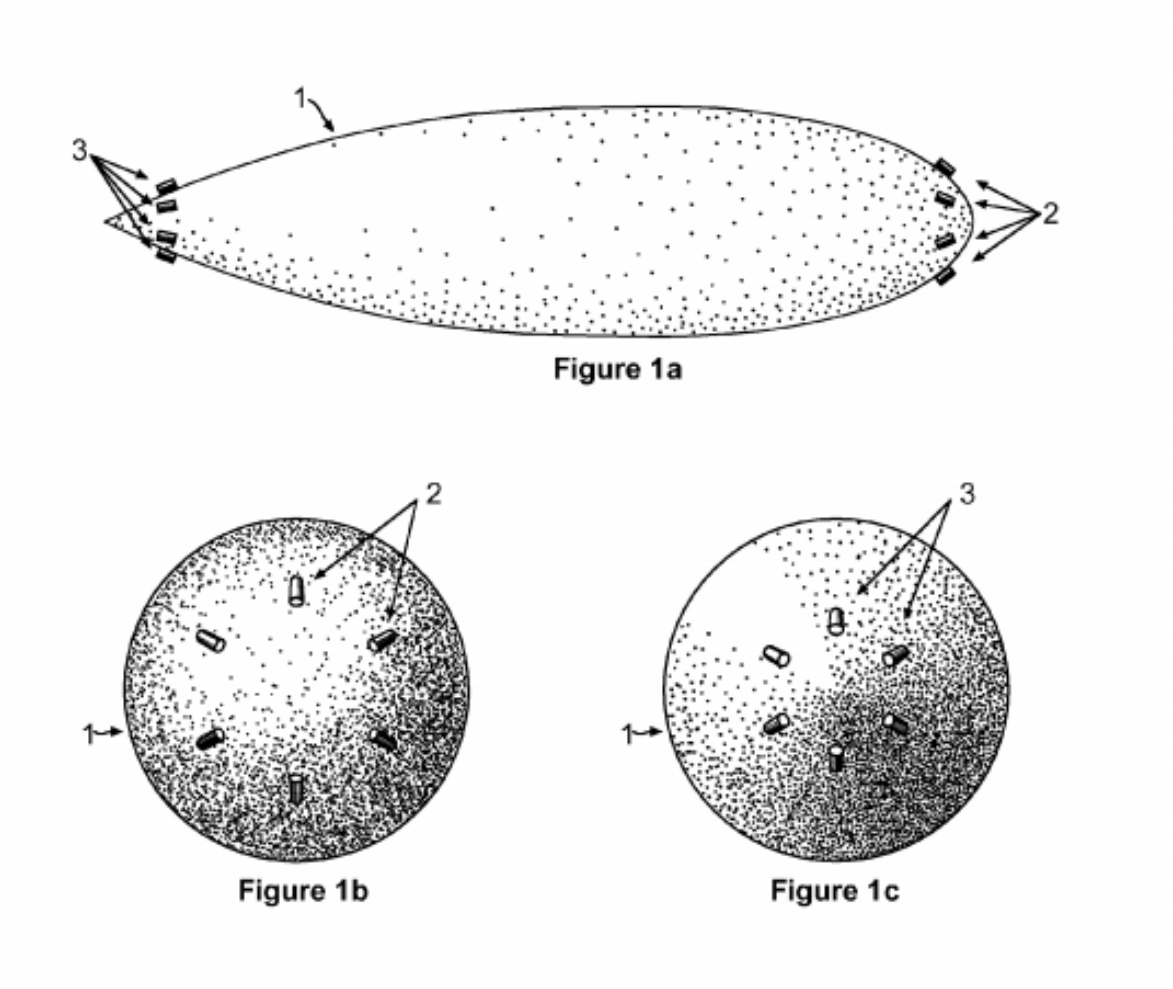
Here's the Skylite Aeronautics website:
http://www.skylite.aero/geoship/Welcome.html

2. Key patents

Two key US patents governing the operation of the GeoShip are US 7891603 B2, which describes the differential thrust control system, and US 8091826 B2, which describes the variable buoyancy control system. We'll take a look at both of those patents.

<u>Patent US 7891603 B2, Differential Thrust Control System, 22 February 2011</u>

This is a patent for using an array of bow and stern thrusters to propel the airship and provide high and low-speed maneuverability, thereby eliminating the need for conventional control surfaces (stabilizers, rudder



Array of individually controllable thrusters on the bow (2) and stern (3) of the airship (1). Source: Patent US 7891603 B2

The patent describes this design feature as follows:

> "A system allowing for the controlled propulsion of aircraft, especially buoyant and semi-buoyant airships designed as a symmetric body of revolution, without the need for or use of aerodynamic control surfaces, comprised of a plurality of ducted fan thrusters placed both fore and aft, designed to ingest air flowing at less than free stream velocity. Fans are arranged such that when at standard orientation, the thrust from each is directed tangentially to an arc drawn along the hull from bow to stern. By defining multiple sets of thrusters based upon their location, differential thrust may be applied based upon set membership in order to affect translational and rotational maneuvering of the aircraft."

You can read the differential thrust patent here: https://patents.google.com/patent/US7891603B2/en?oq=US+7%2c891%2c603+B2

Patent US 8091826 B2: Aerostatic Buoyancy Control System, 10 January 2012

This is a patent for a variable buoyancy control system that operates by compressing or releasing air in chambers within the airship to manage the overall buoyancy and/or the fore and aft trim of the airship. The patent describes this design feature as follows:

> "A system allowing for the active management of aerostatic lift in buoyant and semi-buoyant aerial vehicles comprised of a high tensile-strength outer pressure cell of a given volume and an inner compression cell of only slightly smaller dimensions. The inner compression cell is filled with a lifting gas, such as helium or hydrogen, to some fractional volume of its maximum, allowing for expansion of the lifting gas at different operational altitudes. When a reduction in aerostatic lift is desired, external air is compressed through the use of air handling means, and introduced into the outer pressure cell through a directional valve that prevents the pressurized air from leaving the pressure cell. When increased aerostatic lift is once again desired, the valve system may release all or a part of the

pressurized air in the pressure cell, allowing the lifting gas to expand thereby displacing a greater volume of air and increasing lift."

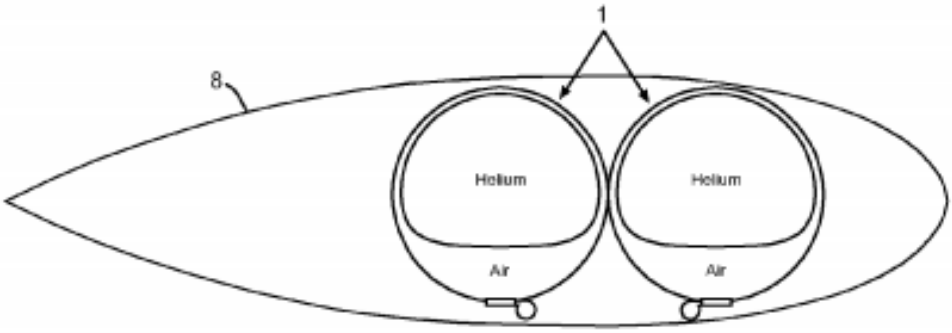


Figure 3a

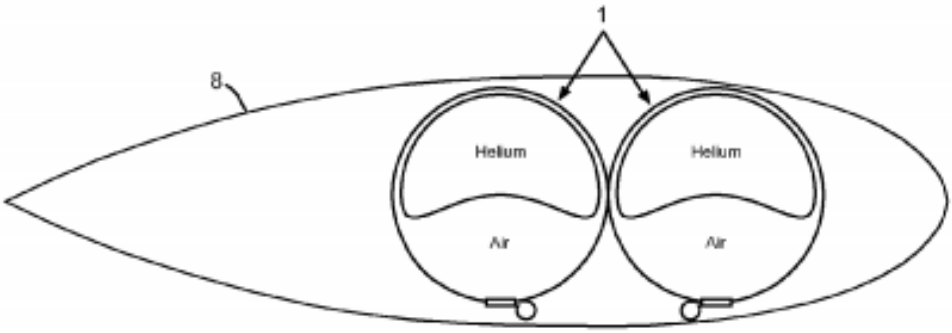


Figure 3b

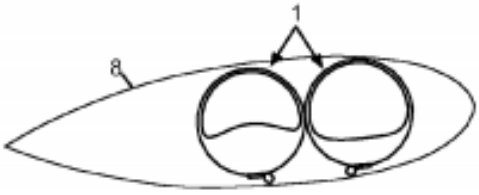


Figure 4a

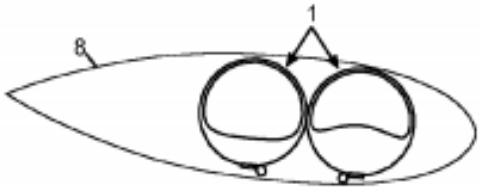


Figure 4b

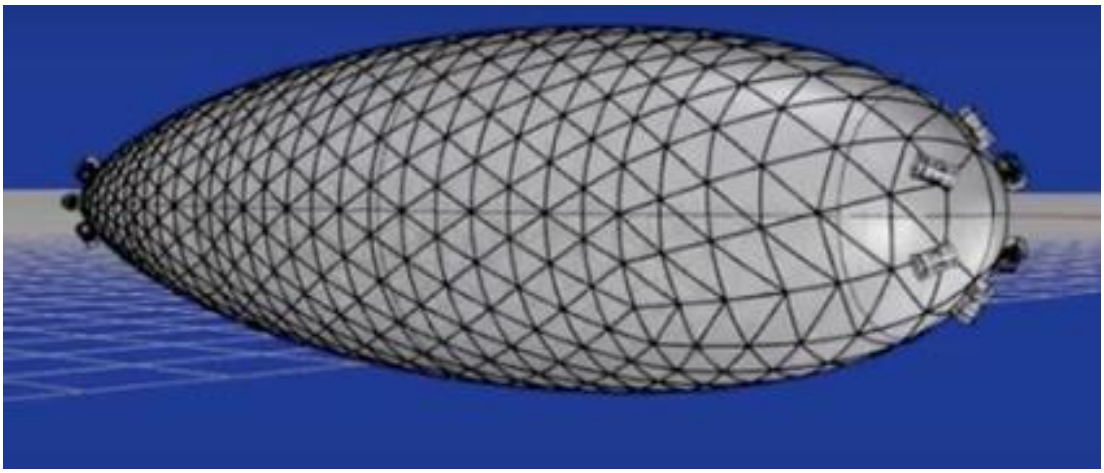
Individually controllable pressurized air and helium volumes (1) within the airship hull (8). Source: Patent 8091826 B2

You can read the buoyancy control patent here: https://patents.google.com/patent/US8091826B2/en?oq=US+8%2c091%2c826+B2

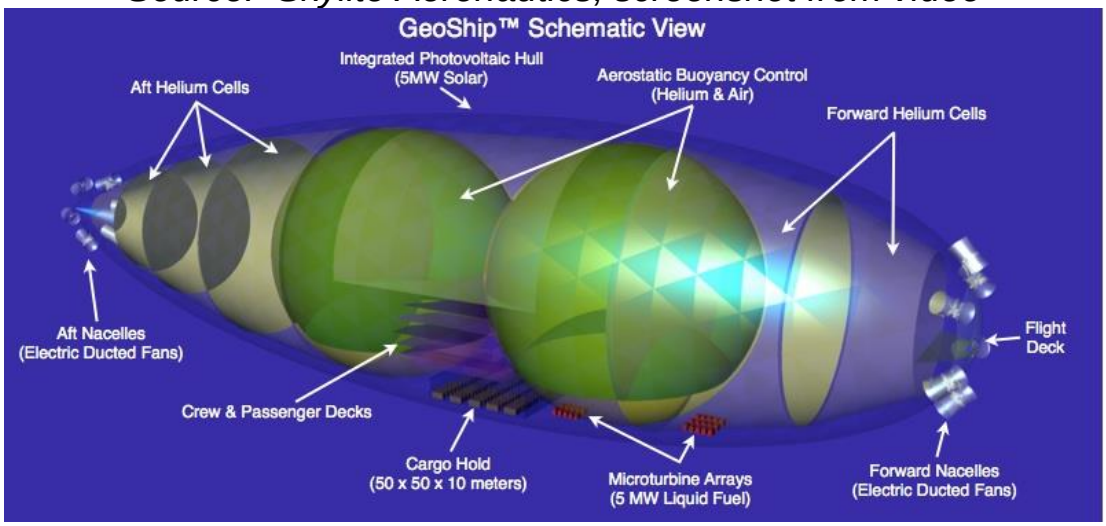
3. General features of the GeoShip

The GeoShip is a very large, streamlined, rigid airship with the following features.

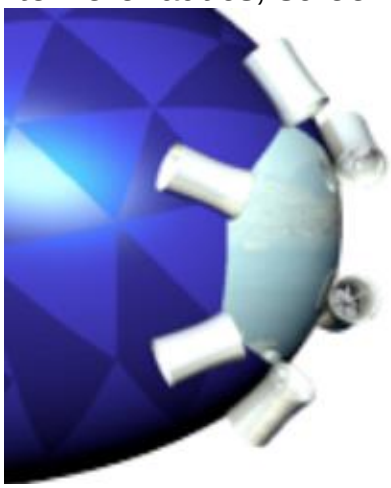
- Fully-triangulated geodesic, rigid airframe based on the geodesic design principles developed by Buckminster Fuller.
    - The geodesic hull structure distributes loads well and enables handling very large payloads. This should improve the operational economics of the airship.
- Streamlined shape with high fineness ratio (length-to-maximum width ratio).
- Very large airship - 500 meters (1,640 ft) in length, 133 meters (436 ft) in diameter, gas volume 3 million m^3 (106 million ft^3)
- Capable of carrying very large loads:
    - Up to 1,000 metric tons (1,102 short tons) of cargo in a large cargo hold measuring 50 m wide x 50 m deep x 10 m high (164 x 164 x 33 ft), or
    - 600 passengers in comfortable staterooms
- Patented variable aerostatic buoyancy control system enables important operational capabilities:
    - Vertical takeoff and landing (VTOL)
    - Hovering
    - Load exchange at the landing site without a ballast exchange
- Patented differential thrust system using electrically-powered bow and stern ducted fan thrusters provides propulsion and high- and low-speed maneuverability without the need for aerodynamic control surfaces.
- Electric power system is supplied primarily by:
    - Solar cells on the surface of the airship are the primary source of power, with a generating capacity up to 5 MW
    - A battery system provides energy storage
    - Flex-fuel micro turbines provide up to 5 MW of electric power when needed, with very low fuel consumption
- Range: Intercontinental using both solar power and liquid fuel
- Speed: Up to 86 knots (99 mph; 159 kph)
- Can land on unimproved fields without a ground crew.



GeoShip geodesic rigid airframe.
Source: Skylite Aeronautics, screenshot from video



Anatomy of the GeoShip, showing internal arrangement.
Source: Skylite Aeronautics, screenshot from video



Bow ducted fan thruster array. Source: Skylite Aeronautics

Regarding operational economics, Skylite Aeronautics reported:

> "….because of the GeoShip's maneuverability and independence from fixed infrastructure, it can economically access locations unreachable by any conventional means. Traveling at speeds of up to 86 knots—more than three times that of the fastest container ships—the GeoShip will outperform trucking, even in developed nations with quality road networks. This enables an attractive pricing model for both operator and client, providing a better price/speed value than competing modes, while securing a significantly higher profit margin."

You can watch Skylite Aeronautics' 2011 short video "The GeoShip Project," here:

https://www.youtube.com/watch?v=JwqixPWHTV0

Artist's rendering of a GeoShip in flight over Vancouver.
Source: Skylite Aeronautics, screenshot from video