AERONAUTICAL LIFT COMPANY

INTRODUCTION

This White Paper introduces new innovative disruptive technology for creating aeronautical lift that can be applied to drones, VTOL aircraft, space vehicles, handicap mobility devices, and many other lift applications.

The technology consists of small, lightweight, energy efficient electronic lifting devices with no external moving parts, sound, or altitude restrictions. Multiple independent lifting devices can be joined together to provide any desired magnitude of lift or lift redundancy (for safety).

Multiple patent applications are pending on this technology. The first patent:

ARTIFICIAL BUOYANCY METHOD AND APPARATUS
(US Patent 11,472,537) was issued 10-18-22.

The goal of this White Paper is to introduce this new technology, describe its principal of operation, and discuss a potential business structure to maximally exploit the technology.

LIFTING DEVICE PRINCIPAL OF OPERATION

Extensive lifting device details are contained in the attached issued patent. This section presents the patented technology using more tutorial language, targeted for an audience not used to reading patents. To obtain more detail and to view the figures referenced, simply refer to the issued patent attached in this White Paper.

The simpler intuitive explanation in this section describes the lift produced as somewhat similar to buoyant force (lift) based on the Archimedes' Principle. That is, the buoyant force that allows helium balloons to float in air and boats and people to float in water.

Another way to express buoyancy in air, is that the upward air pressure force on the bottom of an object is greater than the downward air pressure force on the top of the object.

Similarly, this patented technology is based on the coined word "Artificial Buoyancy", in which similar to true "Archimedes buoyancy", air pressure on the top surface of a lifting device is reduced below the air pressure on its bottom surface.

For example, normal atmospheric air pressure is approximately 14 pounds per square inch (psi) at low altitudes. Therefore air pressure on each face of a 1 inch cubic block is 14 pounds (lbs) because the surface area of each six sides of the block is one square inch. The block doesn't move because air pressures on opposite sides of the block are equal.

However, if the block top surface air pressure is reduced by 2 psi (to 12 psi), the block bottom surface upward force is 14 lbs and the block top surface downward force is 12 lbs. Therefore, an upward force (lift) of 2 lbs (14 lbs upward force minus 12 lbs downward force) is created.

Creating the same 2 psi lifting force on a lifting device whose surface area is 1 square foot, would produce 288 lbs of lift since there are 144 square inches per square foot.

The attached US Patent 11,472,537 illustrates four techniques for reducing top lifting device air pressure below bottom lifting device air pressure.

A pyramid or pyramidal shaped lifting device is illustrated in FIG. 2 using a 4 sided pyramid whose base is 1 square inch, and whose height is approximately 1 inch tall. The pyramid is composed of a stack of thin sections in which each section is both rapidly extended and not extended in length using ultrasonic movements.

The effect is that air is first pushed sideways away from the pyramid when each section is extended, and a low pressure void is momentarily formed on the top surface of each section when not extended. By extending and retracting opposite faces at the same time, no sideways movement forces are exerted on the pyramid. The momentary low pressure void on the top surface of each section when not extended, creates an upward lifting force on the pyramid.

Lift on the pyramid can be estimated assuming 14 psi air pressure. Since the entire 1 square inch top surface of the pyramid is void of air for approximately half the time, the lift is approximately half the 14 psi air pressure. That is, the upward lift is approximately 7 lbs. If 144 pyramids were attached to a 1 square foot surface, the total upward lift would be approximately 1000 lbs.

The attached patent calculates the total power to move all sections of these 144 pyramids as 8.9 watts to produce an upward lift of approximately 1000 lbs. The ultrasonic movements can be generated using ultrasonic actuator components such as piezoelectric, magnetostrictive, electrostatic, or MicroElectroMechanical Systems (MEMS) components. This example illustrates the high lifting device energy efficiency possible using these artificial buoyancy techniques.

The primary reason for requiring only 8.9 watts to produce an upward lift of approximately 1000 lbs is due to the fact that great quantities of air are not being propelled away from the lifting device. In helicopters, huge quantities of air at high velocities are blown downward. Likewise for rocket propulsion. In contrast, the pyramid moves air only a few millimeters away from its surface. No energy is expended to blow great quantities of air far away from the pyramid surface, as occurs in existing lifting devices.

An example of creating lift using a rotating lifting device is illustrated in FIG. 3. This device also creates lift by pushing air sideways off the lifting device top surface.

As with the pyramid approach, the rotating lifting device is composed of a stack of thin circular plates which resemble a truncated cone shaped stack of circular saw blades. Each upper plate has a slightly smaller diameter than the preceding lower plate.

The initial bottom plate is simply a flat circular plate with no teeth. All succeeding plates are flat circular plates with teeth. As the lifting device rotates counterclockwise (CCW), teeth of the plate forces air sideways away from the lower plate.

This creates a momentary low pressure void on the top surface of the lower plate which provides upward lift similar to the previous pyramid example. All subsequent lower plates operate similarly.

For a 12 inch diameter bottom plate spinning at 83,333 revolutions per minute in 14 psi air pressure, the combined upward lift from all plates is 594 lbs. The optimum method to fabricate this spinning lifting device is to 3D print it as a single structure.

Instead of pushing air sideways off a lifting device top surface, another method for achieving aeronautical lift by reducing downward air pressure on a top surface, without changing upward air pressure on a bottom surface is to rapidly move the top surface downward, thus reducing downward air pressure on the top surface.

Traditionally, piezoelectric ultrasonic transducers have been used to generate ultrasound for multiple applications, of which medical ultrasound imaging is the primary application. More recently, MicroElectroMechanical Systems (MEMS) technology has emerged in which Micro-machined Ultrasonic Transducers (MUTs) have the advantages of small size, low cost and broad bandwidth.

MUTs are divided into Capacitive Micro-machined Ultrasonic Transducers (CMUTs) and Piezoelectric Micro-machined Ultrasonic Transducers (PMUTs). CMUTs have higher operating frequencies and can be constructed using Complementary Metal-Oxide-Semiconductor (CMOS) compatible fabrication processes, which allows them to be fabricated as large arrays. They can also be batch fabricated on the same wafer with high yields and reduced cost. CMUT technology has enabled realizing densely packed CMUT elements in 2D configurations.

Over the last dozen years or so, numerous research has been conducted, and papers published, on MEMS and MUTs technology. Although most MEMS devices are implemented using an excitation voltage, some are designed using current, magnetic, radio frequency, thermal, or other types of excitation signals. In this patent, voltage excitation signals were assumed, described, and illustrated when referring to MEMS. However, any of these alternate excitation signals might also be used to perform the described function.

A CMUT element is composed of multiple cells, acting as interconnected plate capacitors in which a thin movable plate is placed between the top and bottom electrodes. When an excitation voltage is applied, modulation of the electrostatic force between the electrodes induces plate vibrations that generate an acoustic wave.

An example of a typical CMUT cell is illustrated in FIG. 4. A voltage generator is connected between the top and bottom electrodes, which forms a parallel plate capacitor. When voltage is applied, electrostatic force of attraction bends a silicon membrane down into an air gap. When voltage from voltage generator goes to zero, the silicon membrane springs back up out of the air gap.

Typically, many CMUT cells are fabricated on a CMUT device, which might contain 100 or more CMUT cells. A large number of CMUT devices can be batch fabricated on a single 4 inch diameter (or larger wafer) which makes CMUT technology an ideal ultrasonic component for this artificial buoyancy application.

There are numerous different CMUT designs described in the literature for use in many different applications. For this artificial buoyancy application, CMUT cells only require pulsed movement which greatly simplifies the CMUT device design. CMUT cells are an ideal device to implement this artificial buoyancy, whereby downward air pressure is reduced on a top surface by moving the top surface downward, without changing the upward air pressure on a bottom surface. That is, CMUT cells are mounted to a top plate of the lifting device such that all top electrodes are pointing up. The voltage generator is programmed to output a voltage for a short period and then output zero voltage for the next short period.

When voltage is applied, the silicon membrane is rapidly retracted to the bottom electrode which creates a low air pressure on the top electrode. A short time later, no voltage is applied which causes the top electrode to return to its initial no voltage position. That is, the ultrasonic movement is similar to that illustrated in FIG. 2 for the pyramid lifting device. However, instead of the CMUT cell pushing air sideways away from a top surface, it is a top surface pulling away from the air.

One or more CMUT modules can be powered and driven by separate voltage generators and power supplies for flight safety. If a particular voltage generator or power supply fails, aeronautical lift will be only slightly reduced and easily restored by increasing the lift of other CMUT modules.

CMUT cells are low profile, low power, and low cost. CMUT cells can be combined to provide as much lift area as required. They can also be placed in thin flat enclosures, attached together using connectors, and stacked in layers as illustrated in FIG. 8.

The assembly illustrated in FIG. 9 indicates another advantage of artificial buoyancy, with respect to normal buoyancy. Assume a lifting device is attached inside a vented outer box. At low altitudes, air pressure on top and bottom of the outer box, and the air pressure on the bottom of the lifting device is 14 psi and the resultant lift vector is 3 lbs which propels the assembly upward.

At some higher altitude, air pressure on the top and bottom of the outer box, and on the bottom of the lifting device drops to 0 lbs so the assembly no longer rises.

When outer box is not vented, but rather sealed and pressurized to 14 psi using normal air or some other gas, air pressures have not changed on the lifting device, which continues to propel the assembly higher.

Sealing any lifting device in a pressurized temperature-controlled enclosure has many advantages. It protects the lifting device, allows the lifting device design to be optimized to operate at a particular pressure and temperature that doesn't change, could streamline the outer box assembly for high velocity flight normal to lift, mutes all lifting device ultrasonic sound, and allows the assembly to operate outside the atmosphere (that is, there are no altitude restrictions).

There are numerous applications for these methods and apparatus implementations of artificial buoyancy. The most immediate useful application is for drones, as the use of drones is increasing exponentially for industry, business, and recreation. In the near future, package delivery use alone will mean that drones with noisy rotors will invade nearly every neighborhood. The silent and energy efficient method for providing aeronautical lift by these artificial buoyancy methods will allow drones to fly silent, longer, and with heavier payloads.

Another important humanitarian use is for handicap mobility vehicles as illustrated in FIG. 12. By installing MEMS cells in thin flat enclosures and mounting them on top of mobility vehicles such as carts, wheelchairs, etc., individuals with mobility deficiencies could return to many common activities. Currently, stairs, curbs, off-road (hiking, woods, beach sand, etc.) activities are not possible for these people. The ability to float a foot or so off the surface would solve all these problems.

The ability to float to the edge of space and dwell stationary indefinitely, powered by solar cells, would be very beneficial for communications, surveillance, space tourism, etc.

The advantage of CMUT, PCMUT, and DPCMUT technology (explained in the patent) is that once a single MEMS technology cell is optimized for a lifting application, multiple identical cells can be fabricated into modules such as illustrated in FIG. 7. Numerous modules can then be assembled into structures such as illustrated in FIG. 8 to obtain any lift required.

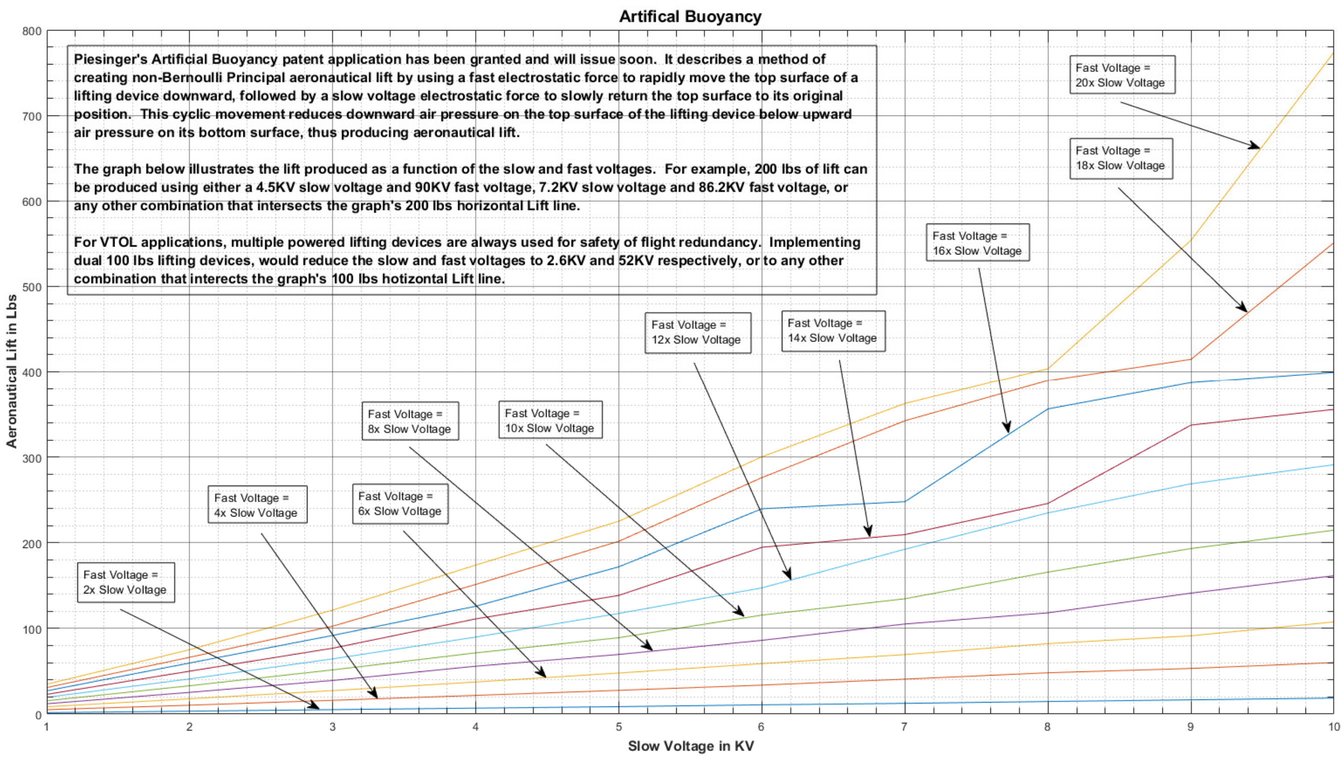
PROJECT STATUS

This project was started approximately 3 years ago and was initially targeted towards light drones. Like most new projects, many concepts and techniques were investigated for new technology that could provide lift without the use of noisy propellers. As is now standard practice, ideas were tested via extensive computer simulations. Based on these simulations, MEMS proved to be the best technology for small drones as adequate lift could be obtained using low voltages of around 100 volts.

Much was learned through these simulations, which led to new more efficient lift techniques that are capable of lifting much higher loads. These techniques are currently patent pending.

These enhanced techniques are similar to the MEMS approach of achieving aeronautical lift by reducing downward air pressure on a top surface by rapidly moving the top surface downward, thus reducing downward air pressure on the top surface. However, it can use larger diameter non-MEMS pistons and higher electrostatic voltages.

The graph below illustrates the simulated lift obtainable using a 12 inch diameter piston. Electrostatic pistons are extremely energy efficient. The capacitance of a 12 inch diameter piston is in the low picofarad range. Only a few watts of power are required to drive them, even at high lift settings.



WILL IT WORK?

Piesinger has been granted 45 patents over his 50+ years of engineering experience as a Senior Engineer working at Bell Telephone Laboratories, Motorola Government Electronics Division, Sperry Flight System, Honeywell Avionics Division, ACSS, and other large and small companies.

The only way to prove new technology will actually work, is to build and test it. However, as all my previous patents worked as expected, confidence is high that this Artificial Buoyancy technology will also work as expected. Modern computer simulation allows nearly all aspects of new technology to be pretested prior to actual hardware construction.

PROPOSED PRODUCT COMPANY

Piesinger formed his current company "Origo Corporation" http://www.origocorp.com/ in 2003 to manufacture and market Phase Identification products for the Electric Utility Industry. These products are based on multiple innovative technologies patented by Piesinger and are sold worldwide.

However, Origo is far to small a company to adequately exploit this Artificial Buoyancy technology. It is now time to select the most lucrative market for the first product and build a "proof of concept" hardware prototype.

The first task is to pick an appropriate company name, such as **"Aeronautical Lift, Inc."** or other name, and Incorporate it in Arizona and perhaps other states. As this technology has numerous potential applications, it would make sense to form multiple "Company Divisions" to exploit different classes of products. Below is a potential list of Divisions, and comments on potential products, that could be manufactured and sold by each of the various Divisions.

Aeronautical Division

Numerous companies currently produce drones for industrial applications such as powerline, roof, and construction inspections. An emerging application is for package delivery. Soon, numerous noisy drones will be evading neighborhoods, resulting in complaints and possible restrictions on their use. The ability to swap out noisy propellers for silent efficient Artificial Buoyancy lifting devices will be a great marketing advantage. That is **Aeronautical Lift, Inc**. need not have to design drones, but simply sell the lifting devices to current drone manufacturers.

Numerous other companies are working on VTOL aircraft for intercity transportation. Noise, safety, and Federal regulations are the current main obstacles to this market. The ability to provide silent operation and quad, octal, or higher lift redundancy using Artificial Buoyancy lifting devices would greatly accelerate growth of this intercity transportation application.

Again, **Aeronautical Lift, Inc**. need not have to design the VTOL Aircraft, but simply sell the lifting devices to current VTOL manufacturers.

On a smaller scale, there is great interest and demand for small personal flying machines (light recreational aircraft) like powered hang gliders, gyrocopters, etc. Piesinger currently has a patent pending for such an aircraft which would allow anyone with no skill or training to safely fly.

The concept incorporates modern drone technology (obstacle avoidance, auto takeoff and land, one button return home, etc., with quad or octal lift redundancy. That is, it would be impossible to crash short of hiding under a bridge, waiting for a vehicle to approach, and flying into its path at the last moment.

At low cost, this product would allow virtually everyone to experience the joy of silently soaring or flying like an eagle.

Aeronautical Lift, Inc. could design, build, and sell millions of these worldwide. Undoubtedly, there are many other unique new aeronautical products that could be sold using Artificial Buoyancy.

Space Division

Currently, sending anything into space requires very inefficient rocket power. That is, for every pound of payload, many pounds of rocket propellant are required.

However, instead of blasting the payload into space, Artificial Buoyancy now allows a payload to be floated into space. It also allows the payload to be floated out of space, which eliminates the need (and weight) of a fiery reentry heat shield.

Another great advantage is that the payload can be built and assembled into its final deployed form on earth, instead of having to package it in a special protective enclosure to survive the rocket trip into space.

Also, large structures no longer have to be launched separately and assembled in orbit or at their final destination. This feature will make future large moon or mars habitats practical. As multiple lifting devices can be assembled together, any required lift can be generated, no mater the size and weight of the habitats.

A Mars launch window (when Earth and Mars are closest together) occurs approximately every 2 years. The next window is around November 2024. If you assume enough Artificial Buoyancy propulsion lift is implemented to provide a constant 0.1g acceleration towards Mars, and a constant 0.1g deceleration at the half-way point, then a one-way trip from Earth to Mars only takes around 10 days. This is in stark contrast to the estimated 1/2 year currently postulated.

As nuclear power allows submarines and ships to run for about twenty years without needing to refuel, using a similar electric power supply on a Mars Artificial Buoyancy vehicle/habitat, would allow routine trips to Mars and back without ever refueling.

Another useful Artificial Buoyancy space product would be a vehicle designed to return satellites to Earth for repair or upgrade, or to collect space junk, that is currently a threat to all types of satellites and spacecraft.

Handicap Mobility Division

One of the most beneficial applications of Artificial Buoyancy is for handicap products. There are currently numerous wheelchair bound individuals whose activities are severely limited due to the restricted mobility of wheelchairs.

Using Artificial Buoyancy, wheelchairs could be given the ability to float a short height above the surface. This would allow users to now travel over non-smooth terrain such as street curbs, grass, beach sand, through wooded areas, etc. They could also float up stairs, store escalators, and the like.

By equipping these Artificial Buoyancy vehicles with modern drone sensors and software, they could be automatically prevented from moving forward outside their ability to navigate the immediate terrain. Also, the mobility capabilities of each vehicle could be customized, via software selections, for the particular user. Mobility capabilities, of severely disabled persons, such as speed, terrain, etc. would be programmable. This would allow temporary or lightly disabled individuals to allowed all mobility capabilities so they could regain nearly all normal pre-handicap mobility.

Communications Division

Another very large application of Artificial Buoyancy is as communication platforms. By incorporating solar cells and overnight batteries on an Artificial Buoyancy platform, a communication repeater could be parked at low altitude over a specific location, such as a city. This capability would allow low power cellular transmitters to service a much broader area than current traditional cell towers.

There is also currently much interest in providing satellite to cell phone service over population areas. Instead of launching thousands of small satellites into orbit (which is currently required because each orbiting satellite quickly moves out of each specific service area), a low power stationary Artificial Buoyancy communication platform could simply be floated over each population area.

Earth Imaging and Surveillance Division

Current Earth imaging satellites require a tradeoff between geostationary satellites and orbiting satellites. For high image resolution, geostationary satellites require powerful telescopes, whereas low orbiting satellites do not.

The optimum imaging solution could be provided using an Artificial Buoyancy platform that can be placed at the optimum position and height for the imaging task. By simply varying the platform height, any desired resolution/area tradeoff could easily be obtained.

Industrial Mobility Division

In the Electrical Utility Industry, Linemen use tens of thousands of bucket trucks to work on power lines. In many cases, wooded terrain or other obstacles obstructs driving them into position.

An ideal solution would be to simply add Artificial Buoyancy lifting devices to the bucket portion, and routinely carry the bucket in the back of their standard pickup trouble truck.

As with the Aeronautical Division, the bucket would incorporate modern drone technology to freeze the bucket in its current position until repositioned by the lineman. The bucket would also incorporate quad or octal lift redundancy for safety and would have no height restrictions so could be used on even the tallest structures or buildings.

Other very useful industrial lift products could be small portable lifting units to pickup and transport heavy loads. That is, instead of having to use a crane, remote control lifters could perform the same task.

Heavy Lift Division

Another product area could be large generic heavy lift units that could lift containers onto and off ships, or could move prefabricated houses or buildings from the factory to the customer.

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Disaster Assistance Division

Large special purpose disaster relief units could be built for use in fighting forest fires, rescuing earthquake or hurricane flood victims, portable hospitals, and the like.

Conclusion

The uses for Artificial Buoyancy are unlimited, and would change everything with respect to products for aeronautical, space, handicap, communications, satellites, surveillance, industrial, etc.

Piesinger is looking for individuals, established companies, investors, and others who would be interested in participating, financing, or marketing this new technology.

To maximize sales and profits, consideration should also be given to US and foreign patenting of all product key technologies and implications.

Origo would appreciate any comments and suggestions. Thanks.

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