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PROPULSION TECHNOLOGY FOR JET PACK SUITS

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Abstract-Jetpack suits rely on propulsion technology to generate the necessary thrust to lift the wearer off the ground and allow them to fly. There are various types of propulsion technologies used in jetpack suits, including chemical rockets, gas turbines, electric fans, and even water jets. The design of the propulsion system depends on various factors, such as the desired flight time, the weight of the user, and the level of control required.

In general, jetpack suits use a combination of thrust generated by one or more engines and a system of nozzles that direct the thrust in different directions to allow for maneuverability. The engines can be fueled by a variety of materials, including kerosene, hydrogen peroxide, or electricity. The fuel is typically stored in tanks located on the user's back or in the jetpack itself.

One of the challenges of developing jetpack suits is to balance the weight of the propulsion system with the user's weight to ensure that the suit remains stable and easy to control. Additionally, the propulsion system must be designed to be safe and reliable, as any failure could result in serious injury or even death. As technology advances, it is likely that jetpack suits will become more efficient, lightweight, and easier to use, making them accessible to a wider range of users.

I. INTRODUCTION

Jetpack suits are a type of personal flying device that allows the user to take to the skies and experience the freedom of flight. These devices rely on propulsion technology to generate the necessary thrust to lift the user off the ground and keep them airborne. Propulsion technology for jetpack suits has come a long way since the first prototypes were developed in the 1960s. Today, there are a variety of propulsion technologies available, each with its own set of advantages and disadvantages.

The development of propulsion technology for jetpack suits is a complex process that involves a range of engineering disciplines, including aerodynamics, materials science, and control systems. Engineers must consider factors such as the weight of the propulsion system, the safety of the user, and the level of control required to maneuver the device.

Jetpack suits have a variety of potential applications, from recreational flying to military and emergency response operations. In recent years, there has been renewed interest in jetpack technology as advances in materials science, control systems, and energy storage have made it possible to build safer, more reliable, and more efficient devices.

Despite these advances, there are still challenges to be overcome, including the need to balance the weight of the propulsion system with the weight of the user, and the development of more efficient and sustainable fuels. However, as technology continues to improve, it is likely that we will see a wider range of jetpack suits available to consumers, making it possible for more people to experience the thrill of flight.

Propulsion technology refers to the mechanisms and systems used to generate the necessary force to move an object through a fluid or a vacuum. Propulsion technology is used in a wide range of applications, including aircraft, spacecraft, ships, and automobiles.

The development of propulsion technology has played a critical role in shaping the modern world, enabling us to travel faster and farther than ever before. Propulsion systems have evolved from simple steam engines to complex rocket engines and electric motors, with each new advancement bringing new levels of speed, efficiency, and safety.

The design of propulsion systems involves a range of engineering disciplines, including thermodynamics, fluid mechanics, and materials science. Engineers must consider factors such as the weight of the system, the efficiency of the

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engine, and the safety of the user or operator.Advances in propulsion technology have enabled us to explore new frontiers, from deep space to the depths of the ocean. They have also transformed transportation, enabling us to travel across the globe in a matter of hours rather than days or weeks.

As we continue to push the limits of propulsion technology, we are likely to see even more exciting advancements in the years ahead, including new forms of propulsion that are more efficient, sustainable, and capable of taking us to places we have never been before.

Jetpack suits are a type of personal flying device that allows the user to take to the skies and experience the thrill of flight. They typically consist of a small engine or set of engines attached to a lightweight frame that is worn on the user's back or integrated into a suit. The engines generate thrust that propels the user upwards, allowing them to fly through the air.Jetpack suits have a long history, with the first prototypes dating back to the 1960s. However, it is only in recent years that advances in materials science, control systems, and energy storage have made it possible to build safer, more reliable, and more efficient devices.

Today, jetpack suits have a range of potential applications, from recreational flying to military and emergency response operations. They offer users a unique and thrilling experience, allowing them to soar through the air and experience the world from a new perspective.The development of jetpack suits involves a range of engineering disciplines, including aerodynamics, materials science, and control systems. Engineers must consider factors such as the weight of the device, the safety of the user, and the level of control required to maneuver the device.As technology continues to improve, it is likely that we will see even more advanced jetpack suits become available to consumers, making it possible for more people to experience the thrill of flight in a safe and controlled manner.

II.TECHNOLOGY

Propulsion Technology
Propulsion is the generation of force by any combination of pushing or pulling to modify the translational motion of an object, which is typically a rigid body (or an articulated rigid body) but may also concern a fluid.The term is derived from two Latin words: pro, meaning before or forward; and pellere, meaning to drive. A propulsion system consists of a source of mechanical power, and a propulsor (means of converting this power into propulsive force).

Plucking a guitar string to induce a vibratory translation is technically a form of propulsion of the guitar string; this is not commonly depicted in this vocabulary, even though human muscles are considered to propel the fingertips. The motion of an object moving through a gravitational field is affected by the field, and within some frames of reference physicists speak of the gravitational field generating a force upon the object, but for deep theoretic reasons, physicists now consider the curved path of an object moving freely through space-time as shaped by gravity as a natural movement of the object, unaffected by a propulsive force (in this view, the falling apple is considered to be unpropelled, while the observer of the apple standing on the ground is considered to be propelled by the reactive force of the Earth's surface).

Biological propulsion systems use an animal's muscles as the power source, and limbs such as wings, fins or legs as the propulsors. A technological system uses an engine or motor as the power source (commonly called a powerplant), and wheels and axles, propellers, or a propulsive nozzle to generate the force. Components such as clutches or gearboxes may be needed to connect the motor to axles, wheels, or propellers. A technological/biological system may use human, or trained animal, muscular work to power a mechanical device.

Fig 1.Armadillo Aerospace's quad rocket vehicle showing shock diamonds in the exhaust plume from its propulsion system.

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Turbojet Packs

Packs with a turbojet engine are fueled with traditional kerosene-based jet fuel. They have higher efficiency, greater height and a duration of flight of many minutes, but they are complex in construction and very expensive. Only one working model of this pack was made; it underwent flight tests in the 1960s and at present it no longer flies. Jet packs and rocket packs have much better flight time on a tankful of fuel if they have wings like an aeroplane's.

1.Bell Jet Flying Belt: wingless

1965 Bell Aerosystems concluded a new contract with the Defense Advanced Research Projects Agency (DARPA) to develop a jet pack with a turbojet engine. This project was called the "Jet Flying Belt", or simply the "Jet Belt". Wendell Moore and John K. Hulbert, a specialist in gas turbines, worked to design a new turbojet pack. Williams Research Corporation (now Williams International) in Walled Lake, Michigan, designed and built a new turbojet engine to Bell's specifications in 1969. It was called the WR19, had a rated thrust of 1,900 newtons (430 lbf) and weighed 31 kg (68 lb). The Jet Belt first flew free on 7 April 1969 at the Niagara Falls Municipal Airport. Pilot Robert Courter flew about 100 m (330 ft) in a circle at an altitude of 7 m (23 ft), reaching a speed of 45 km/h (28 mph). The following flights were longer, up to 5 minutes. Theoretically, this new pack could fly for 25 minutes at velocities up to 135 km/h (84 mph).

2.Visa Parviainen's jet-assisted wingsuit

On 25 October 2005 in Lahti, Finland, Visa Parviainen jumped from a hot air balloon in a wingsuit with two small turbojet jet engines attached to his feet. Each turbojet provided approximately 160 N (16 kgf) of thrust and ran on kerosene (Jet A-1) fuel. Parviainen apparently achieved approximately 30 seconds of horizontal flight with no noticeable loss of altitude.

3.Yves Rossy's jet wingpack

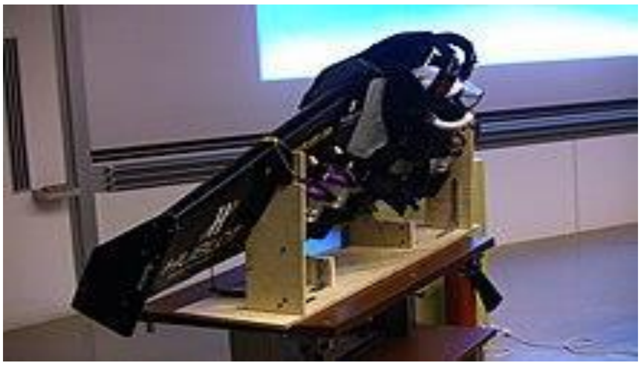

Fig 2.Rossy's wing showing the four purple and silver jet-engines mounted close to the centre

Swiss ex-military and commercial pilot Yves Rossy developed and built a winged pack with rigid aeroplane-type carbon-fiber wings spanning about 2.4 m (8 ft) and four small kerosene-burning Jetcat P400 jet engines underneath; these engines are large versions of a type designed for model aeroplanes. He wears a heat-resistant suit similar to that of a firefighter or racing driver to protect him from the hot jet exhaust .Similarly, to further protect the wearer, the engines are modified by adding a carbon fiber heat shield extending the jet nozzle around the exhaust tail.

Rossy claims to be "the first person to gain altitude and maintain a stable horizontal flight thanks to aerodynamic carbon foldable wings", which are folded by hinges at their midpoint. After being lifted to altitude by a plane, he ignites the engines just before he exits the plane with the wings folded. The wings unfold while in free-fall, and he then can fly horizontally for several minutes, landing with the help of a parachute. He achieves true controlled flight using his body and a hand throttle to maneuver; jet wingsuits use small turbojets, but differ from other aircraft in that the fuselage and flight control surfaces consist of a human.

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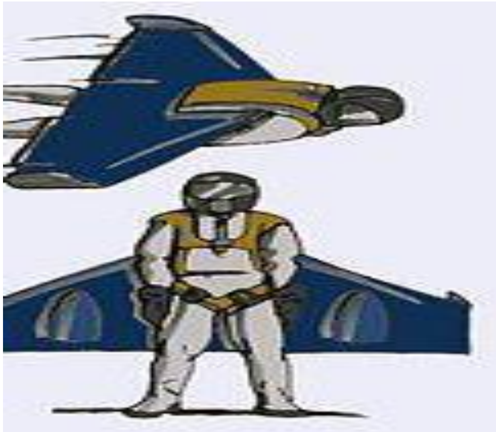

Fig 3.A jet-powered wingpack

The system is said by Rossy to be highly responsive and reactive in flight, to the point where he needs to closely control his head, arm and leg movements to avoid an uncontrolled spin. The engines on the wing must be aligned precisely during set-up, also to prevent instability. An electronic starter system ensures that all four engines ignite simultaneously. In the event of a spin, the wing unit can be detached from the pilot, and pilot and wing unit descend to Earth separately, each with a parachute.

Rossy appeared in a February 2012 episode of Top Gear (S18 E5) where he raced against a Skoda rally car driven by Toni Gardemeister with Richard Hammond as a passenger. The race started with the rally car launching down the rally course while Rossy and his support helicopter climbed to reach altitude, upon which he dropped and ignited his engines and followed the course to race the car. Periodical smoke dashes (such as those used by sky-writers or air force display teams) were used to track his progress. In the onboard footage of Rossy flying the tight and twisty course, one can see how he uses his body parts as control surfaces to perform various maneuvers.

4. Space

Fig 4. Astronaut propulsion unit

Rocket packs can be useful for spacewalks. While near Earth a jet pack has to produce a g-force of at least 1 g (a smaller g-force, providing only some deviation from free fall is of little use here), for excursions outside a free falling spaceship, a small g-force providing a small deviation from free fall is quite useful. Hence much less delta-v is consumed per unit time, and not during the whole EVA. With only small amounts of thrust needed, safety and temperature are much more manageable than in the atmosphere in Earth's gravity field.

Nevertheless, it is currently worn to be used only in case of emergency: the Simplified Aid For EVA Rescue (SAFER).

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5.Hydrojet Packs

The 21st century has seen a new approach to jet packs where water is used as a high-density propulsion fluid. This requires a very large mass of fluid that makes a self-contained jet pack infeasible.

Fig 5. Jetlev water powered jet pack

Fig 6.Flyboard with its distinctive configuration of having the nozzles located below the pilot's feet

Instead, this approach separates the engine, fuel and fluid supply from the pilot's flying apparatus, using a long flexible hose to feed the water to the jet nozzle pack attached to the pilot's body. These inventions are known as "hydro jet packs", and successful designs have used jetski technology as the powerplant operating in a body of water (an ocean, lake, or pool) to provide the needed propulsion. Several hydro jet pack approaches have been successfully tested and put into production. Flow rate can be controlled by a throttle operator on the jetski, or by the pilot using a remote actuator.

III. RESULTS

Jetpack technology has come a long way since its inception in the 1960s. Today, there are several companies and organizations that have developed working jetpacks that can be used for a variety of purposes, including military and search and rescue operations, as well as recreational activities.

The primary means of propulsion for jetpacks is through the use of small jet engines, which provide the necessary thrust to lift the wearer off the ground and enable them to fly. These engines can be powered by a variety of fuels, including kerosene, diesel, and hydrogen peroxide. One of the main challenges in developing jetpack technology has been achieving sufficient thrust while maintaining stability and control. To address this challenge, many jetpack designs incorporate sophisticated computer systems that monitor and adjust the thrust output to keep the wearer stable in the air.

Another important consideration is fuel efficiency. Jetpacks require a significant amount of fuel to provide the necessary thrust, which can limit their range and flight time. To improve fuel efficiency, some jetpacks incorporate hybrid-electric propulsion systems, which combine traditional jet engines with battery-powered electric motors.

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IV. CONCLUSION

The success of small satellites has led to increased mission and scientific capabilities of miniaturized spacecraft, spurred by the decreased mission cost and faster development schedules. As mission complexities evolve, the need for high capability propulsion, previously mostly reserved for traditional large satellite platforms with high power budgets, has driven the development of a plethora of propulsion solutions for small satellites, CubeSats, and beyond. This review discusses the different propulsion principles applicable to small satellites, and presents a classification of available propulsion solutions, including a variety of different chemical and EP systems of varying complexity and performance. A classification of these propulsion systems is given, based on the tradeoffs in performance parameters, including thrust, specific impulse, and input power. A review of selected space qualified propulsion systems is presented, highlighting key technologies for specific satellite classes. A discussion of the predominant scaling laws for miniaturization of different propulsion systems is given, identifying the limiting factors in miniaturization on thruster, and system level is given. Based on this, the propulsion related requirements and state-of-the-art technologies for the extreme cases of chip and membrane satellites, and infinite specific impulse missions are discussed.

ACKNOWLEDGEMENT

The development of propulsion technology for jetpack suits has been made possible through the hard work and dedication of many engineers, scientists, and researchers over the years. Their efforts have led to the creation of jetpacks that are not only capable of providing sufficient thrust to lift a wearer off the ground but also incorporate advanced control systems to maintain stability and control in flight.

Furthermore, the use of various fuels and hybrid-electric propulsion systems has made these devices more efficient and practical for a variety of applications, from recreational activities to military and search and rescue operations.In addition to the contributions of individual engineers and scientists, the development of jetpack technology has also been supported by governments, private companies, and academic institutions around the world, who have invested significant resources and funding in research and development.

Thus, the success of propulsion technology for jetpack suits is a testament to the collective efforts of many individuals and organizations working together towards a common goal of advancing human transportation and exploration
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