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Design of Landing Gear Retraction System for UAV's

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Abstract: **Landing gear is the undercarriage of an aircraft or spacecraft and is often referred to as such. For aircraft, the landing gear supports the craft when it is not flying, allowing it to take off, land and usually to taxi without damage. Wheels are typically used but skids, skis, floats or a combination of these and other elements can be deployed depending both on the surface and on whether the craft only operates vertically (VTOL) or is able to taxi along the surface. Faster aircraft usually have retractable undercarriage, which folds away during flight to reduce air resistance or drag. The retraction of landing gear is the folding and opening of the landing gear inwards and outwards from the wings. In this paper I have designed a landing gear retraction system using CATIA V5 which can be used in the UAV's to reduce the drag component. The landing gear here is retracted using the servos, so with the help of a transmitter and a receiver we can perform the retraction operation very easily by connecting the servos to the receiver. This operation will also give us the feeling of a real retraction system as seen in the landing and take-off of manned aircrafts. This process mainly focuses on protecting the landing gear of UAV's from breaking due to any obstacle in its way during flying, this can be due to any bird hit or in any other means. This design is made in such a way that both the landing gears retract exactly at 90 degrees with respect to the horizontal axis of wing. The system followed here is a two axis system where the landing gear will fold in sideways into the wings.**

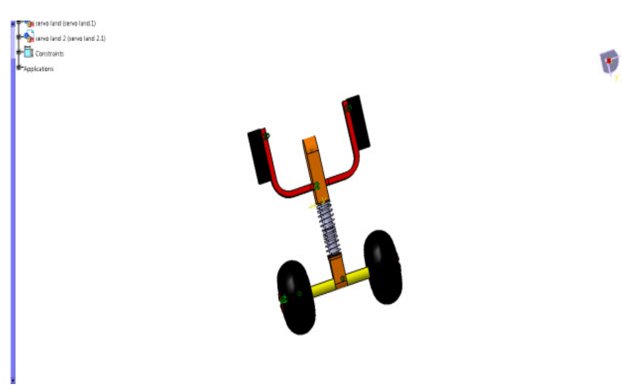
1. INTRODUCTION

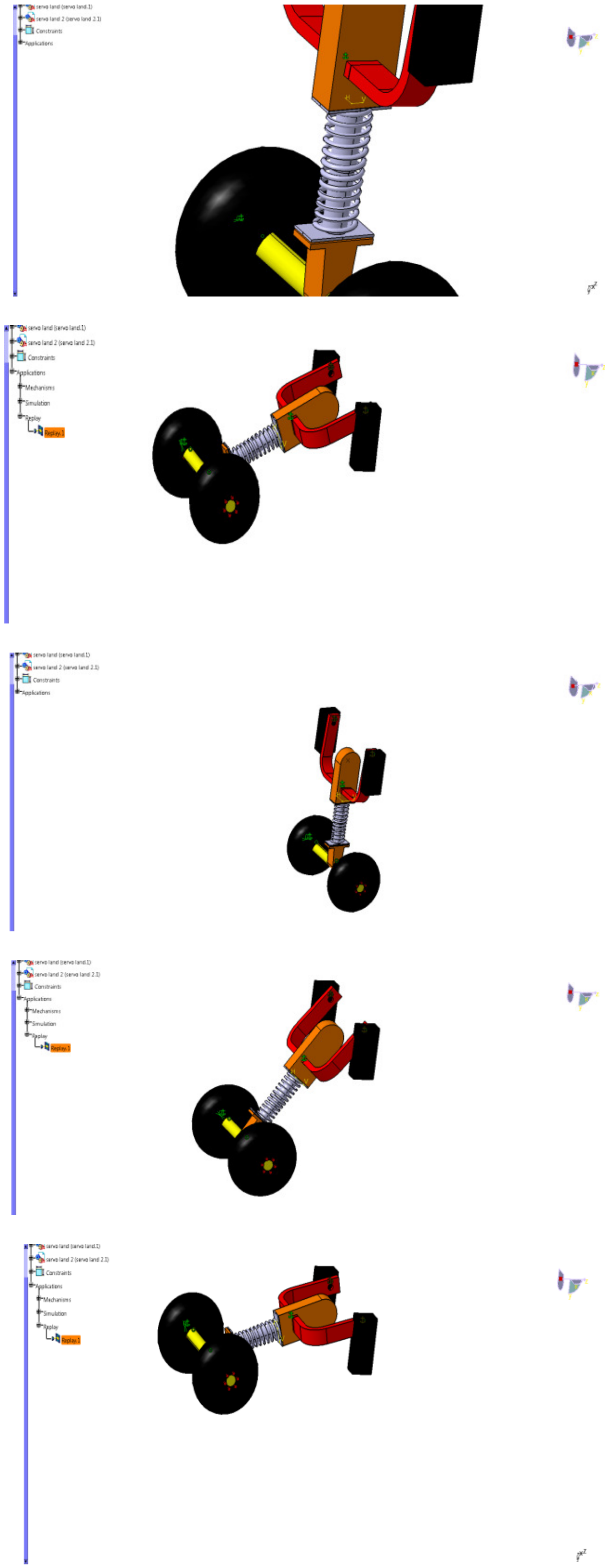
Mechanism design processes tend to focus on determining paths for key parts of the mechanism. If the path is the only desired output, specific methods to compute the kinematics can be used. These types of approaches are prevalent in robotics applications an area in which much of the current mechanism research occurs . When the dynamics of the mechanism along a path is required, a multibody dynamics-based formulation tends to be sought. A multibody dynamics approach is often used in a wide variety of engineering applications, of which mechanism design forms a subset. Due to the capabilities of multibody dynamics software packages to simulate dynamic systems in general (rather than just mechanisms), engineers working in an industrial context where mechanism analysis is not commonplace, will tend to use these methods during the design process. Dynamical systems theory is a branch of mathematics that provides methods for the analysis of ordinary differential equations for background information on this topic. The idea is that the underlying equilibria form the backbone of the system's dynamics. Knowledge of the underlying equilibria can therefore be used to understand various aspects of a given system's behaviour. One tool available to compute loci of equilibria is numerical continuation. This numerical tool enables points of interest to be traced, or `continued', through the given model's state-parameter space. By considering how the system's equilibria (or other invariant objects) change under the variation of a parameter of interest, it is possible to build up a global picture of the equilibria structures that govern the dynamic behaviour. Several examples in the literature have shown the benefits offered by this approach for the

analysis of engineering system: with applications in aerospace, civil and automotive engineering, a dynamical systems approach has been shown to provide a useful, complementary tool, when paired with more traditional dynamic simulations. In this paper I have designed a landing gear retraction system using CATIA V5 which can be used in the UAV's to reduce the drag component. The landing gear here is retracted using the servos, so with the help of a transmitter and a receiver we can perform the retraction operation very easily by connecting the servos to the receiver.

2. RETRACTION MECHANISM USING SERVOS:-

Fig 1:- The above figures shows the retraction of the landing gear.





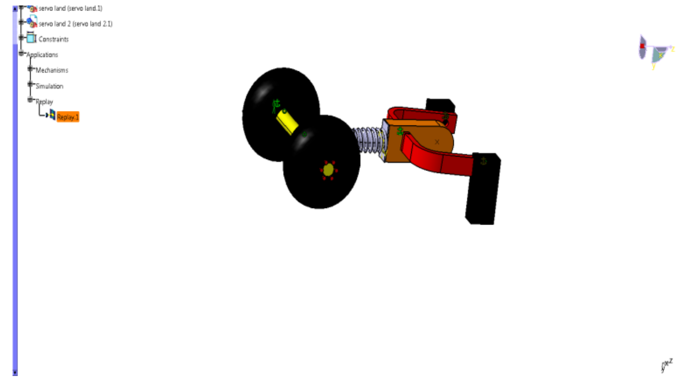


Fig 1:- The above figures shows the retraction of the landing gear.

The retraction mechanism shown above is done with the help of servos where a transmitter is used to control the servo movements. An oleo type strut is used here where the shock absorbers will absorb the vibrations produced in during landing of the aircraft. This landing gear is mainly designed for its use in the UAV's. The damping motions are also prevented by the use of the shock absorbers. The functions of an oleo type strut is explained below.

3. OLEO STRUT TYPE LANDING GEAR

I have used a kind of oleo type of strut to design my landing gear. An **oleo strut** is an air–oil hydraulic shock absorber used on the landing gear of most large aircraft and many smaller ones. It cushions the impacts of landing and while taxiing and damps out vertical oscillations.

An oleo strut consists of an inner metal tube or piston, which is attached to the wheel axle, and which moves up and down in an outer (or upper) metal tube, or cylinder, that is attached to the airframe. The cavity within the strut and piston is filled with gas (usually nitrogen, sometimes air – especially on light aircraft) and oil (usually hydraulic fluid), and is divided into two chambers that communicate through a small orifice. When the aircraft is stationary on the ground, its weight is supported by the compressed gas in the cylinder. During landing, or when the aircraft taxis over bumps, the piston slides up and down. It compresses the gas, which acts as a spring, and forces oil through the orifice, which acts as a damper. A tapered rod may be used to change the size of the orifice as the piston moves, and a check valve may be used to uncover additional orifices so that damping during compression is less than during rebound.

Nitrogen is usually used as the gas instead of air, since it is less likely to cause corrosion. The various parts of the strut are sealed with O-rings or similar elastomeric seals, and a scraper ring is used to keep dust and grit adhering to the piston from entering the strut.

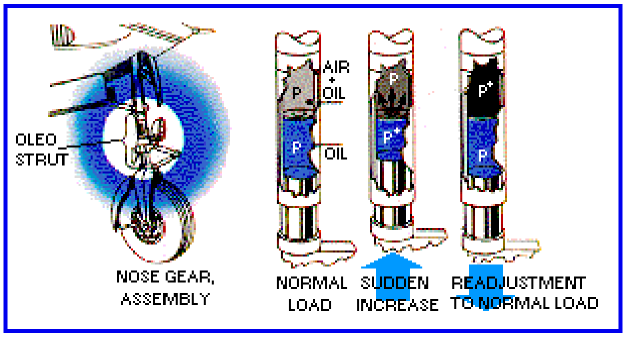


Figure 1-9 The function of an oleo strut.

4. RETRACTABLE LANDING GEARS

1. To decrease drag in flight some undercarriages retract into the wings and/or fuselage with wheels flush against the surface or concealed behind doors; this is called retractable gear.

2. If the wheels rest protruding and partially exposed to the airstream after being retracted, the system is called semi-retractable.

3. Most retraction systems are hydraulically operated, though some are electrically operated or even manually operated.

4. This adds weight and complexity to the design. In retractable gear systems, the compartment where the wheels are stowed are called wheel wells, which may also diminish valuable cargo or fuel space.

5. Multiple redundancies are usually provided to prevent a single failure from failing the entire landing gear extension process. Whether electrically or hydraulically operated, the landing gear can usually be powered from multiple sources. In case the power system fails, an emergency extension system is always available. This may take the form of a manually operated crank or pump, or a mechanical free-fall mechanism which disengages the uplocks and allows the landing gear to fall due to gravity. Some high-performance aircraft may even feature a pressurized-nitrogen back-up system.

5. REASON FOR THE ARRIVAL OF THIS DESIGN FOR THE DRAG EFFECTS ON THE LANDING GEAR

The landing gear (or undercarriage) is the structure (usually struts and wheels) that supports the aircraft weight and facilitates its motion along the surface of the runway when the aircraft is not airborne. Landing gear usually includes wheels and is equipped with shock absorbers for solid ground, but some aircraft are equipped with skis for snow or floats for water, and/or skids. To decrease drag in flight, some landing gears are retracted into the wings and/or fuselage with wheels or concealed behind doors; this is called retractable gear. In the case of retracted landing gear, the aircraft clean C_{Do} is not affected by the landing gear.

When landing gear is fixed (not retracted) in place, it produces an extra drag for the aircraft. It is sometimes responsible for an increase in the aircraft drag as high as 50%. In some aircraft, a fairing is used to decrease the drag of a non-retracted gear. The fairing is a partial cover that has a streamlined shape such as airfoil.

The parameter C_{Dlg} is the drag coefficient of each wheel; that is 0.15, when it has fairing; and is 0.30 when it does not have any fairing. The frontal area of each wheel is simply the diameter (dg) times the width (wg).

$S_{lg} = d_g w_g$

6. IMPLEMENTING THIS DESIGN FOR REAL CASE IN FUTURE

Servo Installation:-

1. Here the two servos are defined and marked as left servo and right servo.

2. Connect the left servo to the [L] port on the control board, and the right servo to the [R] port.

Mechanical Assembly:-

1. Assemble the left and the right parts respectively, and then fix the screws at the joints with appropriate screw thread lock.

2. Connect the left and right parts with the connecting rod.

3. For safety reasons, make sure to connect the springs to both parts.

Electrical Connections:-

1. Plug the cables from the servos into the correct ports on the control board. Make sure the right servo is connected to the [R] port, and the left servo to the [L] port.

2. Connect the required 2-position switch channel of the R/C receiver to the [IN] port.

7. CONCLUSION

Therefore to reduce the drag component in UAV's this type of landing gear is mainly designed. To reduce the vibrations produced at the time of landing the shock absorbers are mainly used at the strut. The implementing of this idea in real time will give better results on the side of drag and vibrations caused in other types of landing gears.

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