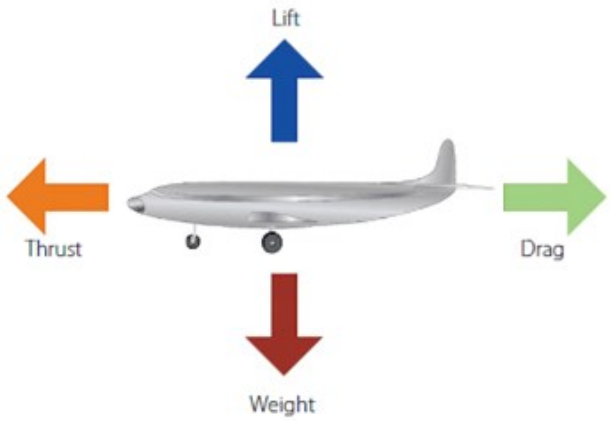
Guideline : Unmanned Aircraft General Knowledge



1.1 Basic Principle of Flight

In Aviation , There are **4 forces of flight**.

- **Lift** is the force that directly opposes the weight of the unmanned aircraft and holds the unmanned aircraft in the air.
- **Weight** is the weight of the unmanned aircraft.
- **Thrust** is the force which moves the unmanned aircraft through the air. That's the same direction as the unmanned aircraft movement.
- **Drag** is The resistance force of the unmanned aircraft. That's the opposite direction as the unmanned aircraft movement.

4 forces of flight are very important in aviation in order to control to fly the unmanned aircraft.

1.2 The Effect of Environmental Conditions on The Performance of the UAS

1.2.1 How does wind affect flight

Unmanned aircraft is like any other type of aircraft that can be affected by wind. It depends on the type, size and weight of the unmanned aircraft. Small and light aircraft are more easily affected by wind than larger aircraft. Wind effect of Multirotor unmanned aircrafts are greater than fixed-wing unmanned aircrafts. When the

unmanned aircraft hovers in place in relation to the ground, the wind effect creates an airspeed for the unmanned aircraft that is equivalent to the force of the wind, and the unmanned aircraft requires steering commands to stay in place, which may affect the motor power required as well as the consumption of battery charge. In a strong wind, the unmanned aircraft may not be able to maintain its position. A fixed-wing unmanned aircraft flies in relation to the air, and the unmanned aircraft's groundspeed varies depending on the flight direction and the wind force. In general, wind force increases with altitude. For all commercially produced unmanned aircraft, the manufacturer has stated the highest recommended wind force in which the unmanned aircraft can fly. The remote pilot must study the manufacturer's instructions and follow them to ensure a safe flight. If the wind is too strong, the unmanned aircraft may drift away with the wind, or the remote pilot may lose control.

1.2.2 Rain, thunder, fog can affect flight

Unmanned aircrafts are vulnerable to rain, thick fog. Moisture can enter the unmanned aircraft's body and damage the components of the control system. The moisture damage may only be revealed later as malfunctions in the unmanned aircraft's operation. This will affect the processing system. Aircraft cameras and receivers. Humidity is also likely to result in damage to the aircraft later. There was Hail , Strong wind gusts and lightning strikes can cause a number of hazards in flight operations, including hazards to other aircraft and persons or property on the ground, as they can cause loss of aircraft control. It also affects the cognitive and visual abilities of Remote Pilot in Command. This reduces the visibility ability. As a result, more caution must be taken when flying.

1.2.3 Air density can affects flight from altitude, air pressure and temperature

The characteristics of atmosphere vary based on the density of air. Air density is affected by the altitude, air pressure and temperature. In cold air, there is a greater

density of air than in hot air. As a result, the unmanned aircraft is able to generate lift in cold air better than in hot weather.

1.2.4 How different weather conditions affect flight

- Wind affects the unmanned aircraft's ability to fly and wind may affect the external payloads (Cameras etc.) . therefore, external payloads must always be attached carefully.

- Humidity can affect the processing unit due to rain and fog. Unmanned aircraft may also attract lightning strikes and the unmanned aircraft's sensors do not work normally in humid conditions.

- Air density In cold air has a greater density of air than in hot air. And unmanned aircrafts can generate lifts in cold air better than in hot weather.

- Turbulence may occur if Remote Pilot control to fly unmanned aircraft near buildings, forest or variable terrain. This can disturb the flow of the air mass.

1.2.5 Find out the weather conditions and forecasts

Remote Pilot in Command must check the weather conditions in the flying area from www.tmd.go.th This is to prepare before flying so that the flight can be carried out in maximum safety.

2. Principle of Command and Control

Remotely piloted Aircraft (Unmanned Aircraft) means an aircraft where the flying pilot is not on board the aircraft and use the aircraft control system but not include small airplane which using as a toy pursuant to the Ministerial Regulation on the Non-Aircraft Object B.E. 2548 (A.D. 2005)

Remotely piloted Aircraft System means a set of configurable elements consisting of a remotely-piloted aircraft, its associated remote pilot stations, the required command and control links and any other system elements as may be required, at any point during flight operation.

1. Unmanned Aircraft Control is commanded by controlling the unmanned aircraft through the remote controller. This will be a command to control the unmanned aircraft
2. The frequency used mainly in remote controller is in the range of 2.4 – 5.8 GHz. The Remote Pilot in Command must request the signal from The National Broadcasting and Telecommunication Commission (NBTC).
3. Normally, Unmanned Aircraft Control System can command and control both of the movement of the unmanned aircraft and the use of the recording cameras installed on the unmanned aircraft. If the unmanned aircraft control system is malfunction, the unmanned aircraft has a return to home mode. This is the basic mode that every unmanned aircraft must have. The position of the antenna is very important in control the unmanned aircraft in long distance. The section of the antenna should point to the unmanned aircraft all the time. (If it is not pointed to the unmanned aircraft, it may affect its ability to transmit and receive signals.)
4. **In Critical time** The Return to home Mode is a very important mode, especially if flying at night. The Return to home Mode can automatically control the unmanned aircraft to fly back to take off point or starting point or can control to fly to the remote controller (Radio transmitter), depends on the settings. To ensure flight safety, the Remote Pilot in Command must study and learn how to set up and use this mode skillfully before flying. This is to avoid lost in the direction of flight. the Remote Pilot in Command must be looking at the unmanned aircraft at all times.

3. General knowledge of Unmanned Aircraft

3.1 Important component of Unmanned Aircraft

- **Motor** is a device that rotates the propeller.

- **Propeller** is a device that rotates to create the lift force for the purpose of allowing the unmanned aircraft to fly.

- **Navigation lighting** Usually, the Navigation light is a red light on the front of the unmanned aircraft and a green light on the rear of the unmanned aircraft , or a red light on the left wing and a green light on the right wing.

- **Video Shot** is a camera that is equipped with the unmanned aircraft to record pictures and videos.

- **Landing gear**

3.2 What to know about Unmanned Aircraft

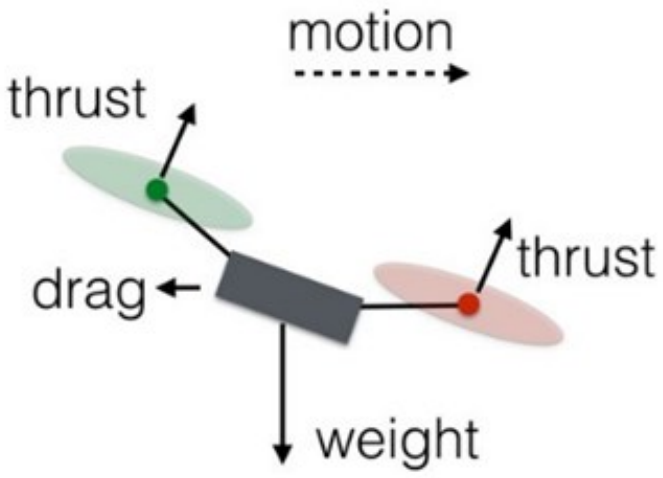
- Unmanned aircrafts can have several propellers, which, combined with the varying speeds of the engines, create lifting power and movement. Normally, the Unmanned aircraft has four arms and four propellers: two propellers spin clockwise and two propellers spin counterclockwise. In this way, the total rotational force becomes neutral. It is important that the propellers are installed in the right place to make flight safe.

- Fixed-wing unmanned aircrafts, This type of unmanned aircraft often has one or two propellers. It has more functions and used for more purposes than the multirotor unmanned aircraft. The fixed wing type looks more like an airplane. These unmanned aircrafts have longer range and flight time, and are also faster than a multirotor. The wings of a fixed wing mean the unmanned aircraft can handle a crash or engine loss better than a multirotor : the wings keep it sailing in the air, unlike a multirotor, which can falls straight down. However, the fixed wing cannot hover, nor can it evade obstacles as easily as the multirotor. Fixed wing unmanned aircrafts often have to be tossed to start, and therefore require a runway. And the camera on a fixed wing is often completely fixed or mounted in a two-axis gimbal, facing down, which can be good if you are mapping large areas. But if your purpose with the flight is to film or photograph, a multirotor with a movable gimbal is a better choice.
- Maintenance of unmanned aircraft's batteries. Before Flight, You should keep batteries in room temperature. Usually, extremely hot or cold temperatures can negatively affect the battery, and every time after flying, you should charge the battery fully. This is to maintain the battery's long service life. If the next flight doesn't happen within ten days from charging, the battery will automatically discharge to about 60 percent. This is done to protect the batteries, since they may be damaged if fully charged for an extended period of time. And if the batteries are stored with a low charge (below 10 percent), they can take permanent damage and be dangerous to fly. Therefore, make sure you charge them as soon as possible after flight.

3.3 Unmanned Aircraft control in flight

Unmanned Aircraft control in flight, There are 3 patterns.

- **Take off** is controlling unmanned aircraft to leave the ground and begin to fly. From principle 4 forces of flight , the Remote Pilot in Command must control the Lift force greater than the weight of the unmanned aircraft.
- **Hovering** is controlling unmanned aircraft to stay still in the air. From principle 4 forces of flight , the Remote Pilot in Command must control the Lift force equal to the weight of the unmanned aircraft and control the thrust force equal to drag of the air.
- **Landing** is controlling unmanned aircraft from the air to the ground, by the landing gear touch the ground safely. From principle 4 forces of flight , the Remote Pilot in Command must control the weight of the unmanned aircraft greater than the Lift force.



3.4 Key principles of Flight

- According to the Announcement of the Ministry of Transport Unmanned Aircraft in the Category of Remotely Piloted Aircraft B.E. 2558 (A.D. 2015)
- The Remote Pilot in Command must **not fly over 90 meters above the ground**.
- The Remote Pilot in Command must **only fly between sunrise to sunset** when the unmanned aircraft can clearly be seen.
- The Remote Pilot in Command must not fly into Restricted area , Limited area and Dangerous area announced in Aeronautical Information Publication – Thailand or AIP-Thailand and also at government building and hospitals unless permission is given.
- Before flight , The Remote Pilot in Command must check the unmanned aircraft's registration and insurance policy to check whether the documents have expired and bring the documents every time you fly.
- The Remote Pilot in Command must study and have knowledge of unmanned aircraft safety considerations such as battery life , maximum weight that the unmanned aircraft can carry , the maximum speed at which the unmanned aircraft can fly and must be careful on the sharpness of the propeller of the unmanned aircraft ,this may cause harm to other people.
- The Remote Pilot in Command must know procedures of Unmanned aircraft loss control.
- The Remote Pilot in Command must constantly review the knowledge and flight rules. In addition, aircraft maintenance according to the manufacturer's manuals in order to ensure maximum safety in flight.

3.5 Stall

Stall is a reduction in the Lift force of unmanned aircraft. This causes the unmanned aircraft to fall off. The reason of the unmanned aircraft falls off or loses lift may be due to propeller malfunctions or inclement air currents. As a result, the propeller is unable to generate a lift force greater than weight of the unmanned aircraft. This caused the unmanned aircraft into a state of falling. If the unmanned aircraft is stall, it will cause the unmanned aircraft to lose altitude or fall to the ground, which may cause damage or harm to persons or property. The Remote Pilot in Command must be mindful and careful not to cause the unmanned aircraft is stall. For example, The Remote Pilot in Command must be careful when control the unmanned aircraft to approach the wall or ceiling because it will cause a fluctuating stream of air. This results in the loss of lift forces and may cause the unmanned aircraft to fall.