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Determination of the wing lift by measuring the pressure difference

Determination of the lift force of the wing by measuring the pressure difference at it upper and lower parts will allow calculating the lift force at different stages of piloting and control the approach of critical flight conditions.

Flying in critical conditions can lead to loss of control and wing lift, so protection from critical conditions is relevant to improve flight safety.

During movement, the aircraft acquires such speed when its wing creates lift equal to the weight of the aircraft. The wing lift is creating by the difference in air pressure on the lower and upper surfaces. The air pressure depends on the distribution of air velocities near these surfaces. Under the wing, the air speed is lower than above it. That is why the lift force is direct upwards (Figure 1).

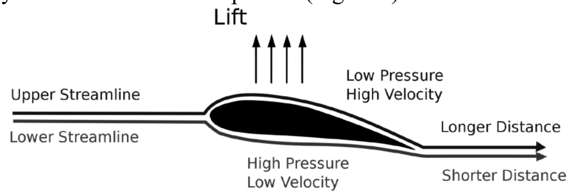

Fig.1. Create of Lift.

One of the critical flight conditions is flight at critical angles of attack. The angle of attack (α) is the angle between the airspeed vector and the wing chord. During the movement of the aircraft, the pressure above the wing is less than under the wing. If you change the angle of attack, the coefficient of lift (C_L) will change proportionally, but an increase in the angle of attack can lead to loss of control, which will turn into to stall (Figure 2). Consequently, one of the main dangers for the aircraft is it stall due to loss of speed, or increasing the angle of attack above it critical value. Therefore, modern aircraft are equipped with means of preventing critical flight condition, in particular critical angles of attack.

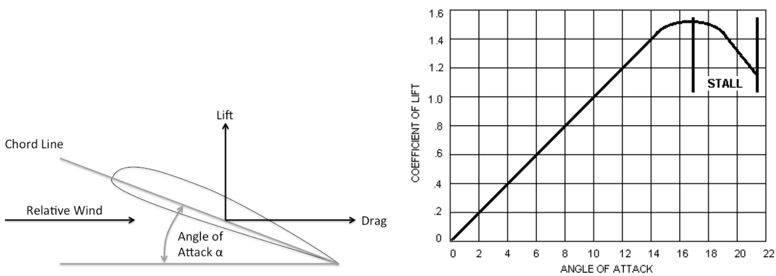

Fig. 2. Angel of attack and stall.

All modern aircraft are equipped with visual, audio and tactile systems to warn the crew about approaching critical angles of attack.

Direction of airflow on the wing defined as a function of the angle of attack obtained from angle of attack sensors located outside the wing (usually in the cockpit area).

It is proposing to determine the lifting force of the wing, the presence of turbulent flows and the approach to the critical flight condition of the wing by directly measuring the difference in air pressure in different parts of the wing.

Since the formation of the lift force of the wing influenced by pressure, it is proposing to use pressure sensors placed in different places of the wing from above and below, which will determine the pressure difference, the change of lift and the approach to critical angles of attack (Fig. 3).

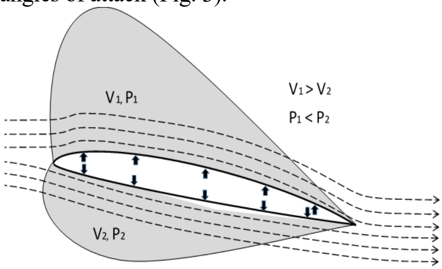

Fig. 3. Scheme of wing air flow and placement of pressure sensors.

Modern technologies make it possible to use micromechanical pressure sensors that have low power consumption, small size, and can be placed in different places of the wing without disturbing its geometry, and modern computing systems allow measuring differential pressure from many groups of sensors for a minimum period of time (Fig. 4).

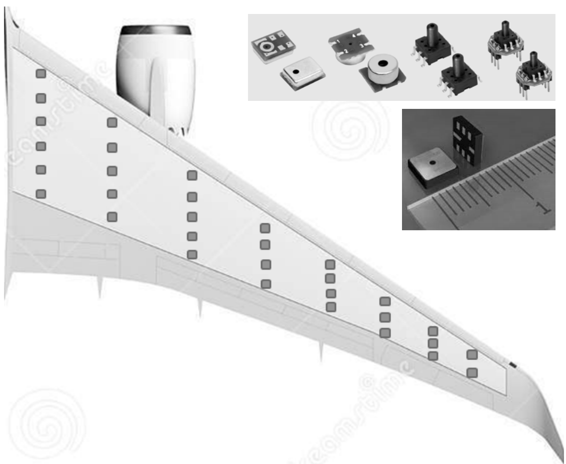

Fig.4. Placement of micromechanical pressure sensors on the wing.

Thus, it is propose to apply a new method for determining the lift of the wing by measuring the pressure difference on its upper and lower parts. The implementation of the method is to install the micromechanical silicon pressure sensors and compare their values in the longitudinal and transverse directions on the upper and lower parts of the wing. Analysis of the readings of these sensors will allow determining the difference in pressure on different parts of the wing, which will allow calculating the lift of the wing at different stages of piloting, to control the approach of critical flight conditions and increase the safety of air transportation.

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