FLIGHT TAXIING GUIDANCE SYSTEM FOR AIRCRAFT ON BOARD AIRCRAFT CARRIER

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Abstract

A system is needed to confirm whether objects in the pilot's field of vision are influenced by the air intake during takeoff. When F-35 jet fighters under development are introduced to the country like Japan where there are few level grounds and consecutive urban areas, the takeoff from the urban area and the confined space is operationally conceivable.

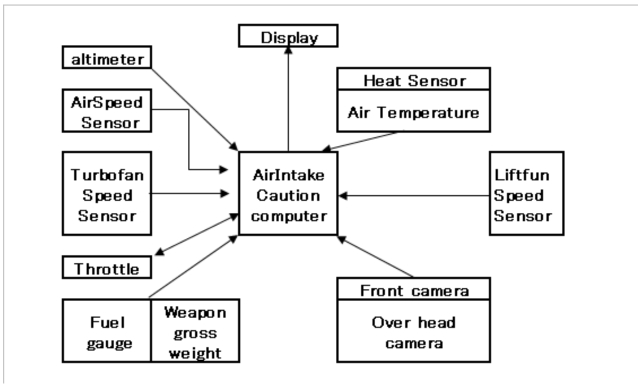
However, the accident that foreign bodies get mixed with air intake is assumed at the vertical takeoff that attains to the maximum output.

The pilot determines according to the experience of many years that the objects of how many meters ahead of the airframe could be sucked by the engine control by the throttle operation. In this system, it is possible to verify on the screen image that the air a certain meters ahead of the airframe is sucked proportionately to the increased engine output. As the example of the danger avoidance while increasing the engine output on the deck of the aircraft carrier when persons and objects projected by the camera appear in the graphics showing the range of suction, then this becomes the criterion that the pilot uses to determine whether to lower the engine output.

The safe air intake of the engine is an important logic not only in the air but also on the ground, especially in the narrow range on the aircraft carrier. This is the system to display on the multi-function display of the cockpit the image by the external camera that projects the front and the rear of the airframe, providing the pilot with information that the air of many meters ahead of the airframe is sucked now, and the composite image of the scaled graphics of the air intake range of the engine in response to the throttle operation by the pilot.

1. System Overview

The air intake computer that has the functionality to display the composite line indicating the danger range of the air intake on the camera image is connected with the sensor in the diagram below or the computer.



1.1 Sensor

Altimeter

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When the aircraft takes off, the conditions necessary for takeoff vary depending on the atmospheric pressure. When taking off at the high altitude, even for STOL and VTOL, conditions deteriorate more than at an altitude close to the sea level, and the danger range by the air intake becomes even greater.

Therefore, it is necessary to provide the air intake computer with information on the barometric altimeter.

Airspeed sensor

Since the volume of air intake proportionate to the air speed is added when the aircraft flies at a certain speed, the volume of air intake of the main engine is not accurately calculated. To solve this problem, the air intake computer should obtain speed information from the pitot tube.

Throttle and Turbo fan speed sensor

Lift fan speed sensor
The volume of air intake is calculated from the throttle and the corresponding number of blade rotations.

Fuel gauge and Weapon gross weight

The engine power required for the takeoff depends on the total weight. The factors determining the weight of the jet fighter are the fuel loaded (remaining fuel) and the total weight of weapons loaded

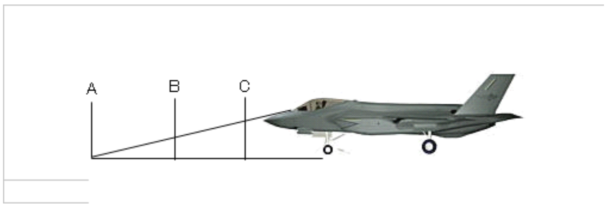
Overhead and Front camera

This is the device for displaying the direction of the air intake of the main engine and the direction of the air intake of the lift engine. The images projected by the camera are transmitted to the air intake computer and projected on the MF combining with the line indicating the danger range of the air intake.

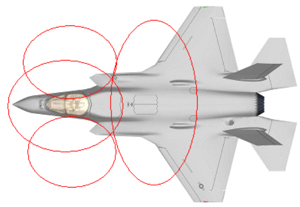
1.2 Display

The field of vision from the cockpit corresponds to the projected range as in the right figure, and there is the possibility that the pilot's perception may be different from the danger range indicated by the computer.

To prevent this, the "omni -directional display" must be adopted that displays the danger area in the virtual field of vision seen from the direction of the upper part of the airframe on the multi-function display of the cockpit.
Combining this danger information and the camera image, it is thought that the takeoff from urban areas is possible without involving obstacles in the danger area.
The mounted camera's position and angle are fixed, and the computer can understand position information such as A, B and C in the figure below. By converting these position information



of A, B and C into plane information, the position of obstacles can be identified in the omni-directional display, and calculating the throttle signal it is possible to give the pilot duplicate information on the air intake range.

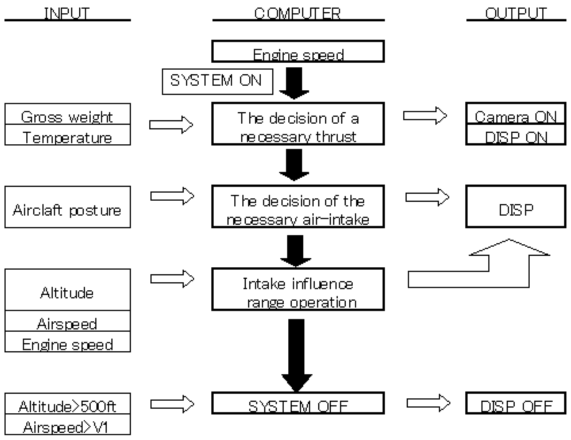


1.3 Camera position

The mounted camera's position and angle are fixed, and the computer can understand position information such as ABC in the diagram below. By converting this ABC position information into plane surface information, the position of obstacles can be identified in the omni-directional display, and calculating the throttle signal it is possible to give the pilot duplicate information on the air intake range.

2. System logic

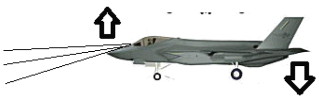
The trigger of system ON is assumed to be the rotating speed of the braid of the turbo fan engine.
In the system the thrust necessary for the vertical takeoff is determined from the total



weight and the temperature (atmospheric pressure).

The amount of the air intake to obtain the above-mentioned thrust is calculated from the pressure loss due to the air intake configuration peculiar to the airframe, and suction and exhaust duct and the range influenced by the suction taking the post-operational airframe orientation into account is transmitted to the display.

The computer continuously receives information on the altitude, the speed and the rotating speed of the braid and calculates the range influenced by the suction every second and SYSTEM is assumed to turn off at a certain altitude (here 500 feet



assuming the airport altitude to be zero feet) or by receiving the signal that the air speed reaches V1.

As for the communication system between computers the information communication system like CAN of cars should be installed, so the system chart is not discussed in this paper.

3. The idea of the aircraft position and danger area on the ground

Depending on the position of the aircraft on the ground, the danger areas affected by the air intake are different. In particular, if the pitch is increased then it is thought that the danger area grows more than when the position of the aircraft is parallel to the ground surface. In addition to the aircraft orientation being perceived by multiple sensors, it is also possible to send this to the computer based on systems engineering, but due to the fuel weight, tire pressure, engine vibration and surface wind, and terrain, determining an accurate value is difficult. Furthermore, given the manufacturing man-hours and maintenance man-hours, it is not the best idea.

As a solution, for the settings of the range affected by this pitch and air intake, the worst value based on the design must be installed in the computer. In other words, the calculation carried out assumes that the pitch of the aircraft's orientation on the ground is always the maximum based on the aircraft's structure, and the danger area should be calculated.

4. Conclusion

In aircraft development, because development is subdivided into specific fields, this time we discussed from the standpoint of a safety systems engineer. When it was time to evaluate this system, software experts, in cooperation with image processing experts, strove for the development of safety for a vertical takeoff and landing aircraft.

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