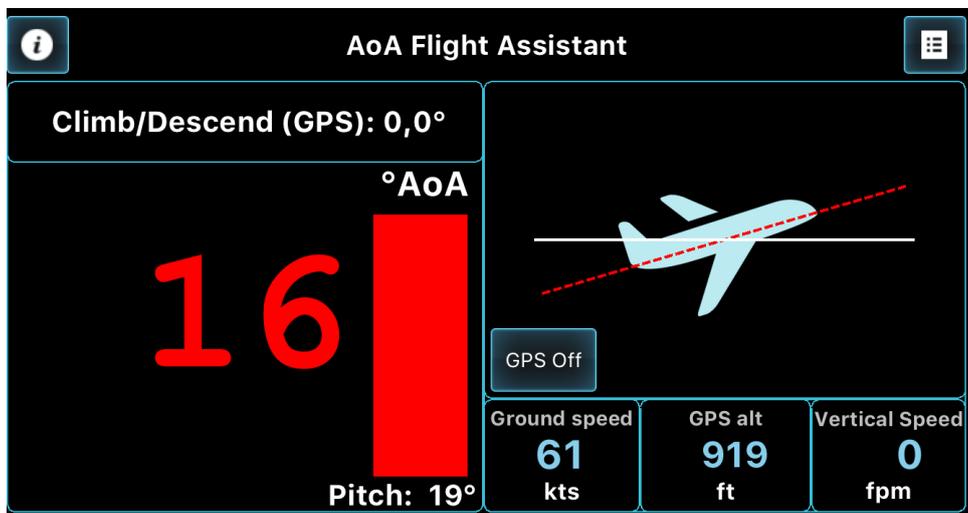




AoA Flight Assistant

User Manual



PLEASE READ

Information displayed in this application should be used only as INFORMATIVE/WARNING

Do NOT attempt to use this application as a replacement for standard avionics instruments! Accelerometer and GPS measurements can vary significantly due to angular gravitational force and other external physical influences.

Readings depend on the quality of built-in GPS and accelerometer devices, not solely on the application logic.

For better accuracy use only on devices in fixed position!

Do NOT use this manual for educational purposes!

Definitions

AoA

The Angle of attack is the angle at which the air hits the wing. It is the angle between wing Chord line (straight line connecting the leading and trailing edges of an airfoil - the wing) and Flight path.

Pitch

Pitch attitude is the angle that the fuselage makes relative to the horizontal. It is the angle between airplane longitudinal axis and horizontal.

Climb/Desc(ent)

Angle of Climb or Descending is the angle between Flight path and horizontal.

AoI

Angle of incidence is the angle at which the wings are attached to the fuselage. It is the angle between airplane longitudinal axis and wing Chord line.

Runway slope

The angle between runway and the horizontal. In that sense runway may be upsloping and downsloping.

Calculating the Angle of Attack

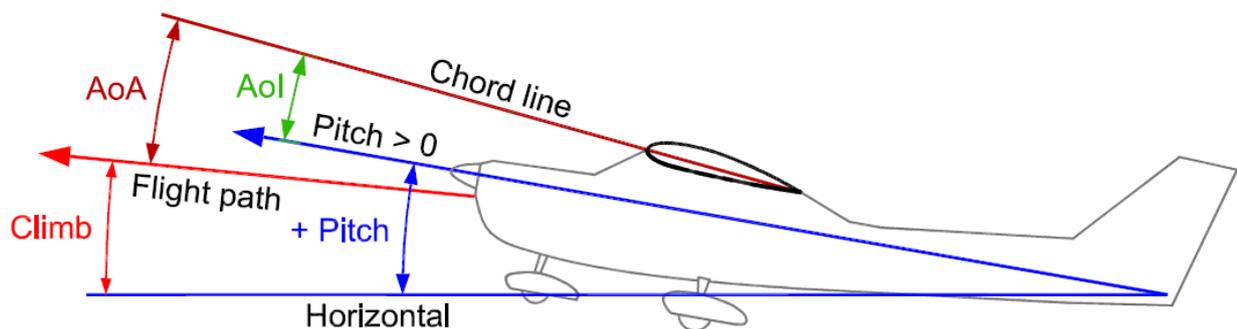
General formula for AoA calculation

$$AoA = Pitch + AoI - (Climb/Desc)$$

or

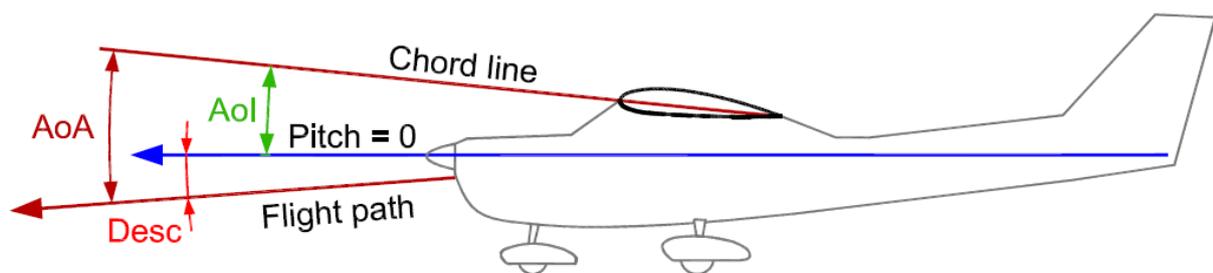
$$(Angle\ of\ Attack) = (Pitch\ attitude) + (Angle\ of\ Incidence) - (Angle\ of\ Climb\ or\ Descending)$$

Situation 1: Airplane climbing, Pitch > 0



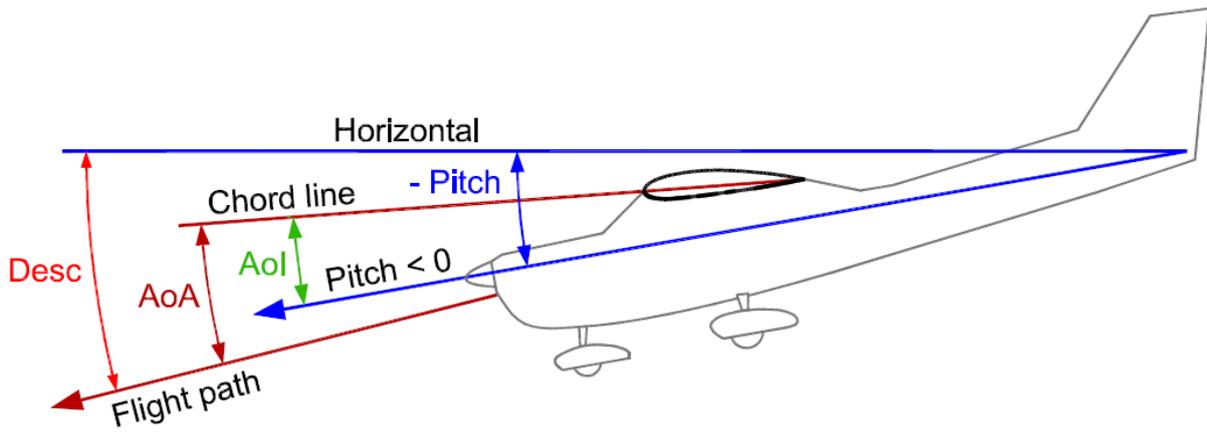
$$AoA = Pitch + AoI - Climb$$

Situation 2: Airplane is in level flight and descending



$$AoA = Pitch + AoI - (- Desc) = AoI + Desc$$

Situation 3: Airplane is descending, Pitch < 0



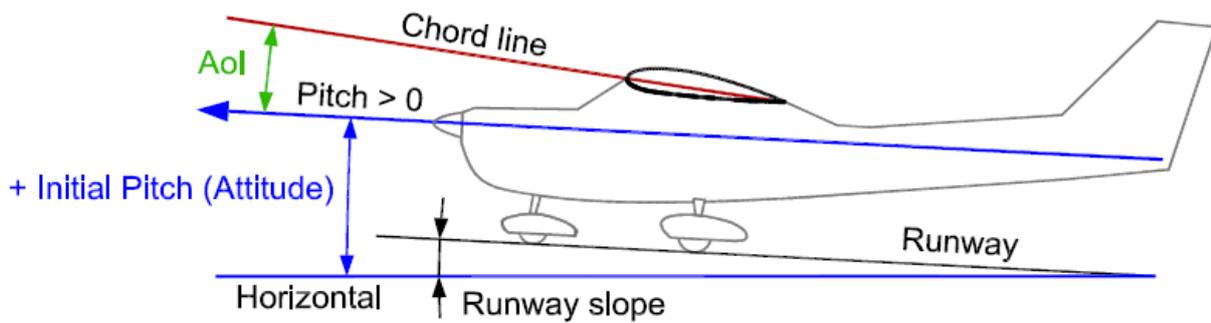
$$AoA = (-Pitch) + AoA - (-Desc) = (-Pitch) + AoA + Desc$$

Calibrating the Pitch

Since airplane can be Hightail or Taildragger we have 6 possible situations on runway.

Hightail

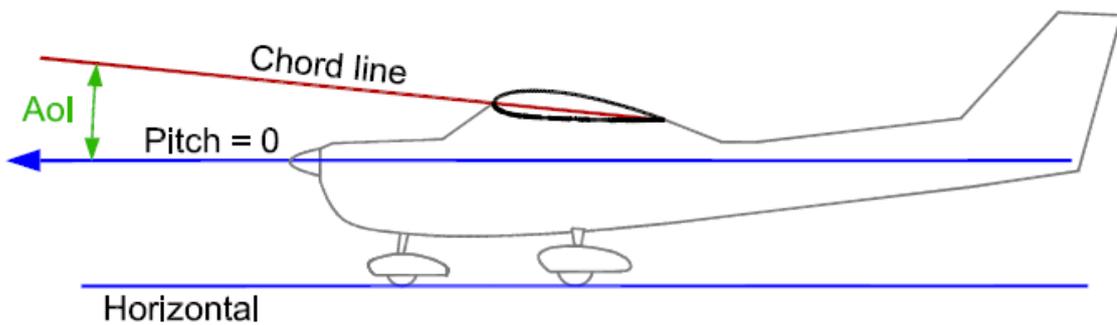
Situation 1: Hightail on upsloping runway



In this case when calibrating the pitch Runway slope must be added as positive angle (+ Runway slope).

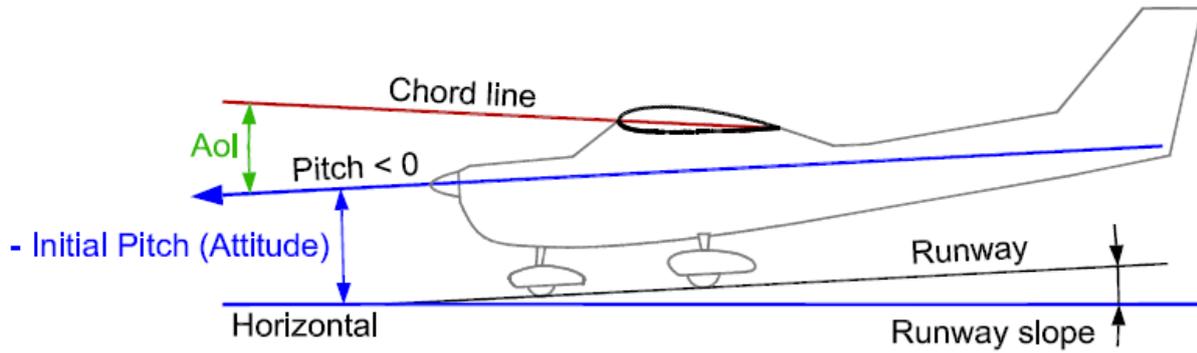
Initial Pitch = + Runway slope

Situation 2: Hightail on horizontal runway



No correction for this case.

Situation 3: Hightail on downsloping runway



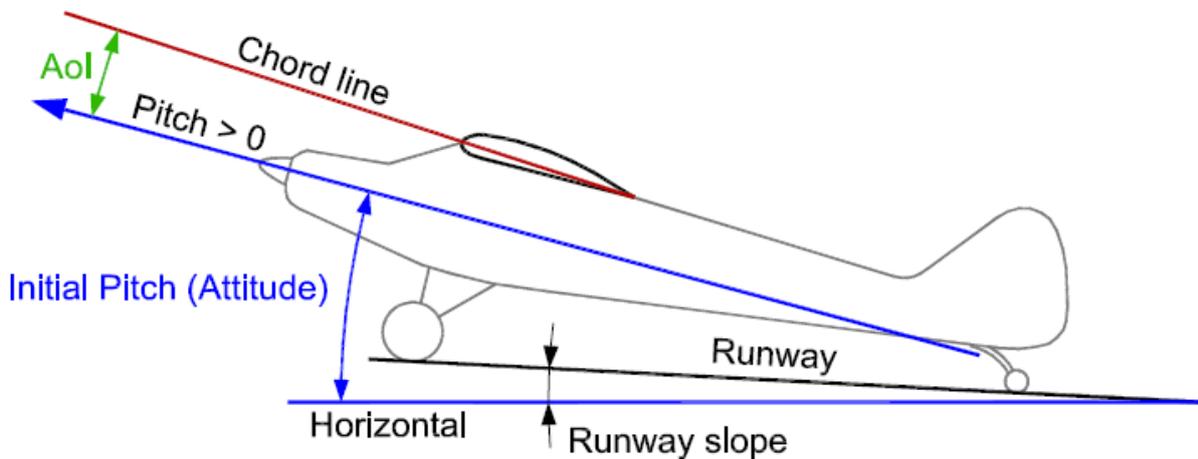
In this case when calibrating the pitch Runway slope must be added as negative angle ($-$ Runway slope).

$$\text{Initial Pitch} = - \text{Runway slope}$$

Taildragger

Design Pitch – Is the angle between taildragger fuselage and horizontal. Usually measures between 10 and 15°.

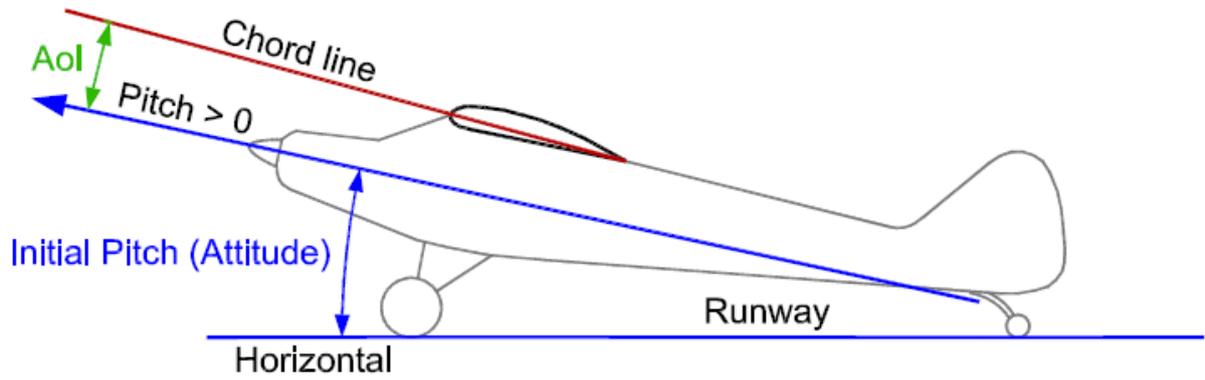
Situation 4: Taildragger on upsloping runway



In this case when calibrating the pitch Runway slope must be added as positive angle ($+$ Runway slope) to Design Pitch of the airplane.

$$\text{Initial Pitch} = \text{Design Pitch} + \text{Runway slope}$$

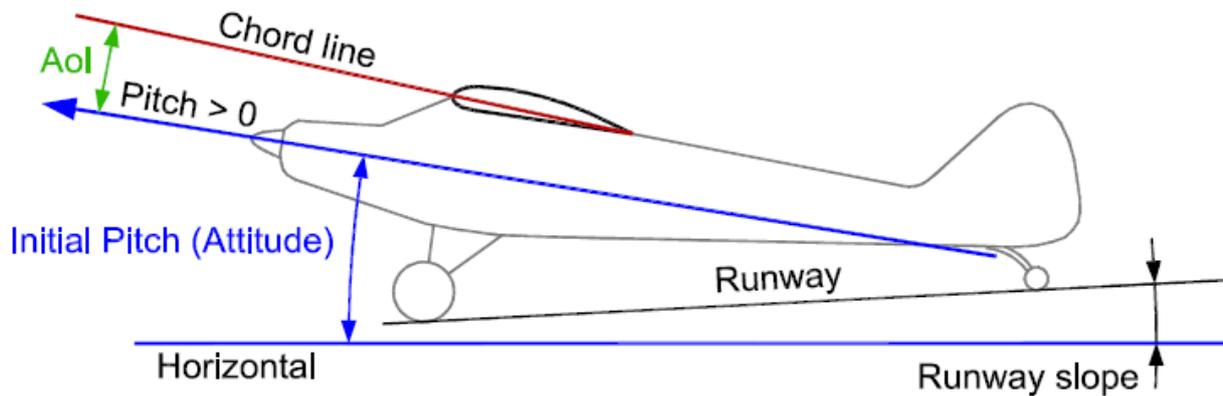
Situation 5: Taildragger on horizontal runway



In this case Initial pitch is represented only by Design Pitch of the airplane.

$$\text{Initial Pitch} = \text{Design Pitch}$$

Situation 6: Taildragger on downsloping runway



In this case when calibrating the pitch Runway slope must be subtracted from Design Pitch of the airplane,

$$\text{Initial Pitch} = \text{Design Pitch} - \text{Runway slope}$$

The Application

Technical demands

For AoA Flight Assistant application to work properly, your mobile device should have GPS unit and accelerometer built-in and enabled. Having newer model of mobile phone / tablet with newer operating system can significantly improve calculation performance and provide information faster.

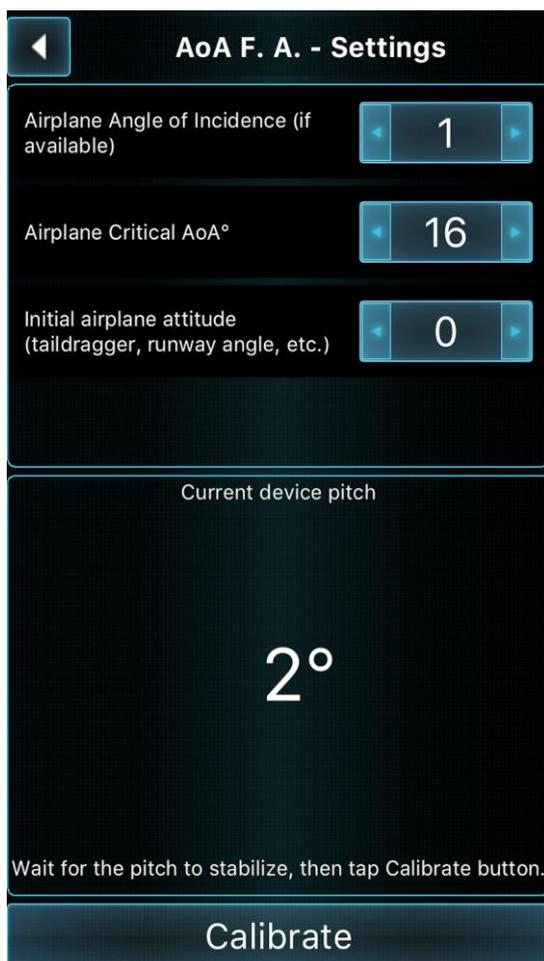
Setting up

Before you start to use the application, please obtain basic information regarding your airplane (usually found in Pilot's operating handbook) such as:

1. Critical angle of attack (in degrees)
2. Angle of incidence (if available, in degrees)
3. Design pitch (for taildraggers, in degrees)

All of above data are used for AOA calculation in flight. If you do not know your airplane's design pitch, it can usually be measured while the airplane is parked on leveled ground using side lines on the fuselage (most aircraft have such lines on their sides, not only for appearance purposes). If design pitch cannot be measured, you can try to determine it from your AI (attitude indicator) when avionics are turned on and all wheels are on the ground.

To set the application up, press "settings" button in upper right corner of main application screen.



Fill in data obtained either from manual or via measurement. When device is fixed in non-movable position in the cockpit, wait for main device angle to stabilize, then press "Calibrate". The device will remember its initial position in the cockpit and know how many degrees AOA has to be

increased/decreased because device is hard to fix in ideally vertical position.
 When fixing your mobile device in the cockpit you can use both portrait (vertical) and landscape (horizontal) position.

AoA Flight Assistant Screen



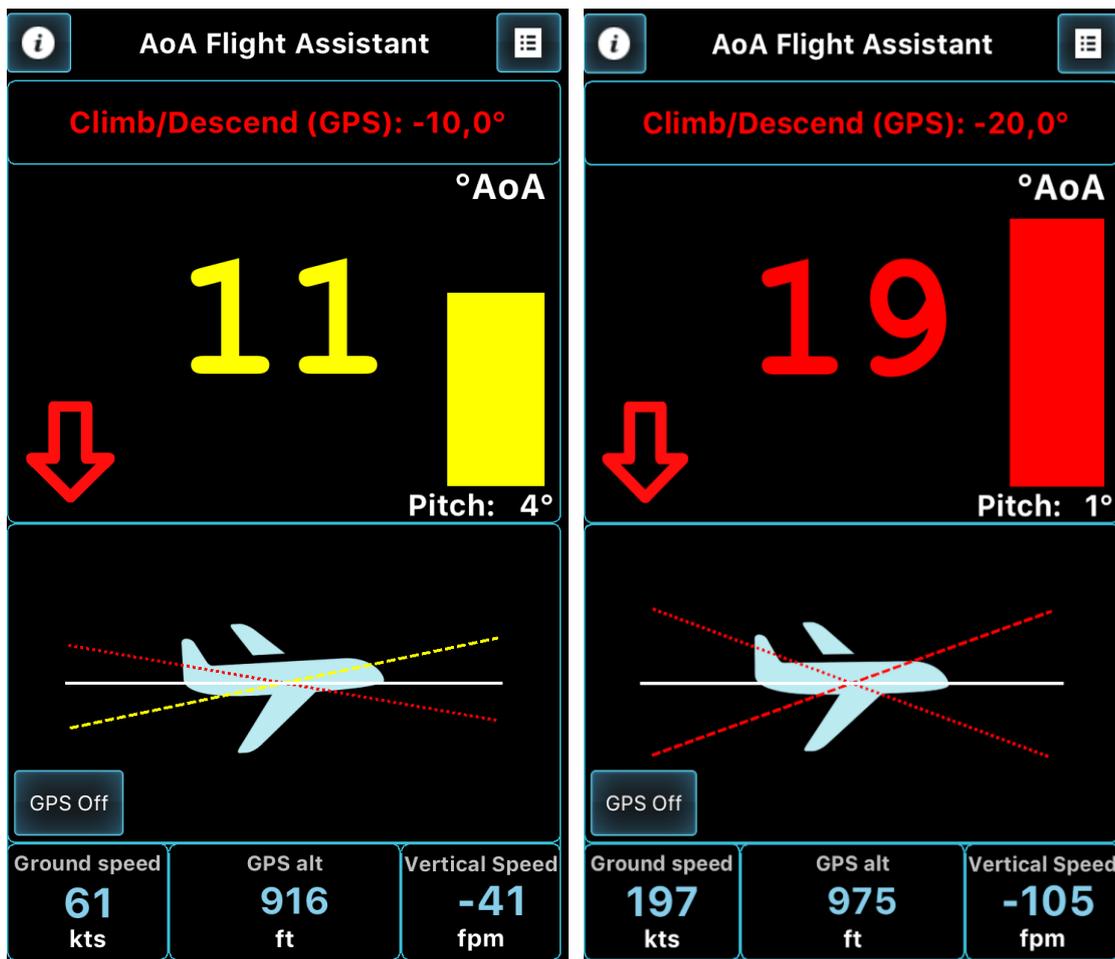
The first of three screen shows placeholders for information that AOA F.A. provides. The upper or left side of the screen, depending on device orientation, shows current calculated Angle of Attack. The scale on the right displays AOA as vertical bar with minimum value of 0 and maximum value critical angle of attack entered in settings. Actual climb or descend angle retrieved by GPS information is shown above the AOA value. The information labeled "Pitch" is actual pitch of the device in relation to Earth gravity, 0 being

vertical and 90 degrees horizontal. This information helps adjusting the device before calibration and to display actual pitch because AOA is also calculated with climb and descend angles. The bottom or right part of the screen holds graphical presentation of airplane's attitude in relation to horizontal (straight and level) flight, with two lines:

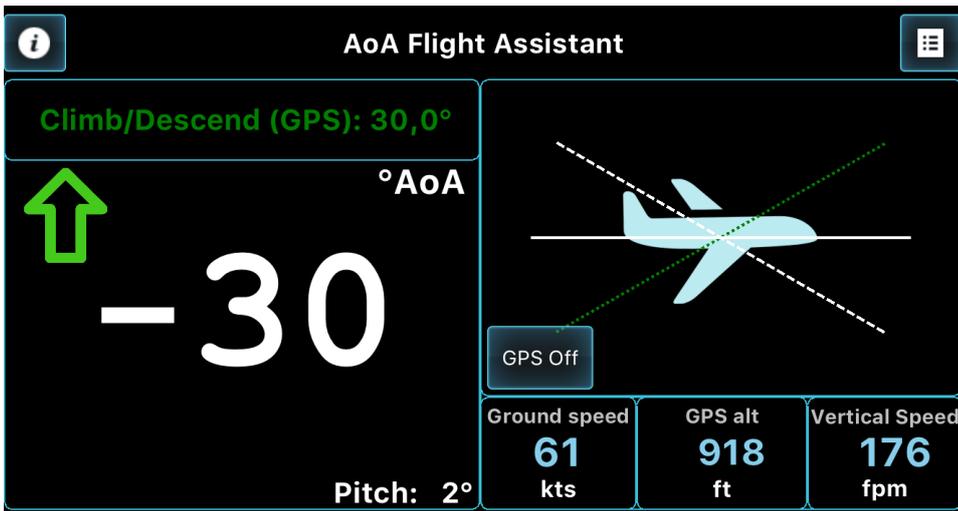
- Dashed line showing actual Angle of Attack in degrees; the color of the line changes according to color of AOA bar on AOA screen part.
- Dotted line showing actual angle of climb or descent; the color of the line is green when airplane is climbing and red when it is descending.

The "GPS Off" button temporarily turns off GPS readings. In that case only airplane pitch will be calculated for the AOA and attitude. Use this function when GPS signal malfunctions or becomes too "noisy" and so unusable. In such situation, only pitch (from the accelerometer) value can be used to still get any usable information. Use the same button to turn GPS tracking back on. Remaining three panels show ground speed, altitude and vertical speed of the aircraft. These data depend heavily on quality and accuracy of GPS signal so please always take it with a grain of salt. We cannot guarantee correct data because we not produce nor certify any of device producers. Use left upper corner "info" button to access short instructions, and right upper one to enter settings/calibration.

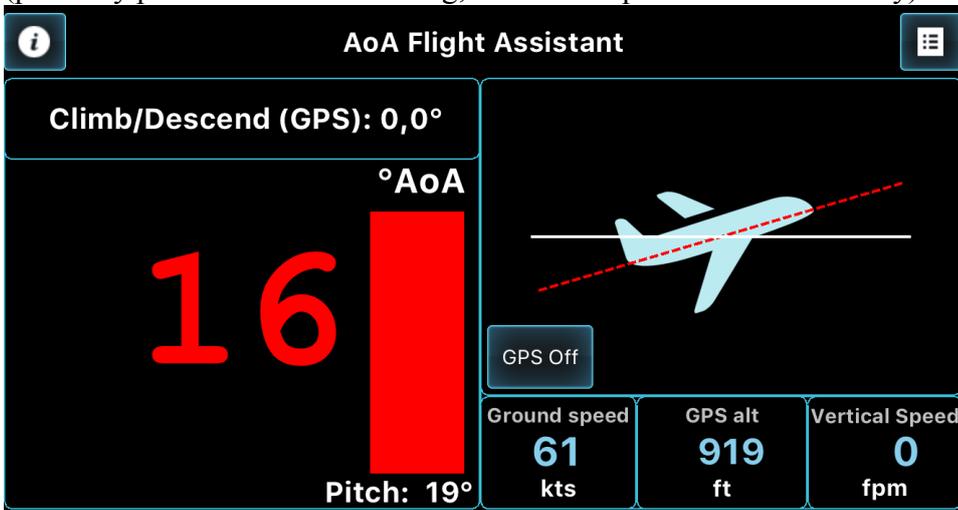
Situation Examples



On left screenshot you can notice that the airplane has quite high angle of attack although while descending at an angle of 10 degrees. The right screen shows (hardly possible, that is an example only) the situation when an airplane has almost horizontal pitch but descends at an angle of 20 degrees, which adds a lot to actual AOA (both screens are made on the ground and do not represent real situations).



The above screen shot shows the opposite situation – because of altitude gain due to steep climb (probably possible with an X-Wing, not with airplanes available today) the AOA has negative value.



Once again on the above screen shot, the airplane is in straight-and-level flight but with extreme pitch, which results in critical AOA.

Last two screens are mocked-up to display variety of possible data shown. Such situations should never occur during normal flight.