X-RAAS 2.0

User manual

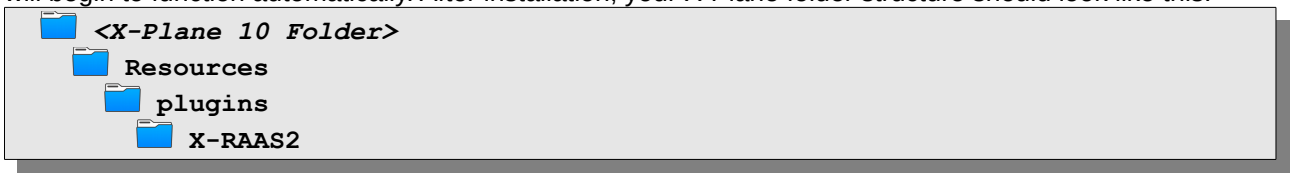
Table of Contents

1 Introduction

X-RAAS implements a simulation of the Honeywell Runway Awareness and Advisory System (RAAS)[1], which is itself a set of software extensions to the Enhanced Ground Proximity Warning System (EGPWS) computer. RAAS monitors the aircraft's GPS position and other sensor inputs to construct a picture of the aircraft's position relative to runways and several other threat conditions. When a potentially hazardous condition is detected, RAAS issues caution and warning aural annunciations and visual advisories. X-RAAS models most of these annunciations.

2 Installation

To install X-RAAS, simply extract the installation ZIP archive into the plugins folder. Once installed, X-RAAS will begin to function automatically. After installation, your X-Plane folder structure should look like this:



After installation, the first time you start up X-Plane, X-RAAS will scan all of your airport sceneries and extract runway information to build its airport data cache. This can take up to 10 seconds or more (depending on how much scenery you have). Once the cache is built, X-RAAS will use the cache and startup will be much faster. The reason for this cache is to make sure that X-RAAS's runway information matches your scenery as closely as possible, so you don't get spurious runway alerts. Once started up, X-RAAS should not impose any significant additional load on your simulator.
X-RAAS checks for updates to airport scenery or the AIRAC database in the simulator during startup. If scenery is added or removed, or the AIRAC cycle is changed, X-RAAS will automatically recreate its airport data cache.

NOTE
Updates to existing scenery might not be detected, as X-RAAS doesn't attempt to detect file modifications. If you have significantly updated existing scenery and would like to force X-RAAS to refresh its airport data cache, simply use the menu entry “Plugins”→“X-RAAS”→“Recreate data cache”.

3 Activating X-RAAS in the aircraft

X-RAAS automatically begins functioning as soon as electrical power is applied to the aircraft's primary avionics systems. Normally, RAAS is only used by airliners with a sophisticated EGPWS. RAAS advisories and performance monitoring can be a poor fit for small general aviation aircraft or aircraft with performance significantly different from airliners. To avoid this, by default X-RAAS checks if the current aircraft isn't a helicopter and also two additional parameters about the currently loaded aircraft prior to starting up:

- The aircraft must have at least two or more engines.
- The aircraft's Maximum Take Off Weight (MTOW) must be at least 5,700 kg or more.

If the aircraft is a helicopter or the value of the above mentioned parameters is less than the limits, X-RAAS startup is inhibited. All of this is configurable in the X-RAAS configuration file, so it is possible to re-enable X-RAAS for any aircraft in X-Plane, provided sufficient electrical power is available. See section 5 for details on how to fine tune X-RAAS's behavior.
Please note that certain aircraft models are either wholly incompatible with X-RAAS, or have certain features restricted. Refer to section 7 for a list of aircraft with known compatibility issues.

3.1 Annunciation mechanism and aircraft integration

3.1.1 Aural annunciations

Aural annunciations are made normally through the aircraft's loudspeaker system. The following details of aural annunciations can be adjusted (refer to section 5 for details on configuring X-RAAS):

- Audio volume.
- Voice gender.

1 More specifically, the SmartRunway and SmartLanding products.

- Style of runway number pronunciation (should single-digit runways have a '0' prepended or not).
- Units of measure (feet or meters).
- Whether to append units of measure to the initial callout.

If the current simulator view is external, annunciations are suppressed.

3.1.2 Visual annunciations

If visual annunciations are supported, they are performed in one of two ways:

- Overlaid in large type on the aircraft's navigation or multifunction displays in the 3D cockpit (see illustrations 1 and 2).
- Using a semi-translucent on-screen overlay near the top center of the screen.

Display of visual annunciations in the 3D cockpit model requires 3rd party aircraft integration. If an aircraft does not provide this integration, X-RAAS will by default fall back to display visual annunciations using the on-screen overlay. If the current simulator view is external, annunciations are suppressed.
Please note that not all real aircraft feature visual annunciations in their avionics. In these cases, X-RAAS will disable all visual annunciations. Refer to section 7.1 for a list of aircraft which support visual annunciations and by what mechanism. Aircraft developers are encouraged to refer to section Error: Reference source not found for details and sample code for integrating visual annunciation into their simulated avionics.

Illustration 1: Example routine visual annunciation

Illustration 2: Example non-routine and caution annunciations

4 Advisories

This section lists all the various normal and caution advisories X-RAAS can issue for various potential hazards. It is organized by phase of flight, starting with initially approaching a runway on the ground for takeoff and progressing towards a landing and runway exit.

4.1 Approaching a runway on the ground

X-RAAS constructs a virtual bounding box around each runway which extends laterally approximately 1.5x the runway width from the runway centerline and 2,000 feet longitudinally from each runway threshold[2]. X-RAAS will issue an advisory when the aircraft's nose is approximately 1 second from penetrating this bounding box (calculated based on ground speed). The advisory names the runway end closest to the aircraft.

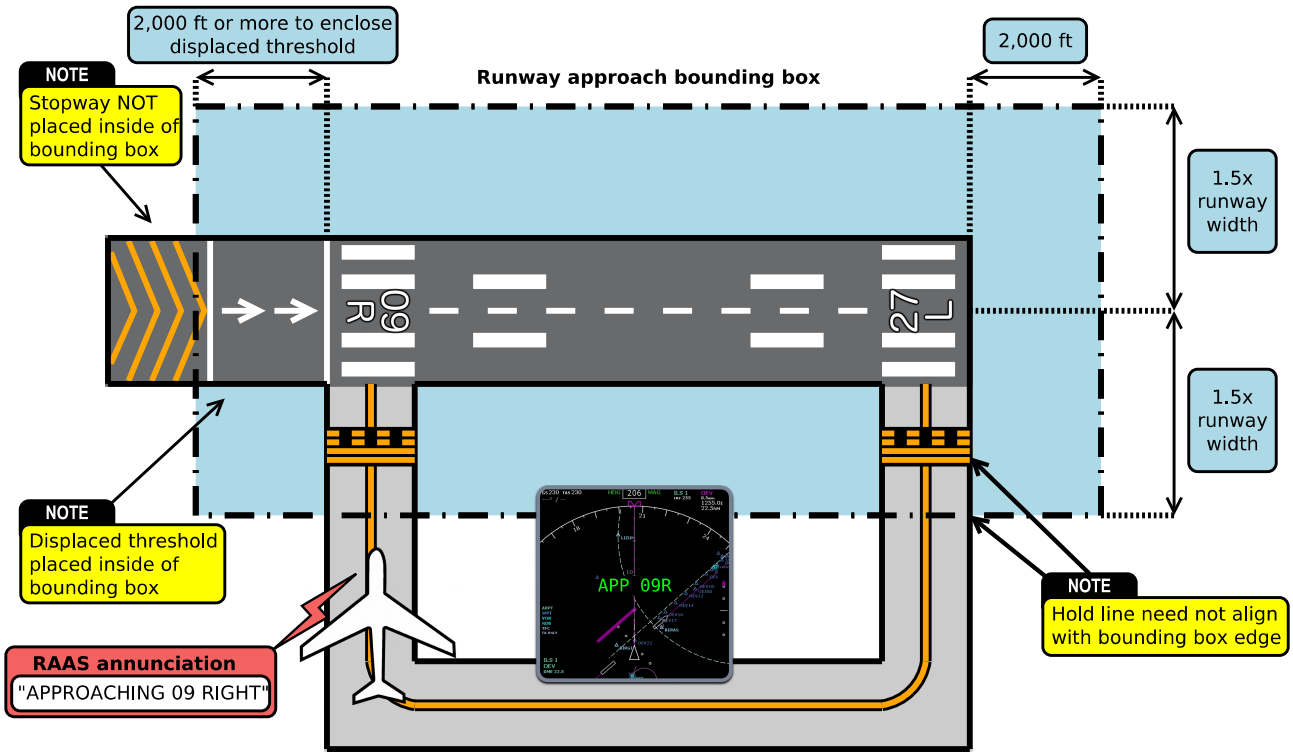


Illustration 3: Approaching a runway on the ground

The aural advisory is accompanied by a routine green visual advisory on the ND:

APP XX

Where 'XX' is the runway identifier. The advisory is inhibited when ground speed exceeds 40 knots (to prevent activation on takeoff through intersecting runways). Please also note that the annunciation does not guarantee the ability to stop before entering the runway.

2 If the runway has a displaced threshold, the bounding box is extended to encompass it completely, but the 2,000 ft buffer is not extended from the displaced end. Stopways are not placed in the bounding box.

4.2 Lined up on runway for takeoff

This annunciation is made initially on lining up on a runway (aircraft heading is within approximately 25 degrees of runway heading). The aural advisory is accompanied by a routine green visual advisory:

ON XX

Where 'XX' is the runway identifier. This annunciation may be supplemented by an annunciation of “FLAPS, FLAPS” if the appropriate takeoff flap configuration has not yet been selected at the time of line up. The takeoff flaps advisory is inhibited if the GPWS flaps override mode is active. If the 'FLAPS, FLAPS' annunciation is to be issued, an amber 'FLAPS' visual caution advisory will be issued instead of the green 'ON XX' advisory:

FLAPS

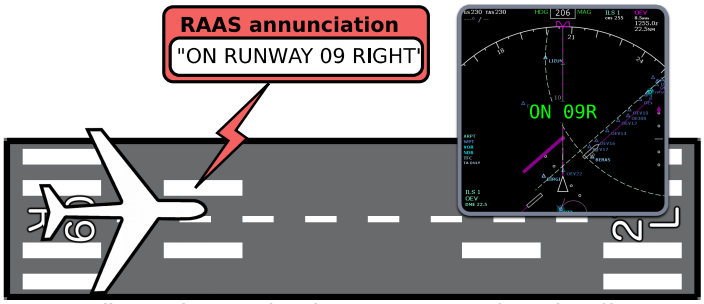


Illustration 4: Lined up on runway for takeoff

4.2.1 Extended holding on a runway

If the aircraft holds in position on a runway for an extended period of time, the on-runway annunciation repeats as a non-routine advisory at configurable intervals. Holding in position is defined as the aircraft being aligned with a runway while its ground speed doesn't exceed 4 knots. The aural annunciation is repeated twice per interval (e.g. “ON RUNWAY 09 RIGHT, ON RUNWAY 09 RIGHT”) and displays an amber “ON XX” visual advisory. The default intervals are defined as follows:

- Delay until the initial annunciation: 60 seconds
- Delay until repeat annunciation: 120 seconds
- Maximum number of repetitions: 3

After the advisory has been repeated for the maximum number of repetitions, further advisories are inhibited until the aircraft lines up with another runway. Refer to section 5 for the interval configuration parameters **RAAS_on_rwy_warn_initial**, **RAAS_on_rwy_warn_repeat** and **RAAS_on_rwy_warn_max_n**.

4.3 Lined up on runway too short for takeoff

If the runway length remaining for takeoff is below an operator-defined minimum for a safe takeoff, the “on runway” annunciation is supplemented by a runway distance available readout (rounded down to the nearest 100 feet or meters). The aural advisory is accompanied by a non-routine amber visual advisory on the ND:

ON XX YY

Where 'XX' is the runway identifier and 'YY' is the runway length available in hundreds of feet or meters.

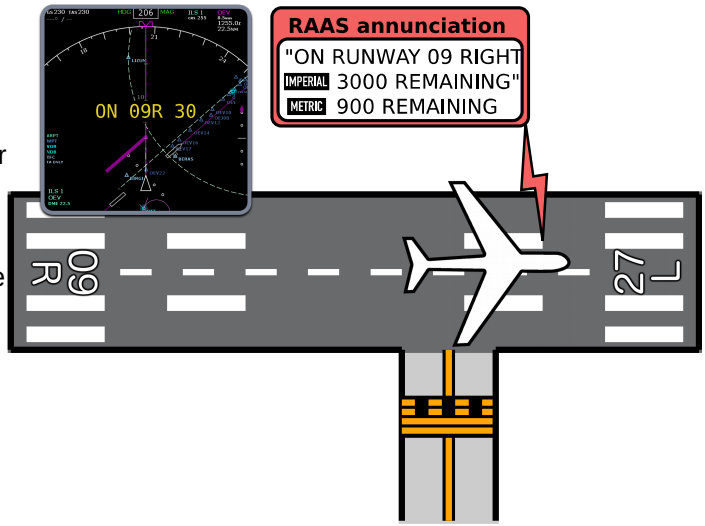


Illustration 5: Lined up on runway too short for takeoff

4.4 Short runway takeoff

If takeoff is attempted on a runway with runway length remaining below an operator defined minimum, once ground speed exceeds 40 knots, a warning annunciation is generated: “CAUTION! SHORT RUNWAY! SHORT RUNWAY!” The aural advisory is accompanied by a caution amber visual advisory on the ND:

SHORT RUNWAY

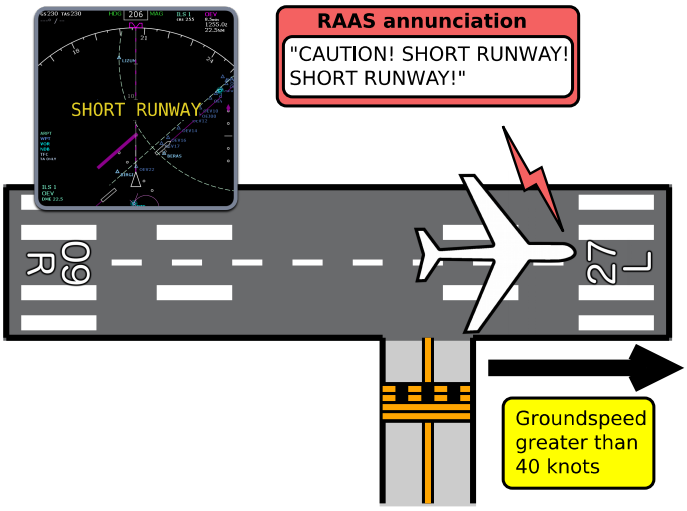


Illustration 6: Short runway takeoff

4.5 Taxiway takeoff

This annunciation warns of attempting takeoff on a taxiway, typically after missing a turn onto the intended departure runway.
The conditions for triggering this annunciation are:

- Aircraft is NOT on a runway
- Ground speed exceeds 40 knots

The aural advisory is accompanied by a caution amber visual advisory on the ND:

ON TAXIWAY

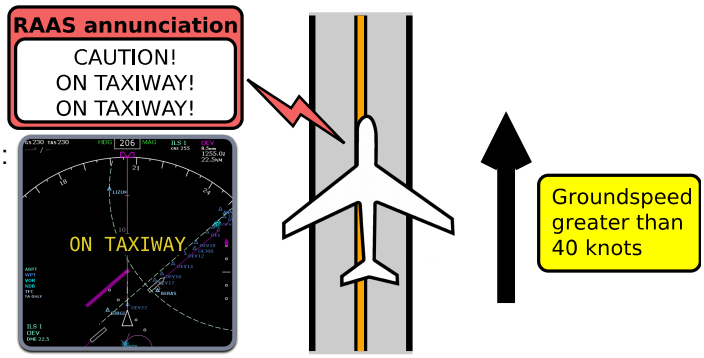


Illustration 7: Taxiway takeoff

4.6 Late rotation on takeoff

If the aircraft is on a runway and accelerates past 40 knots ground speed, X-RAAS switches into takeoff mode. Normally most annunciations are inhibited during this mode, however, if the runway length remaining drops below an operator-defined value and rotation has not yet been initiated, X-RAAS will start to issue runway length remaining annunciations to notify the crew of the rapidly approaching runway end and the need to initiate rotation as soon as possible. No visual advisories are generated.

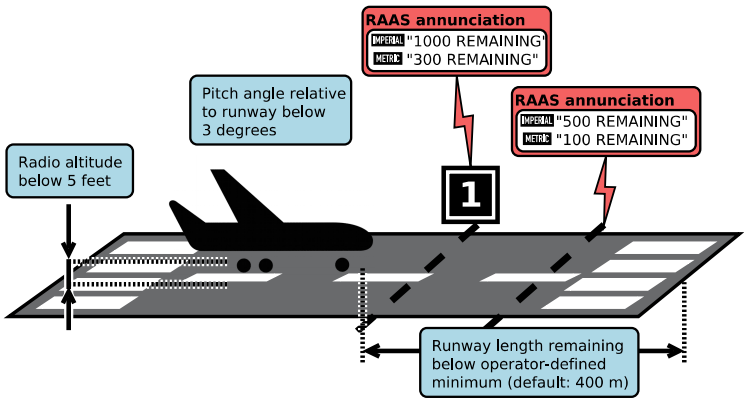


Illustration 8: Late rotation on takeoff

4.7 Rejected takeoff

In takeoff mode (on runway and ground speed greater than 40 knots), X-RAAS closely monitors the aircraft's ground speed. If the aircraft decelerates 5 knots below the maximum ground speed attained during the takeoff roll, X-RAAS assumes that the takeoff is being rejected. During a rejected takeoff, if runway length remaining decreases below 9000 feet or 2700 meters, X-RAAS will start to issue runway length remaining annunciations. No visual advisories are generated.

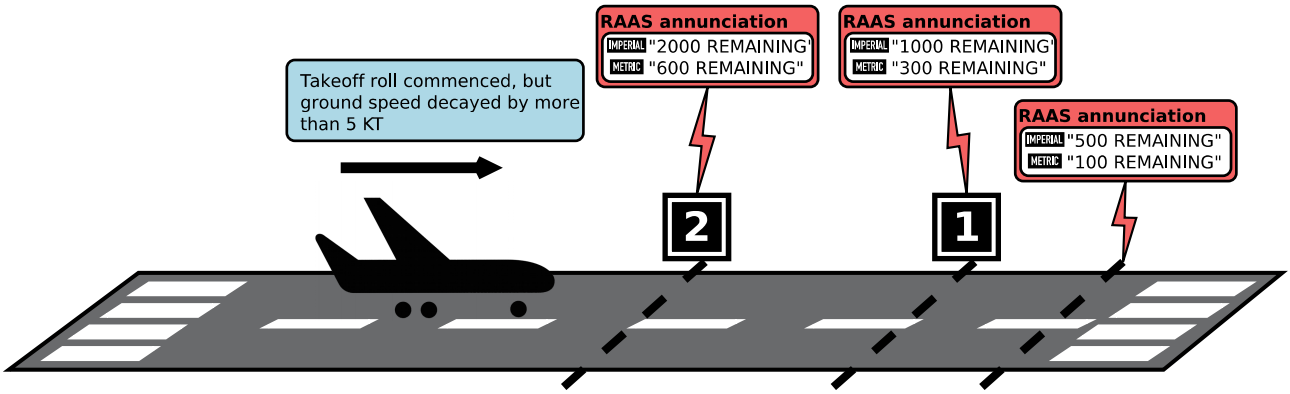


Illustration 9: Rejected takeoff

4.8 Altimeter setting climbing through transition altitude

X-RAAS determines the transition altitude based on database information for the closest airport to the aircraft. If the aircraft climbs through the transition altitude, X-RAAS monitors the barometric altimeter subscale setting. If by 30 seconds after transitioning the subscale is not set to QNE (1013.25 hPa or 29.92 in.Hg), the following advisory is issued: “ALTIMETER SETTING”. This is to prevent incorrect altitude readings in cruise, which increases the possibility of traffic collisions. The aural advisory is accompanied by a caution amber visual advisory on the ND:

ALTM SETTING

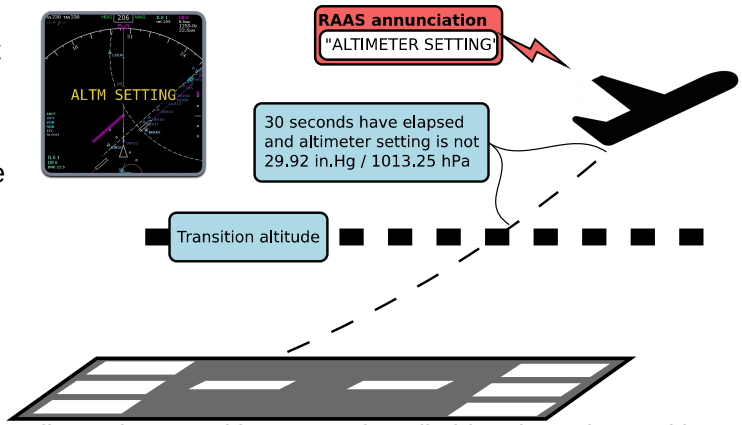


Illustration 10: Altimeter setting climbing through transition altitude

Please note that this advisory might not be available if transition altitude is not published in the navigation database. Flight crews must remain fully alert to crossing the transition altitude and reliance on the altimeter setting RAAS annunciation as part of standard operations is prohibited.

4.9 Altimeter setting descending through transition level

This is the reverse advisory to the altimeter setting advisory during climb and is intended to assist in preventing CFIT (Controlled Flight Into Terrain). X-RAAS determines the transition level based on the navigational database entries of the airport closest to the aircraft. If a fixed transition level is not published, X-RAAS calculates the lowest possible transition level based on barometric pressure readings, GPS calculated elevation AMSL and a published transition altitude, such that the calculated transition level is equal in true elevation AMSL to the transition altitude. Please note that this fallback mechanism might not be as accurate as using the ATC-assigned transition level, so reliance on this annunciation to determine the correct transition level is prohibited.

Once the aircraft descends through the transition level, X-RAAS monitors the barometric altimeter reading and GPS-calculated altitude:

- If QNH altimetry is enabled[3], the GPS-determined elevation AMSL is compared to the barometric altimeter reading. If the values differ by more than a pre-determined threshold after more than 30 seconds has elapsed since crossing the transition level, an “ALTIMETER SETTING” annunciation is generated.
- If QFE altimetry is enabled[4], X-RAAS compares GPS-determined elevation above the nearest aerodrome with the barometric altimeter reading to make sure that they are within a pre-determined threshold.

The default altimetry mode is QNH. The 30 second timeout for the barometric altimeter setting check can be preempted and initiated early if the aircraft descends below 1,500 feet above field elevation of the nearest airport.

The aural advisory is accompanied by a caution amber visual advisory on the ND:

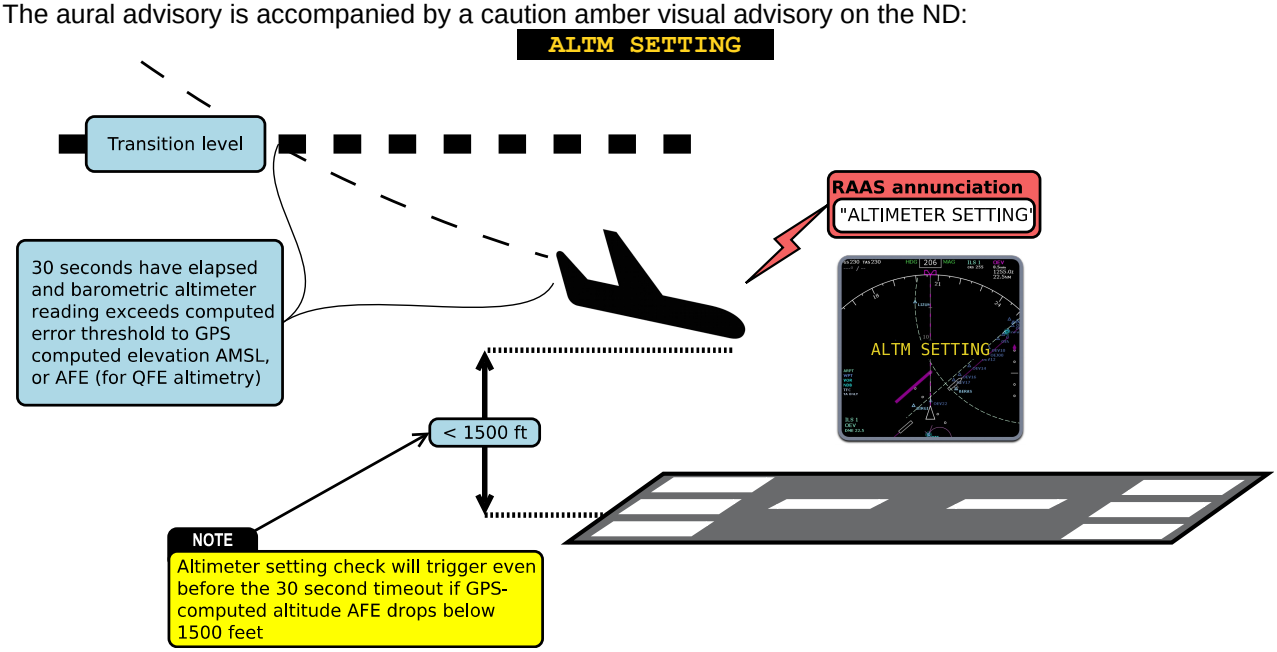


Illustration 11: Altimeter setting descending through transition level

3 See parameter **`RAAS_qnh_alt_enabled`** in section 5.

4 See parameter **`RAAS_qfe_alt_enabled`** in section 5.

4.10 Approaching a runway to land

To facilitate proper runway alignment, X-RAAS issues a runway approach annunciation also when approaching a runway from the air with the intention to land. The following conditions need to be met for this annunciation:

- Within approximately 3 nm of a runway.
- Track is aligned with the runway and heading is within 25 degrees of runway heading.
- In landing configuration.
- Descending through between 700 feet and 320 feet above runway threshold elevation[5].

The aural advisory is accompanied by a routine green visual advisory on the ND:

APP XX

Where 'XX' is the runway identifier. If the runway length is below an operator-defined minimum[6], the annunciation is supplemented by an additional callout of the length available for landing, rounded down to the nearest 100 feet or 100 meters. In this case, the following non-routine amber visual advisory displays on the ND instead:

APP XX YY

Where 'XX' is the runway identifier and 'YY' is the runway length available in hundreds of feet or meters. If the aircraft remains on approach, and descends below 400 feet, but is above 320 feet, an additional annunciation is made: “CAUTION. SHORT RUNWAY! SHORT RUNWAY!” This annunciation is accompanied by a caution amber visual advisory:

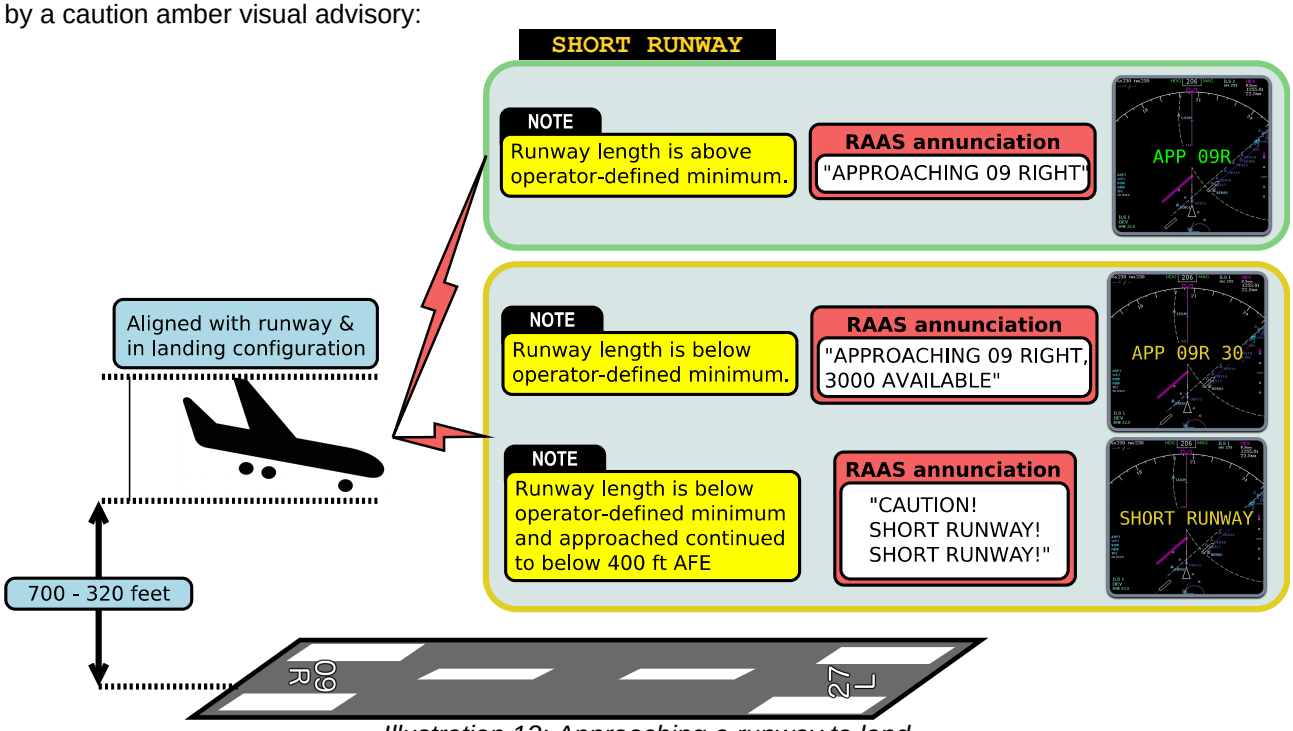


Illustration 12: Approaching a runway to land

5 The annunciation is temporarily inhibited between 520-480 feet and 420-380 feet above threshold elevation to allow for GPWS or manual altitude callouts.

6 See parameter **`RAAS_min_landing_dist`** in section 5.

4.11 Late flap selection during approach to land

X-RAAS also monitors the flaps configuration[7] during an approach to land and issues “FLAPS! FLAPS!” advisories in case flaps are not in the proper setting for landing at certain periods during the approach, based on height above runway threshold:

- 950 feet to 600 feet, annunciation: “FLAPS *(pause)* FLAPS” and a caution **FLAPS** annunciation on the ND.
- 600 feet to 450 feet, annunciation: “FLAPS! FLAPS!” and a caution **FLAPS** annunciation on the ND.
- 450 feet to 300 feet, annunciation: “UNSTABLE! UNSTABLE!” and a caution **UNSTABLE** annunciation on the ND.
- This annunciation is inhibited if:
  - the aircraft descends below 300 feet above threshold elevation, or
  - the GPWS flaps override mode (or terrain override mode if the aircraft isn't equipped with a separate flaps override mode) is active, or
  - gear is not down or the rate of climb exceeds 300 feet per minute.

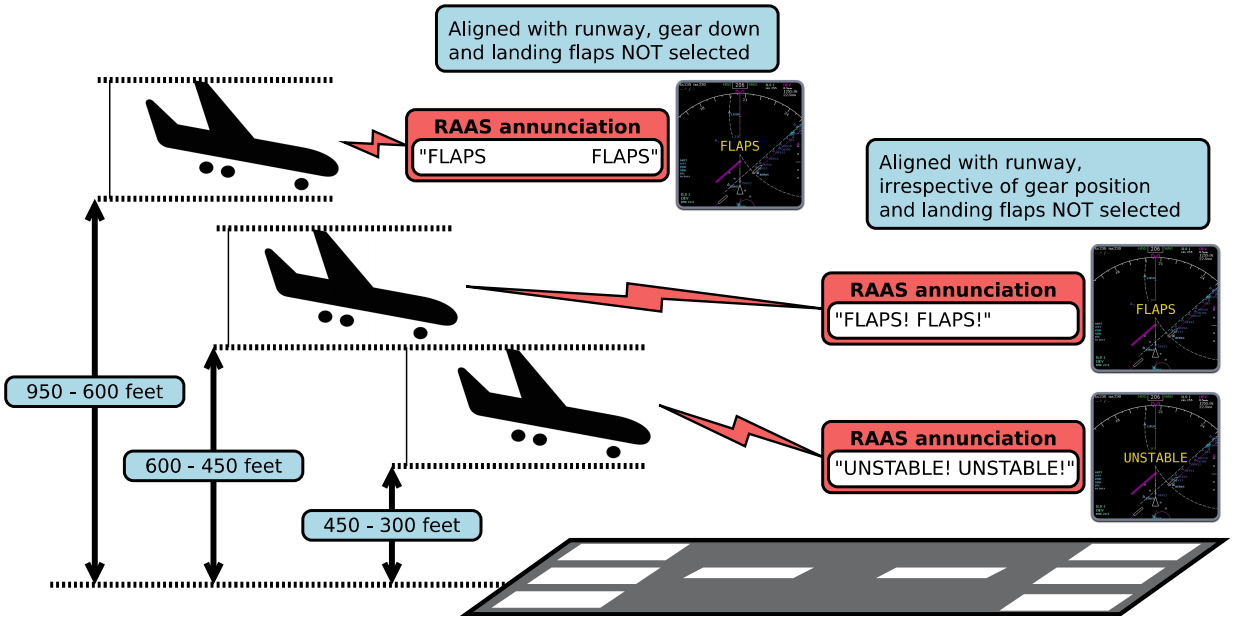


Illustration 13: Late flap selection during approach to land

7 See parameter **`RAAS_min_landing_flap`** in section 5.

4.12 Steep descent late in the approach to land

To protect against steep descents late in the landing approach and “dive bombing it” at the last moment, X-RAAS calculates the aircraft glide path angle and compares it with the optimal glide path angle stored in the database for the runway. If the actual glide path angle exceeds a limiting angle, X-RAAS issues caution advisories, depending on height above runway threshold:

- 950 feet to 600 feet: aural: “TOO HIGH (pause) TOO HIGH” visual: **TOO HIGH**
- 600 feet to 450 feet: aural: “TOO HIGH! TOO HIGH!” visual: **TOO HIGH**
- 450 feet to 300 feet: aural: “UNSTABLE! UNSTABLE!” visual: **UNSTABLE**

Annunciation is inhibited if:

- the aircraft descends below 300 feet above threshold elevation, or
- the GPWS terrain override mode is active, or
- the rate of climb exceeds 300 feet per minute.

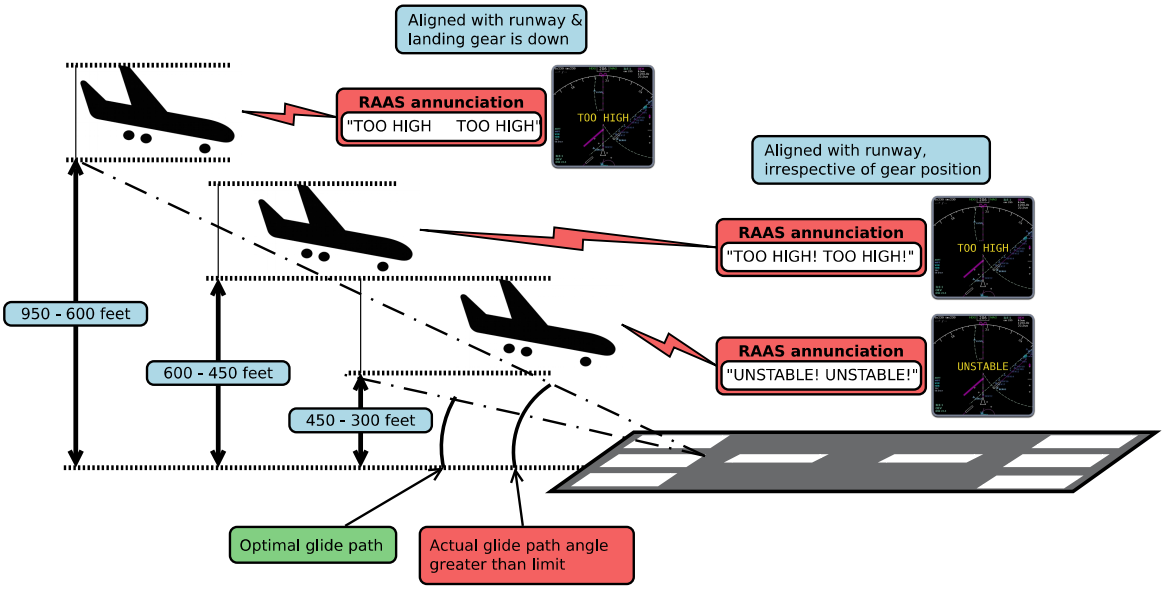
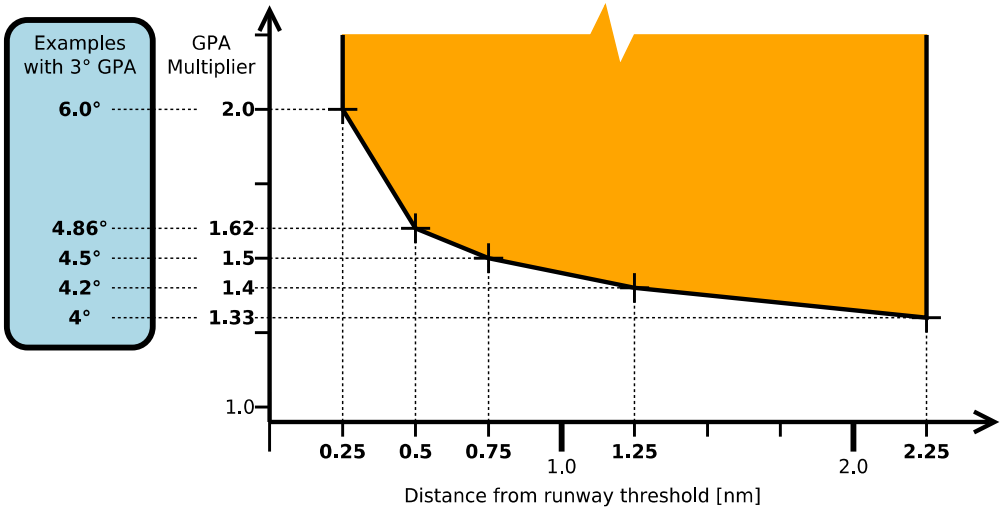


Illustration 14: Steep descent late in the approach to land

The algorithm for calculating the limiting glide path angle is based on the aircraft's distance from the runway threshold. The distance determines a multiplier applied to the optimal angle. For example, if the multiplier is 2 and the optimal glide path angle is 3°, then the limiting angle is 6° for that particular point on the approach. Refer to the table below for details on the actual multiplier values used.



4.13 Excessive airspeed on approach

This check monitors airspeed during an approach and compares it with the landing speed set in the FMS. If the indicated airspeed becomes excessive while passing through pre-determined height gates above threshold elevation, X-RAAS will issue the following annunciations:

- 950 feet to 600 feet: aural: “TOO FAST (pause) TOO FAST” visual: **TOO FAST**
- 600 feet to 450 feet: aural: “TOO FAST! TOO FAST!” visual: **TOO FAST**
- 450 feet to 300 feet: aural: “UNSTABLE! UNSTABLE!” visual: **UNSTABLE**

Annunciation is inhibited if:

- the aircraft descends below 300 feet above threshold elevation, or
- the GPWS terrain or flaps override mode is active, or
- the rate of climb exceeds 300 feet per minute.

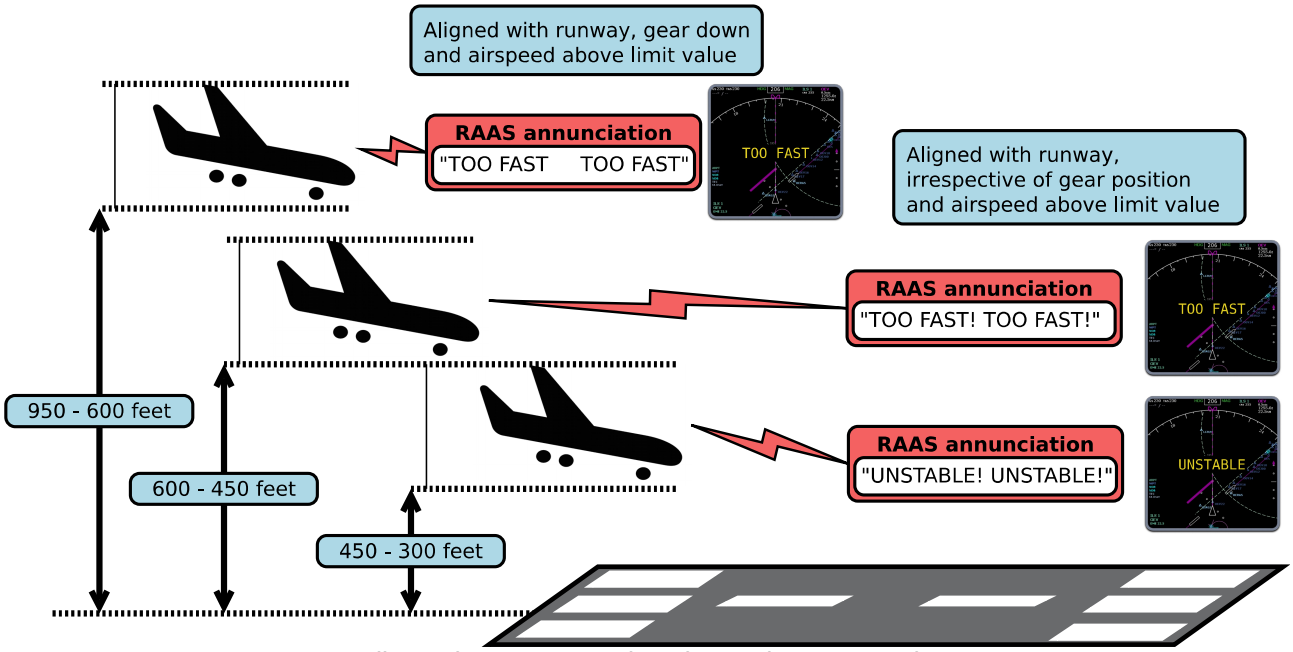
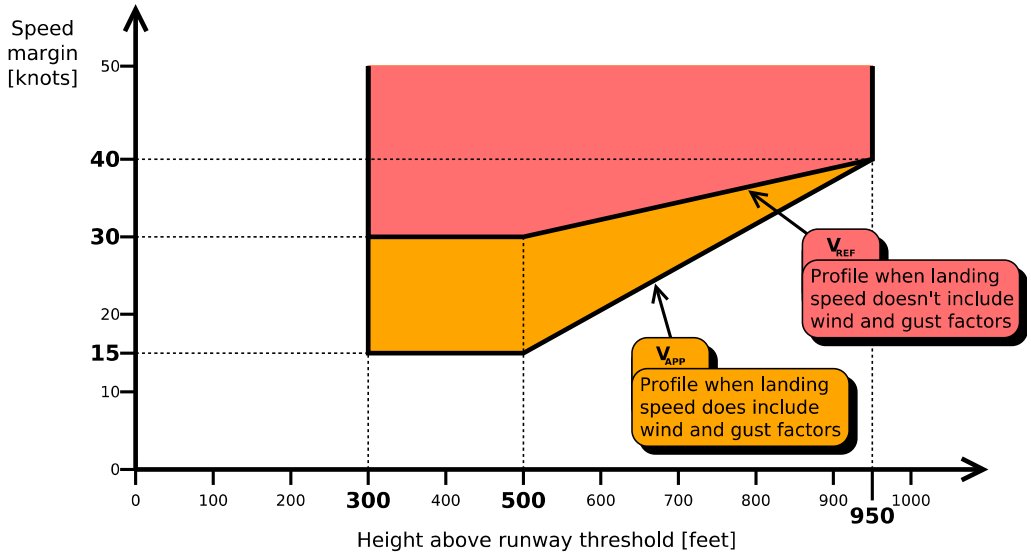


Illustration 15: Excessive airspeed on approach

The amount of speed margin allowed above the landing speed depends on the height above the threshold and whether the landing speed includes wind and gust factors (V_{APP} – common on Airbus) or not (V_{REF} – common on Boeing):



Please note that excessive approach speed monitoring requires aircraft-specific integration. Refer to section 7.1 for a list of aircraft which support this feature.

4.14 Attempting to land on a parallel taxiway

Many airports feature runways with close parallel taxiways. Under certain weather conditions, these can look very similar to each other during final approach and lead to confusion as to which is the runway and which is a taxiway. This increases the risk of an aircraft attempting to land on a taxiway, with obvious potential for a collision as a result.

To help in preventing this hazard, X-RAAS closely monitors an aircraft's position during the final stages of approach. If X-RAAS detects the following conditions, it will issue a warning advisory:

- Radio altitude is less than 250 feet, but above 100 feet.
- Aircraft is in landing configuration (gear is down and flaps in the landing position).
- Aircraft is not in the runway approach area or is not aligned with the runway (aircraft heading within 20 degrees of runway heading).

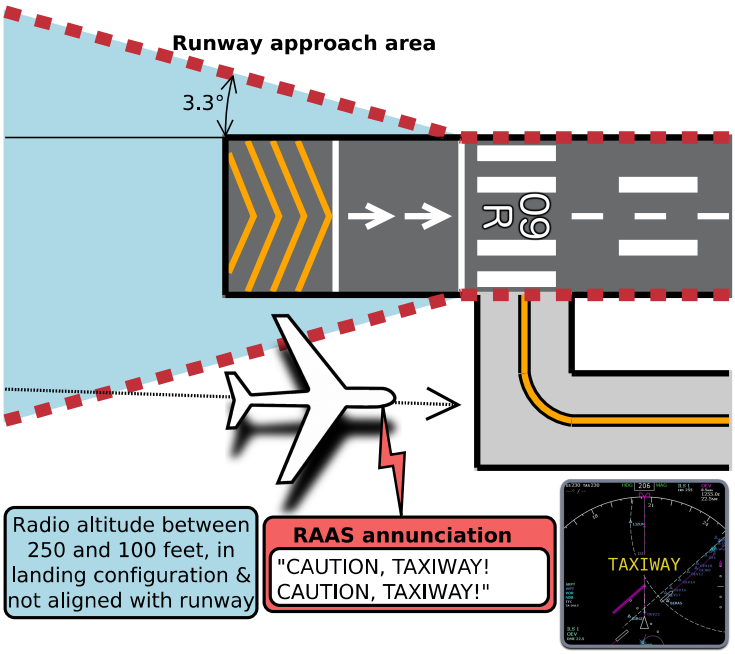


Illustration 16: Attempting to land on a parallel taxiway

The advisory is inhibited below 100 feet radio altitude[8] or if the GPWS terrain override mode is active. The aural advisory is accompanied by a caution amber visual advisory on the ND:

TAXIWAY

8 Due to the minimum radio altitude constraint and the runway approach area shape, there is a minimum lateral deviation of the aircraft's longitudinal center axis off the runway edge, below which this advisory is inhibited. For runways with a 3° glidepath, a threshold clearing height of 50 feet and roughly flat terrain in the runway approach area, the minimum lateral deviation is approximately 56 feet or 17 meters. The shallower the glidepath or the higher the terrain in the approach area, the wider the minimum lateral deviation below which this advisory will be inhibited. Therefore, if the parallel taxiway is very close to the runway, X-RAAS may not be able to detect a taxiway landing attempt.

4.15 Long landing

This annunciation protects against excessive floating on landing or an incorrectly executed too high or too fast approach, resulting in touch down very far down the runway and potentially insufficient runway length available for rollout. Conditions for this annunciation are:

- The aircraft is above the runway.
- Radio altitude indicates less than 100 feet, but more than 5 feet.
- Aircraft is past ¼ of the runway length or 2,000 feet from the approach end (whichever is shorter) or remaining runway length is less than an operator-defined minimum.

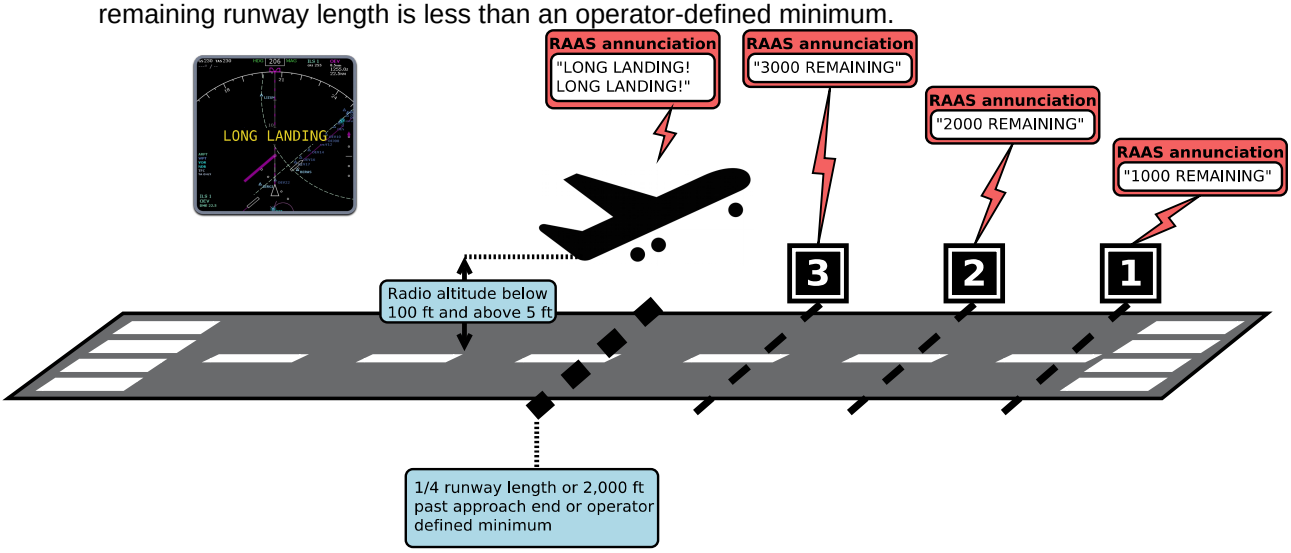


Illustration 17: Long landing

X-RAAS will initially annunciate “LONG LANDING!” twice and the remaining runway length if it is less than 9,000 feet (2,700 meters) or an operator-defined maximum[9]. Afterwards, X-RAAS will continue to annunciate runway length remaining every 1,000 feet (300 meters), unless the aircraft lands and decelerates below 40 knots ground speed, or performs a go-around (refer to section 4.17 for conditions monitored during a go-around). The aural advisory is accompanied by a caution amber visual advisory on the ND:

LONG LANDING

9 See parameter **`RAAS_stop_dist_cutoff`** in section 5.

4.16 Landing rollout runway length remaining

During landing rollout, X-RAAS closely monitors aircraft position, ground speed and deceleration. If the aircraft approaches to within approximately 4,000 feet or 1,200 meters (configurable as an operator-defined value[9]), its ground speed is above 40 knots and the current rate of deceleration is insufficient to come to a complete stop prior to the end of the runway, X-RAAS will start issuing runway distance remaining annunciations in 1,000 foot or 300 meter increments. Thus the annunciation of runway length remaining during a normal landing indicates that additional braking might be required to bring the aircraft to a safe stop. The runway distance remaining annunciations are based on the position the aircraft's nosewheel will attain in approximately 1 second with an added approximate 200 foot or 60 meter buffer. Therefore a “3000 (feet) remaining” annunciation can be sounded between 3,000 to 3,200 feet remaining. The last 1,000 feet or 300 meters of runway length remaining feature two additional annunciations:

- The last 500 feet or 100 meters. Inhibited if ground speed is below 40 knots.
- The last 100 feet or 30 meters. This annunciation is sounded irrespective of ground speed as long as the aircraft remains aligned with the runway to warn the pilot of the need to perform an immediate stop or turn to avoid running off the end of the runway.

The runway length remaining is calculated based on the position of the threshold of the opposite runway. If the opposite runway features a displaced threshold, this displacement length is counted towards the runway length remaining, i.e. the displaced threshold portion of a runway is considered to be suitable for landing rollout. If the opposite runway features a stopway (a “blastpad”), this is NOT counted towards the runway length remaining[10]. No visual advisories are generated.

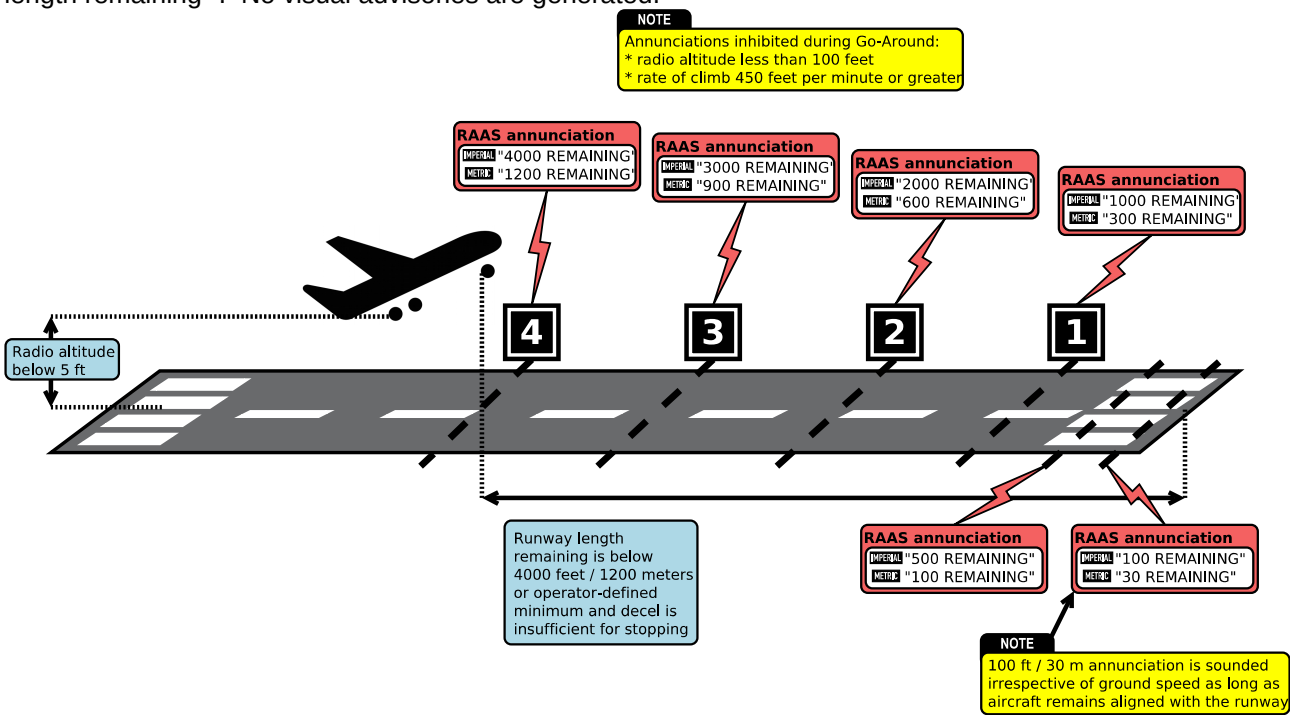


Illustration 18: Landing rollout runway length remaining

Due to how X-RAAS is implemented, landing rollout annunciations are only guaranteed to sound if the aircraft is flying through each distance “gate” below a maximum ground speed:

Distance [feet]	Distance [meters]	Maximum ground speed [knots]
9,000 – 1,000	2,700 – 300	250
500	100	125
100	30	60

10 Stopways are normally designed for emergency use only.

4.17 Go-around

During Go-around, runway length remaining annunciations are inhibited as soon as the aircraft climbs through 5 feet radio altitude and the following two conditions are met:

- radio altitude is below 100 feet
- rate of climb is 300 feet per minute or greater

If the rate of climb decays to below 300 feet per minute, runway length remaining annunciations are continued. If the aircraft climbs through 100 feet radio altitude, runway length remaining annunciations are not resumed, even if the aircraft resumes level flight.

4.18 Runway exit via high-speed exit taxiways

To support efficient high-traffic-density operations, landing traffic needs to be able to exit the runway environment after landing in an expeditious manner. To this end, many airports feature “high-speed exit” taxiways. These taxiways, rather than connecting to the runway at right angles, connect at relatively shallow angles, allowing landing traffic to maintain higher speed when turning off the runway. To support high-speed rollouts onto these kinds of taxiways, X-RAAS monitors groundspeed and aircraft position relative to the runway after landing. If the aircraft exceeds a limiting ground speed, this annunciation will be generated: “CAUTION! ON TAXIWAY! ON TAXIWAY!” and **ON TAXIWAY** on the ND.

- As long as the aircraft remains on a runway, no limiting ground speed is imposed.
- If the aircraft leaves the runway, but remains within the runway approach bounding box (as described in section 4.1), the limiting ground speed is 60 knots.
- If the aircraft leaves both the runway and the runway approach bounding box, the limiting ground speed is 40 knots.

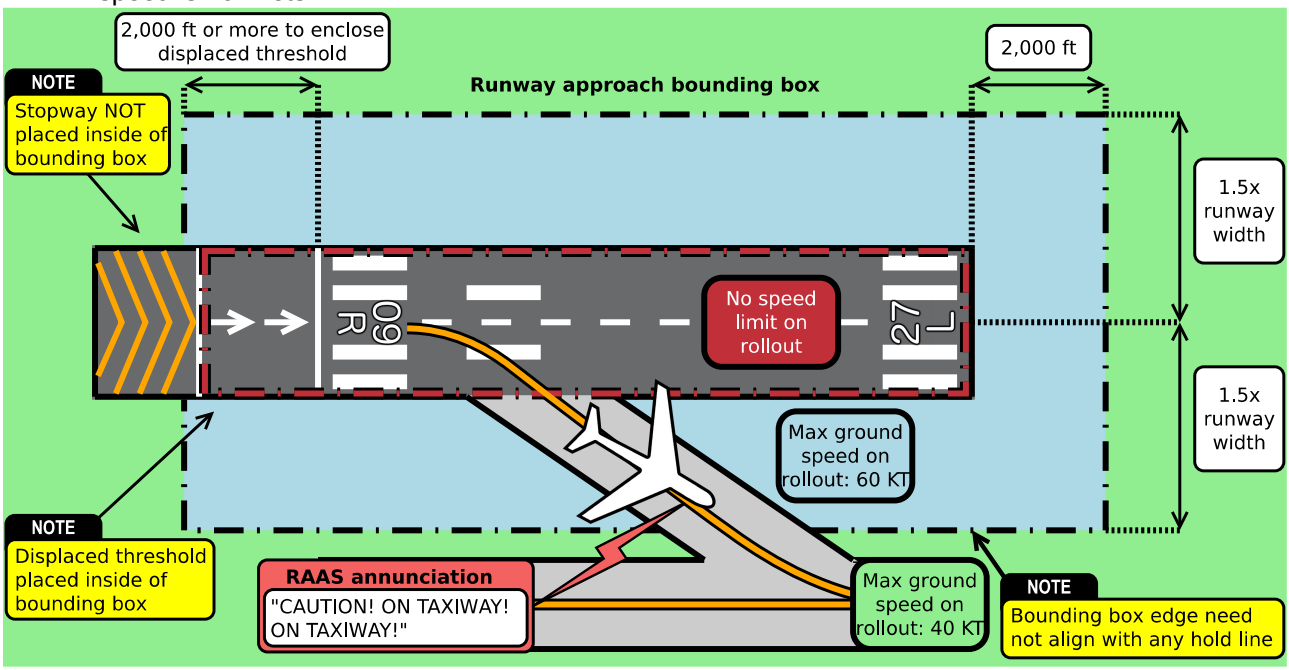


Illustration 19: Runway exit via high-speed exit taxiways

5 Configuration

Just like the real system, X-RAAS can be extensively customized to suit the particular operational requirements of an aircraft or airline. For this purpose, X-RAAS contains both a graphical and textual configuration interface. Both interfaces have equivalent capability. The graphical configuration system simply generates a text configuration that is then stored on disk and read by X-RAAS during startup.

5.1 Graphical configuration

To invoke the graphical configuration interface, choose “Plugins”→”X-RAAS”→”X-RAAS configuration...” from the simulator's main menu menu. This will bring up the main configuration window:

When open, the window will reflect the state of the current configuration of X-RAAS. You can make changes to the configuration and save it, or reset it to a default state. The following table explains what every control does:

#	Description	Default value	Equivalent textual configuration parameter
1	The master ON/OFF switch. **ON:** X-RAAS starts up if the current aircraft is compatible. **OFF:** X-RAAS startup is completely inhibited.	**ON**	`enabled`
2	Switches the unit of measure for distances used. **ON:** use feet as the unit of measure in annunciations. **OFF:** use meters as the unit of measure in annunciations. This setting doesn't affect the units used in the configuration interface. The configuration interface always requires lengths and distances to be specified in meters.	**ON**	`use_imperial`
3	X-RAAS has the option of pronouncing single-digit runways with or without prepending a leading '0'. Prepending '0' is ICAO-standard nomenclature, whereas not prepending '0' is used in FAA-governed territories. **ON:** pronounce single-digit runway numbers without a leading '0'	**OFF**	`us_runway_numbers`

#	Description	Default value	Equivalent textual configuration parameter
	(e.g. '1L'). **OFF:** pronounce single-digit runway numbers with a leading '0' (e.g. '01L').		
4	Sets the aural annunciation voice gender. **ON:** the voice of aural annunciations is female. **OFF:** the voice of aural annunciations is male.	**ON**	`voice_female`
5	During runway distance remaining or available annunciations, selects whether the units of measure used in the annunciation are appended to the initial annunciation (subsequent annunciations omit the units). **ON:** append the units of measure used to initial distance annunciations. **OFF:** don't append the units of measure used to distance annunciations..	**ON**	`speak_units`
6	If a late touchdown on landing is detected, this setting controls what nomenclature is used to annunciate this fact: **ON:** annunciate late touchdown as 'DEEP LANDING'. **OFF:** annunciate late touchdown as 'LONG LANDING'. This setting does not control whether the long landing monitor is enabled. Refer to section 4.15 for more information.	**OFF**	`say_deep_landing`
7	Controls whether X-RAAS startup is allowed if the current aircraft is detected to be a helicopter. **ON:** permit startup if the current aircraft is a helicopter. **OFF:** inhibit startup if the current aircraft is a helicopter. This setting doesn't affect other compatibility checks, such as the minimum number of engines allowed or the minimum MTOW limit. Refer to section 3 for more information.	**OFF**	`allow_helos`
8	On startup, X-RAAS displays a message at the bottom of the screen for 4 seconds to indicate that it is operating correctly and what units of measure are used for distance callouts, e.g: • “Runway Awareness OK, Feet.” • “Runway Awareness OK, Meters.” **ON:** display of the startup message is enabled. **OFF:** display of the startup message is inhibited. This setting doesn't control startup of X-RAAS itself.	**ON**	`startup_notify`
9	When the currently loaded aircraft doesn't meet the minimum requirements for X-RAAS to activate, X-RAAS displays a short message at the bottom of the screen to point out that it is auto-inhibited. This option controls whether this auto-inhibition message isdisplayed. **ON:** the display of the auto-inhibition message is enabled. **OFF:** the display of the auto-inhibition message is disabled.	**ON**	`auto_disable_notify`
10	**ON:** while the simulator view is external, audible playback and display of visual overlay annunciations is inhibited. **OFF:** while the simulator view is external, audible playback and display of visual overlay annunciations is permitted.	**ON**	`disable_ext_view`
11	Controls whether the issuing of visual annunciations is enabled, irrespective of whether on the fallback screen overlay or on the aircraft's ND. **ON:** permit issuing visual alerts on the ND or the screen overlay. **OFF:** inhibit issuing visual alerts on the ND and the screen overlay. Refer to section 3.1.2 for more information.	**ON**	`nd_alerts_enabled`

#	Description	Default value	Equivalent textual configuration parameter
12	Controls whether visual annunciations are allowed to be displayed using the fallback screen overlay. **ON:** permit display of visual alerts using the screen overlay. **OFF:** inhibit display of visual alerts using the on-screen overlay. This doesn't inhibit the issuing of visual alerts, only their display on the overlay. If the aircraft model provides display of visual alerts in the virtual cockpit, those will be displayed even if this setting is set to OFF. Refer to section 3.1.2 for more information.	**ON**	`nd_alert_overlay_enabled`
13	On aircraft which provide visual alert integration into the visual cockpit, X-RAAS will attempt to avoid showing the fallback screen overlay so as not to disturb the pilot by duplicate messages out of the virtual instrument frame. This setting allows you to override this behavior and force the display of the screen overlay. **ON:** permit display of visual alerts using the fallback on-screen overlay. **OFF:** inhibit display of visual alerts using the on-screen overlay. Refer to section 3.1.2 for more information.	**OFF**	`nd_alert_overlay_force`
14	Some aircraft models do not properly set the required datarefs for X-RAAS to detect electrical power being applied to the aircraft's avionics systems, resulting in X-RAAS being inoperable. **ON:** permit startup even if insufficient power is being applied to the aircraft's electrical buses. **OFF:** inhibit startup unless sufficient power is being applied to the aircraft's electrical buses.	**OFF**	`override_electrical`
15	During replays, aircraft position can behave in strange and non-predictable ways, which can cause X-RAAS to give spurious annunciations. **ON:** permit X-RAAS operation even if the simulator is currently in replay mode. **OFF:** inhibit X-RAAS operation if the simulator is currently in replay mode.	**OFF**	`override_replay`
16	In case you encounter compatibility issues with audio playback from X-RAAS and any other remedy is unavailable, you can force X-RAAS to play aural annunciations using the host operating system's text-to-speech function. **ON:** use the host operating system's text-to-speech function. **OFF:** use X-RAAS's own audio playback. NOTE: this feature is not available on Linux.	**OFF**	`use_tts`
17	When generating audio, X-RAAS can either use a dedicated OpenAL audio context, or a context shared with the rest of X-Plane. Certain audio drivers on Windows are known not to properly support multiple OpenAL contexts. If you encounter audio playback issues in that case, try to switch X-RAAS to use a shared audio context. **ON:** X-RAAS should use an OpenAL audio driver context shared with the rest of X-Plane. **OFF:** X-RAAS should use its own dedicated OpenAL audio driver context. NOTE: operating using a shared context can result in compatibility issues with certain 3rd party plugins and aircraft.	**OFF**	`openal_shared`
18	ON: the approaching runway on ground monitor is enabled. OFF: the approaching runway on-ground monitor is disabled. Refer to section 4.1 for more information.	**ON**	`apch_rwy_on_gnd_mon`
19	ON: the approaching runway in air monitor is enabled.	**ON**	`apch_rwy_in_air_mon`

#	Description	Default value	Equivalent textual configuration parameter
	OFF: the approaching runway in air monitor is disabled. Refer to section 4.10 for more information.		
20	ON: the approaching short runway in air monitor is enabled. OFF: the approaching short runway in air monitor is disabled. Refer to section 4.10 for more information.	**ON**	`apch_rwy_in_air_short_mon`
21	ON: the on-runway lineup monitor is enabled. OFF: the on-runway lineup monitor is disabled. Refer to section 4.2 for more information.	**ON**	`on_rwy_lineup_mon`
22	ON: the on-runway (short runway) lineup monitor is enabled. OFF: the on-runway (short runway) lineup monitor is disabled. Refer to section 4.3 for more information.	**ON**	`on_rwy_lineup_short_mon`
23	ON: the on-runway lineup late flap selection monitor is enabled. OFF: the on-runway lineup late flap selection monitor is disabled. Refer to section 4.1 for more information.	**ON**	`on_rwy_lineup_flaps_mon`
24	ON: the short runway takeoff monitor is enabled. OFF: the short runway takeoff monitor is disabled. Refer to section 4.4 for more information.	**ON**	`on_rwy_tkoff_short_mon`
25	ON: the on-runway extended holding monitor is enabled. OFF: the on-runway extended holding monitor is disabled. Refer to section 4.2.1 for more information.	**ON**	`on_rwy_hold_mon`
26	ON: the taxiway takeoff monitor is enabled. OFF: the taxiway takeoff monitor is disabled. Refer to section 4.5 for more information.	**ON**	`twy_tkoff_mon`
27	ON: distance remaining callouts on landing are enabled. OFF: distance remaining callouts on landing are disabled. Refer to section 4.16 for more information.	**ON**	`dist_rmng_land_mon`
28	ON: distance remaining callouts on rejected takeoff are enabled. OFF: distance remaining callouts on rejected takeoff are disabled. Refer to section 4.7 for more information.	**ON**	`dist_rmng_rto_mon`
29	ON: the taxiway landing monitor is enabled. OFF: the taxiway landing monitor is disabled. Refer to section 4.14 for more information.	**ON**	`twy_land_mon`
30	ON: the runway ending distance remaining callout is enabled. OFF: the runway ending distance remaining callout is disabled.	**ON**	`rwy_end_mon`
31	ON: the 'TOO HIGH' approach monitor upper gate (950-600 ft AFE) is enabled. OFF: the 'TOO HIGH' approach monitor upper gate (950-600 ft AFE) is disabled. Refer to section 4.12 for more information.	**ON**	`apch_too_high_upper_mon`
32	ON: the 'TOO HIGH' approach monitor lower gate (600-450 ft AFE) is enabled. OFF: the 'TOO HIGH' approach monitor lower gate (600-450 ft AFE) is disabled. Refer to section 4.12 for more information.	**ON**	`apch_too_high_lower_mon`
33	ON: the 'TOO FAST' approach monitor upper gate (950-600 ft AFE) is enabled. OFF: the 'TOO FAST' approach monitor upper gate (950-600 ft AFE) is disabled. Refer to section 4.13 for more information.	**ON**	`apch_too_fast_upper_mon`
34	ON: the 'TOO FAST' approach monitor lower gate (600-450 ft	**ON**	`apch_too_fast_lower_mon`

#	Description	Default value	Equivalent textual configuration parameter
	AFE) is enabled. OFF: the 'TOO FAST' approach monitor lower gate (600-450 ft AFE) is disabled. Refer to section 4.13 for more information.		
35	ON: the late flap selection approach monitor upper gate (950-600 ft AFE) is enabled. OFF: the late flap selection approach monitor upper gate (950-600 ft AFE) is disabled. Refer to section 4.11 for more information.	**ON**	`apch_flaps_upper_mon`
36	ON: the late flap selection approach monitor lower gate is enabled. OFF: the late flap selection approach monitor lower gate is disabled. Refer to section 4.11 for more information.	**ON**	`apch_flaps_lower_mon`
37	The conditions checked depend on the lower gate setting of the respective approach monitor. ON: the unstable approach monitor is enabled. OFF: the unstable approach monitor is disabled. Refer to section 4.11 for more information.	**ON**	`apch_unstable_mon`
38	ON: the QNE altimeter setting monitor mode is enabled. OFF: the QNE altimeter setting monitor mode is disabled. Refer to section 4.8 for more information.	**ON**	`altm_qne_mon`
39	ON: the QNH altimeter setting monitor mode is enabled. OFF: the QNH altimeter setting monitor mode is disabled. Refer to section 4.9 for more information.	**ON**	`altm_qnh_mon`
40	ON: the QFE altimeter setting monitor mode is enabled. OFF: the QFE altimeter setting monitor mode is disabled. Refer to section 4.9 for more information.	**ON**	`altm_qfe_mon`
41	ON: the long landing monitor is enabled. OFF: the long landing monitor is disabled. Refer to section 4.15 for more information.	**ON**	`long_land_mon`
42	ON: the late rotation on takeoff monitor is enabled. OFF: the late rotation on takeoff monitor is disabled. Refer to section 4.6 for more information.	**ON**	`late_rotation_mon`
43	The relative audio volume for aural annunciations.	**100**	`voice_volume`
44	Minimum number of engines the aircraft must have for it to be considered an “airliner” and permit X-RAAS startup.	**2**	`min_engines`
45	Lowest value of the aircraft's Maximum TakeOff Weight (MTOW) for it to be considered an “airliner” and permit X-RAAS startup.	**5700**	`min_mtow`
46	The minimum runway length remaining that is considered to be safe for conducting a takeoff. If the runway length remaining is less than this value, caution annunciations will be issued. Refer to section 4.3 for more information.	**1000**	`min_takeoff_dist`
47	The minimum runway length remaining that is considered to be safe for conducting a landing. If the runway length remaining is less than this value, caution annunciations will be issued. Refer to section 4.10 for more information.	**800**	`min_landing_dist`
48	The minimum runway length remaining by which if the aircraft hasn't initiated rotation, X-RAAS will start issuing runway length remaining annunciations to warn of rapidly approaching the runway end.	**400**	`min_rotation_dist`

#	Description	Default value	Equivalent textual configuration parameter
	Refer to section 4.6 for more information.		
49	The minimum pitch angle relative to the runway slope above which X-RAAS considers the aircraft to have initiated rotation for takeoff. Refer to section 4.6 for more information.	**3**	`min_rotation_angle`
50	On landing, do not initiate runway length remaining annunciations as long as the runway length remaining is above this value. Refer to section 4.16 for more information.	**1600**	`stop_dist_custoff`
51	Issue the first “ON RUNWAY” annunciation for extended holding on the runway after this number of seconds have elapsed. Refer to section 4.2.1 for more information.	**60**	`on_rwy_warn_initial`
52	Issue subsequent “ON RUNWAY” annunciations for extended holding on the runway after this number of seconds have elapsed. Refer to section 4.2.1 for more information.	**120**	`on_rwy_warn_repeat`
53	Maximum number of “ON RUNWAY” annunciations issued for extended holding on the runway. Refer to section 4.2.1 for more information.	**3**	`on_rwy_warn_max_n`
54	Maximum glidepath angle multiplier for the TOO HIGH approach monitor. Refer to section 4.12 for more information.	**2**	`gpa_limit_mult`
55	Maximum absolute glidepath angle for the TOO HIGH approach monitor. Refer to section 4.12 for more information.	**8**	`gpa_limit_max`
56	Maximum distance from the approach threshold above which if the aircraft has not yet touched down, the landing is considered a long/deep landing. Refer to section 4.15 for more information.	**610**	`long_land_lim_abs`
57	Fraction of the runway length from the approach threshold above which if the aircraft has not yet touched down, the landing is considered a long/deep landing. Refer to section 4.15 for more information.	**0.25**	`long_land_lim_fract`
58	Minimum relative flap handle position, including and above which the flaps setting is considered a valid flaps setting for landing. Refer to section 4.11 for more information.	**0.5**	`min_landing_flap`
59	Minimum relative flap handle position, including and above which the flaps setting is considered a valid flaps setting for takeoff. Refer to section 4.2for more information.	**0.1**	`min_takeoff_flap`
60	Maximum relative flap handle position, including and below which the flaps setting is considered a valid flaps setting for takeoff. Refer to section 4.2for more information.	**0.75**	`max_takeoff_flap`
61	Number of seconds for which visual alerts are displayed on the ND.	**7**	`nd_alert_timeout`
62	A filter which controls what visual alerts are displayed on the ND: **ALL:** all visual alerts are displayed (routine, non-routine, caution). **NON-R:** only non-routine and caution alerts are displayed. **CAUT:** only caution alerts are displayed.	**ALL**	`nd_alert_filter`
63	Specifies the font file (TTF) to use for the fallback screen overlay. To use a custom font, place the font file into the X-RAAS plugin folder under "data/fonts" and specify its filename here. To revert to the default font, simply leave this text field empty.	*(auto)*	`nd_alert_overlay_font`

#	Description	Default value	Equivalent textual configuration parameter
64	The pixel size of the font to use for the ND alert overlay.	**28**	`nd_alert_overlay_font_size`
65	Saves the current configuration into the currently loaded aircraft. The configuration will then only be applied to that specific aircraft.	*N/A*	*N/A*
66	Saves the current configuration as the global configuration. The configuration will be applied to any aircraft which doesn't have its own aircraft-specific configuration.	*N/A*	*N/A*
67	Resets the aircraft-specific configuration to its default values. If there is a global configuration, it will be applied. Otherwise, the default configuration will be applied.	*N/A*	*N/A*
68	Resets the global configuration to its default values. If there is an aircraft-specific configuration, it will be applied when the associated aircraft is loaded. Otherwise the default configuration will be applied.	*N/A*	*N/A*

5.2 Text-based configuration

The text-based configuration file is called **`X-RAAS.cfg`**. A sample file is provided in the **`sample-config`** folder in the X-RAAS distribution package. You can open it up in any text editor such as Notepad or TextEdit. Please note, that the file must first be moved to a different folder if you want to use it (see below). The configuration file is simply a set of lines in the following format:

```
<Parameter> = <Value>
```

You can set the value of a parameter any number of times in a configuration file. The last setting encountered will be the one used. Please note that if you are satisfied with the default value of a parameter, you do not need to set it in the configuration file. Absence of a parameter setting implies that X-RAAS should use the default value. This should help to keep your configuration file short.
Anything following a hash sign (#) is considered a comment and ignored by X-RAAS:

```
# This is a comment. X-RAAS ignores what's on this line.
<Parameter> = <Value>
```

X-RAAS looks for the configuration file in two locations, first in the **Output/preferences** folder under X-Plane's global folder and then in the aircraft folder of the currently loaded aircraft. If both are present, X-RAAS loads both files in this order, so any parameter set in the global configuration file in the **preferences** folder can be overridden by the configuration file in the aircraft folder, giving the ability to override global settings on a per-aircraft basis.

```
<X-Plane Folder>
  Aircraft
    <Your Aircraft's Folder>
      X-RAAS.cfg          ← overrides any global settings only for this aircraft
  Output
    preferences
      X-RAAS.cfg          ← global settings for X-RAAS shared by all aircraft
```

The sample configuration file shipped with X-RAAS contains a list of all settable parameters with comments on what they do (though all lines are commented out, so all parameters are set to their defaults). Refer to the sample configuration file for a reference on what each parameter.

6 Electrical system integration

X-RAAS is internally connected to electrical bus #1 and #2 in the aircraft (normally the “left” and “right” electrical bus) and is also subject to the master “Avionics on” switch (if installed on the aircraft). Losing power on both electrical buses or setting the master avionics switch to the “off” position will result in X-RAAS shutting down. X-RAAS requires a minimum of at least 11 Volts to be present on one of the electrical buses to operate and nominally consumes around 40 Watts of power.
In case your aircraft model is having integration problems with X-RAAS, it is possible to disable X-RAAS's electrical checks and have it always turn on, regardless of power state on the aircraft's electrical buses. See the **`override_electrical`** parameter described in section 5.

7 Compatibility notices

7.1 Feature compatibility matrix

The following table lists aircraft-specific feature compatibility. Features and monitors not listed in the table's columns are supported on all aircraft.

Aircraft Model Name	GTO	GFO	VAND	VAO	EASM
FlightFactor 757	✔	✔	✘	✔	✘
FlightFactor 777	$✔_{GEAR}$	✔	✘	✔	$✔_{REF}$
IXEG 737-300	$✔_{GEAR}$	✔	✘	✘	✘
FlyJSim 732 Twinjet	$✔_{FLAP}$	✔	✘	✔	✘
JARDesign Airbus A320 Neo	✔	✔	✘	✔	✔
JARDesign Airbus A330-243	✔	✔	✘	✔	✔
Other aircraft	✘	✘	✘	✔	✘

Legend:

- **GTO (GPWS Terrain Override):** GPWS terrain override selection is supported. Subscripts:
  - $✔_{GEAR}$: GPWS terrain override mode is engaged using the GPWS gear override switch.
  - $✔_{FLAP}$: GPWS terrain override mode is engaged using the GPWS flap override switch.
- **GFO (GPWS Flaps Override):** GPWS flaps override selection is supported.
- **VAND (Visual Alerts on Navigation Display):** Visual alerts will display integrated in the 3D cockpit on the navigation display.
- **VAO (Visual Alerts on Overlay):** Visual alerts will display using an on-screen overlay near the top center of the screen.
- **EASM (Excessive Approach Speed Monitor):** Monitoring of excessive approach speed is supported. Refer to section 4.13 for details on this monitor. Subscripts:
  - ✔: Both the V_{REF} and V_{APP} methods are supported. Which method is used depends on the setting in the FMS. If a V_{APP} speed is set, the V_{APP} method will be used. Otherwise X-RAAS falls back to trying the V_{REF} method.
  - $✔_{REF}$: Only the V_{REF} method is supported.
  - $✔_{APP}$: Only the V_{APP} method is supported.

8 About the X-RAAS project

8.1 Author

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8.2 Acknowledgements

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- Chris Hargreaves
- Jean Joubert
- Kyle Madore

8.3 License

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3. If you modify X-RAAS and wish to distribute it in any way, you must share the source code for the modifications you have made to it. If you've made it part of a larger work, you don't have to share the source code for all of your work, only the bits of X-RAAS you've modified.

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