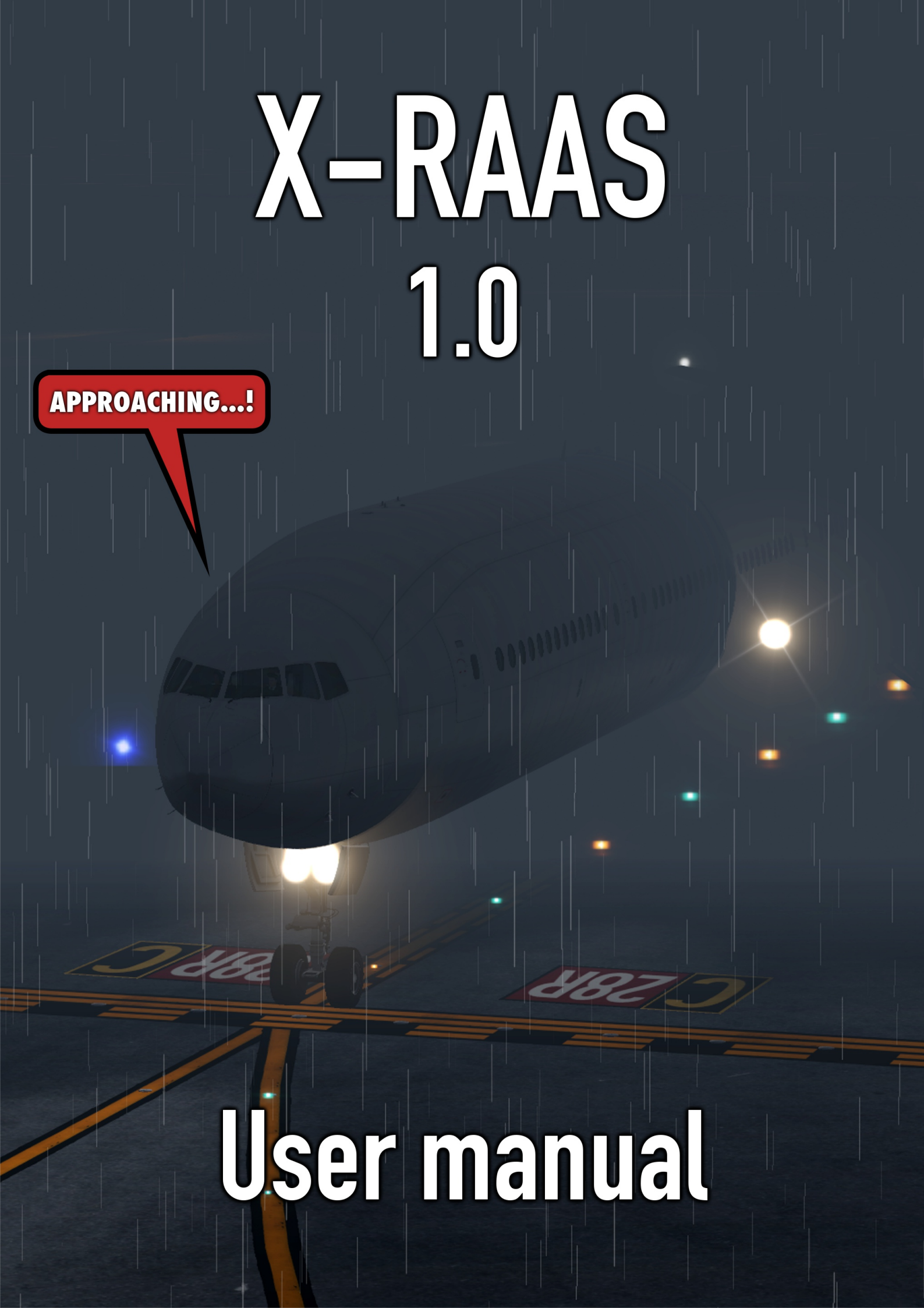
X-RAAS

1.0



User manual

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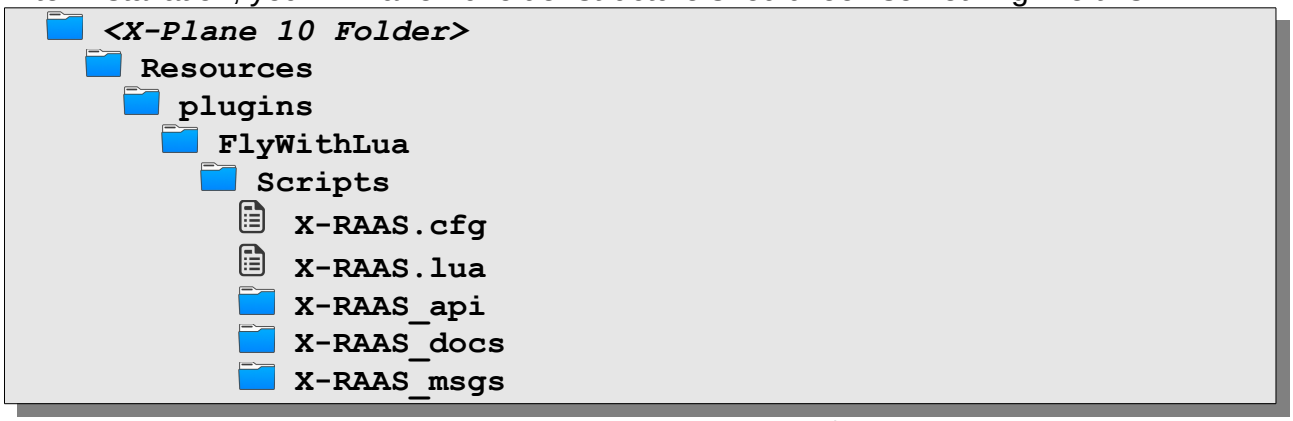
1 Introduction

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

X-RAAS is written in Lua and as such requires the **FlyWithLua** plugin (minimum version 2.4.3) for X-Plane 10. Once that is installed, to install X-RAAS, simply copy **all the files** provided in the compressed ZIP file to the **`Scripts`** folder in **`FlyWithLua`**. X-RAAS is for the most part fully automated, but you are encouraged to read through this manual to fully understand what it monitors and how to extract the most use from its advisories.
After installation, your X-Plane 10 folder structure should look something like this:



The first time you start up X-Plane 10 and load any airliner[2], 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), during which time the simulator will appear to be frozen. Do not be alarmed. 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.

NOTE
If you add or update scenery in the simulator, X-RAAS's airport data cache can become outdated. To correct this, you will need to manually delete this cache. On subsequent startup, X-RAAS will recreate it. The cache is located in the **`X-RAAS_apt_dat_cache`** folder in the **`FlyWithLua/Scripts`** folder. To remove the cache, delete the **`X-RAAS_apt_dat_cache`** folder. **DO NOT DELETE ANYTHING ELSE**.

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, since RAAS advisories and performance monitoring can be a poor

1 More specifically, the SmartRunway and SmartLanding products.
2 By default X-RAAS is inhibited in small general aviation aircraft. See section 3 for more details.

fit for small general aviation aircraft or aircraft with performance significantly different from airliners (such as helicopters). To avoid this, by default X-RAAS checks two 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 any of these parameters is below the above mentioned limits, X-RAAS startup is inhibited. Both of these limits are 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.

3.1 Annunciation Mechanism and Aircraft Integration

Aural annunciations are simply played through the aircraft's loudspeaker system. Visual annunciations are normally displayed on the aircraft's navigation display. Proper display of visual annunciations requires 3rd party aircraft integration. If an aircraft does not provide this integration, X-RAAS will by default fall back to display visual annunciations as an overlay near the top center of the video screen. Please note that if the current simulator view is external, both aural and visual annunciations are suppressed.
Aircraft developers are encouraged to refer to section 8 for details and samples on visual annunciation integration.

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[3]. X-RAAS will issue an advisory in case 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.

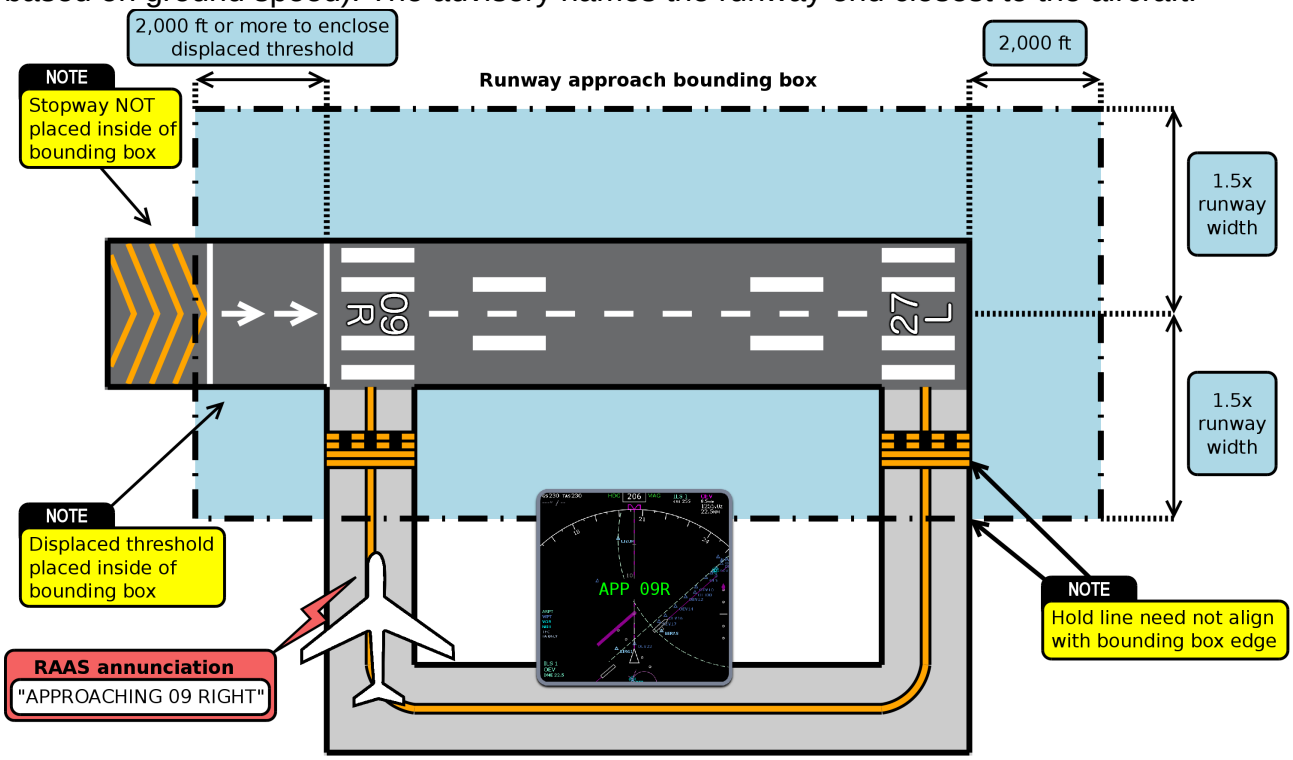


Illustration 1: Approaching a runway on the ground

The aural advisory is accompanied by a green visual advisory on the navigation display:

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.

3 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). If the aircraft holds in position on a runway for extended periods of time, the annunciation is repeated at configurable intervals up to a configurable maximum number of repetitions before auto-inhibiting. The aural advisory is accompanied by a green visual advisory on the navigation display:

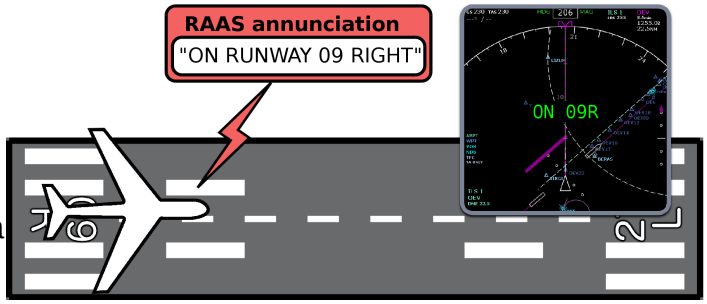


Illustration 2: Lined up on runway for takeoff

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' advisory will be issued instead of the green 'ON XX' advisory:

FLAPS

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 an amber visual advisory on the navigation display:

ON XX YY

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

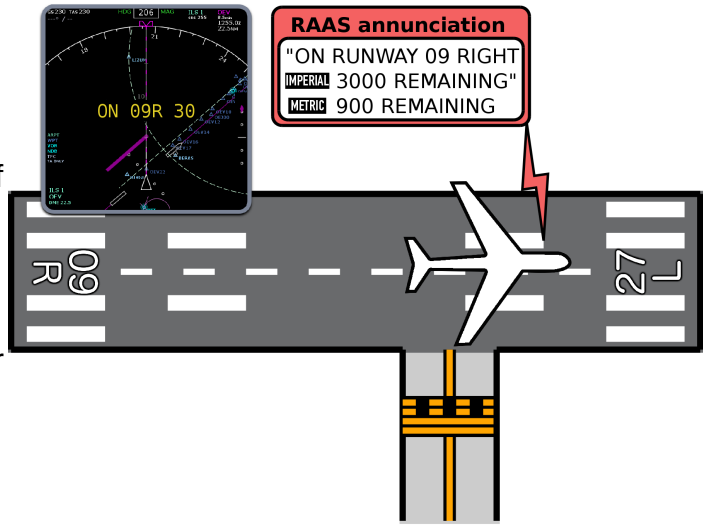


Illustration 3: Lined up on runway too short for takeoff

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 an amber visual advisory on the navigation display:

SHORT RUNWAY

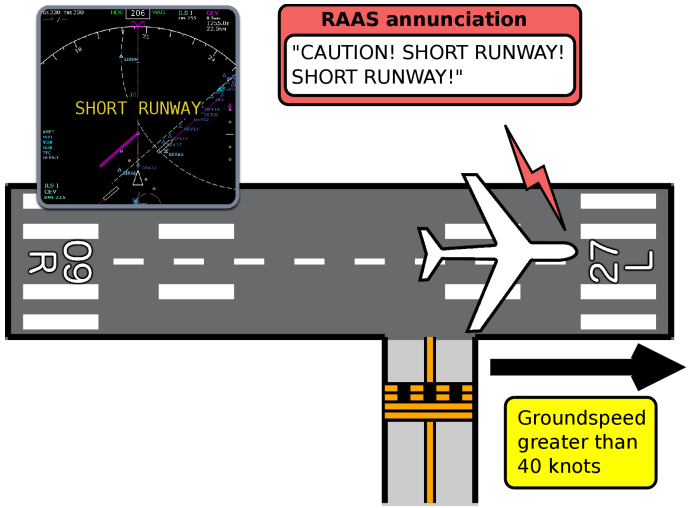


Illustration 4: Short runway takeoff

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 an amber visual advisory on the navigation display:

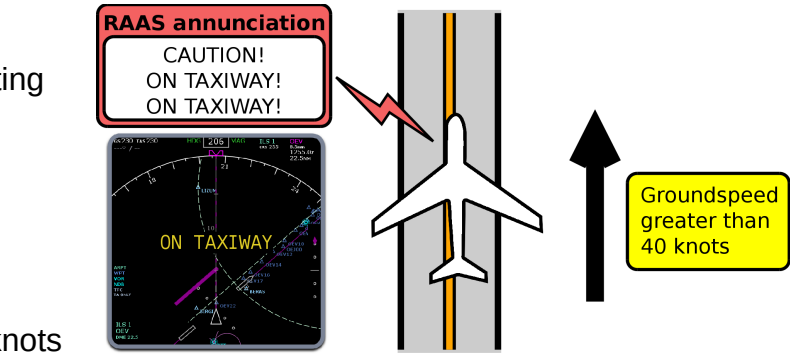


Illustration 5: Taxiway takeoff

ON TAXIWAY

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.

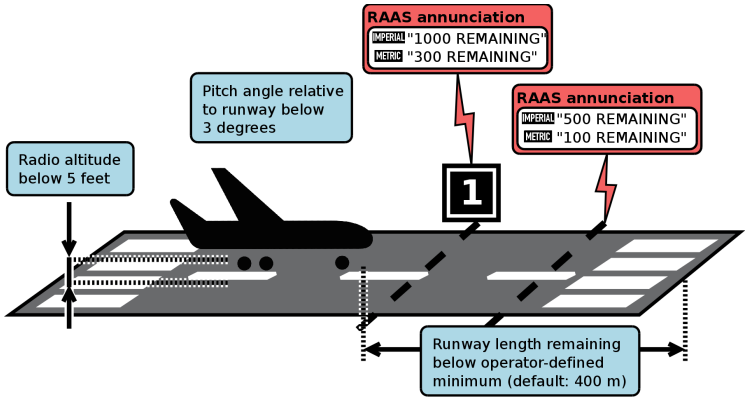


Illustration 6: Late rotation on takeoff

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.

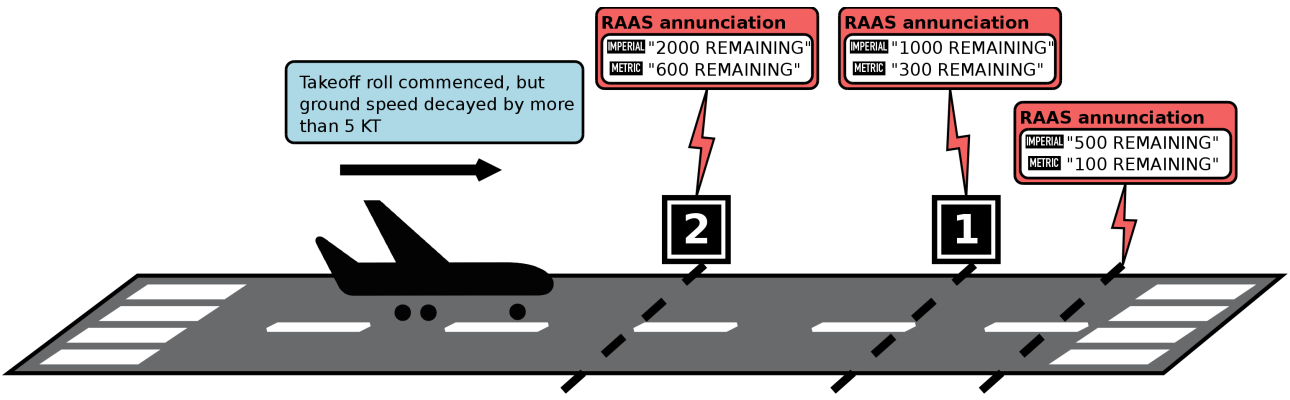


Illustration 7: Rejected takeoff

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 an amber visual advisory on the navigation display:

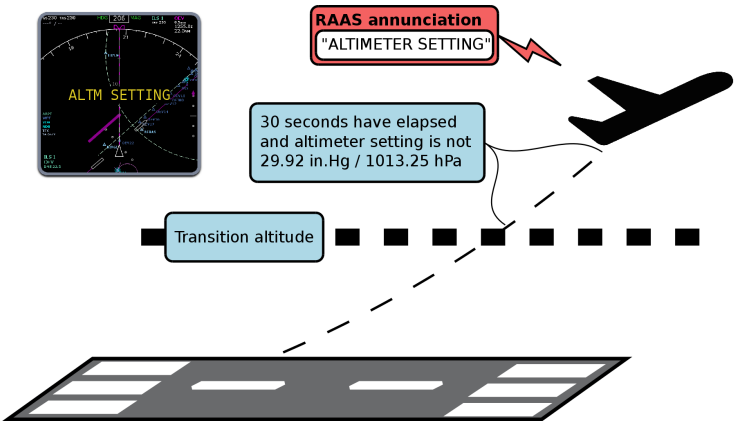


Illustration 8: Altimeter setting climbing through transition altitude

ALTM SETTING

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[4], 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[5], 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 an amber visual advisory on the navigation display:

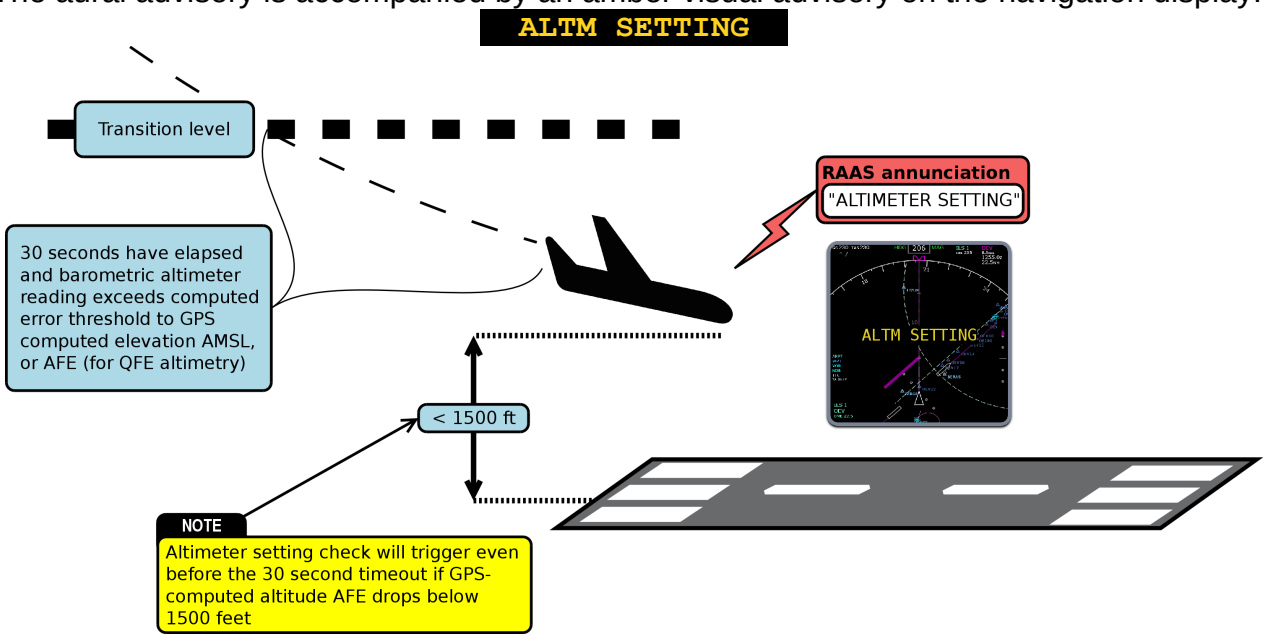


Illustration 9: Altimeter setting descending through transition level

4 See parameter **RAAS_qnh_alt_enabled** in section 5.
5 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[6].

The aural advisory is accompanied by a green visual advisory on the navigation display:

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Where 'XX' is the runway identifier. If the runway length is below an operator-defined minimum[7], 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 amber visual advisory displays on the navigation display 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 an amber visual advisory:

SHORT RUNWAY

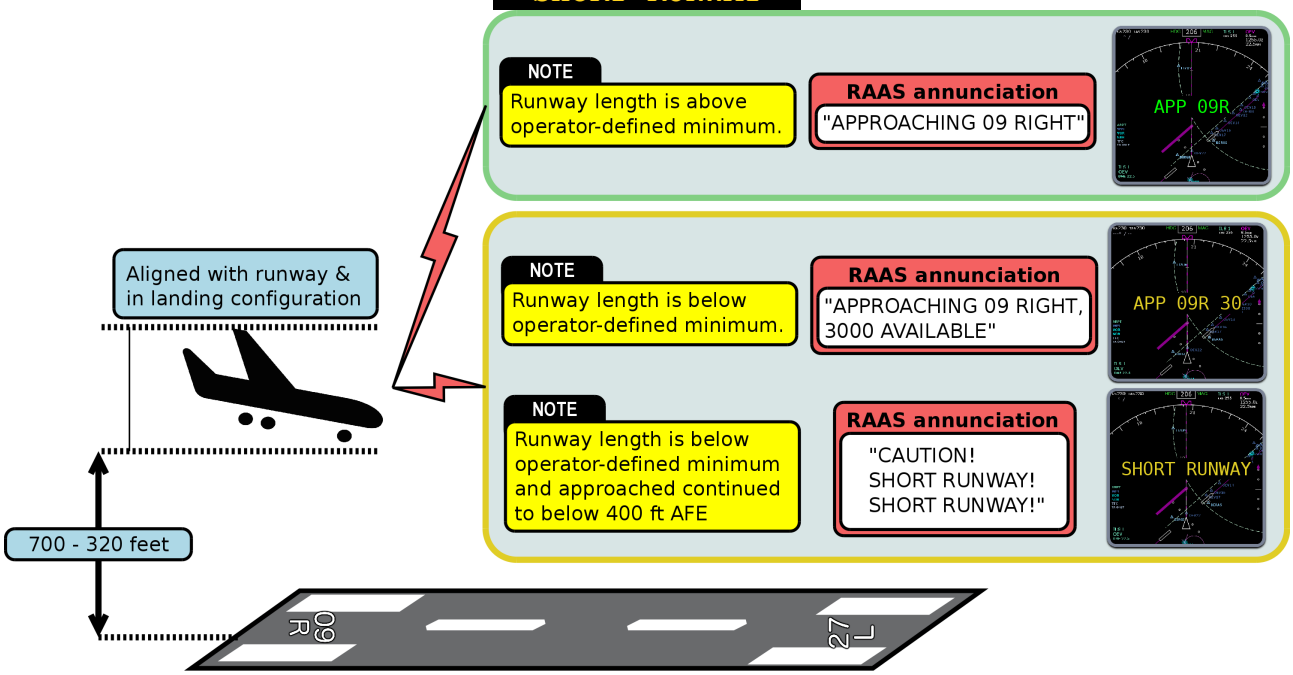

Illustration 10: Approaching a runway to land

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

7 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[8] 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 elevation above runway threshold:

- 950 feet to 600 feet, annunciation: “FLAPS *(pause)* FLAPS” and **FLAPS** on the ND.
- 600 feet to 450 feet, annunciation: “FLAPS! FLAPS!” and **FLAPS** on the ND.
- 450 feet to 300 feet, annunciation: “UNSTABLE! UNSTABLE!” and **UNSTABLE** 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.

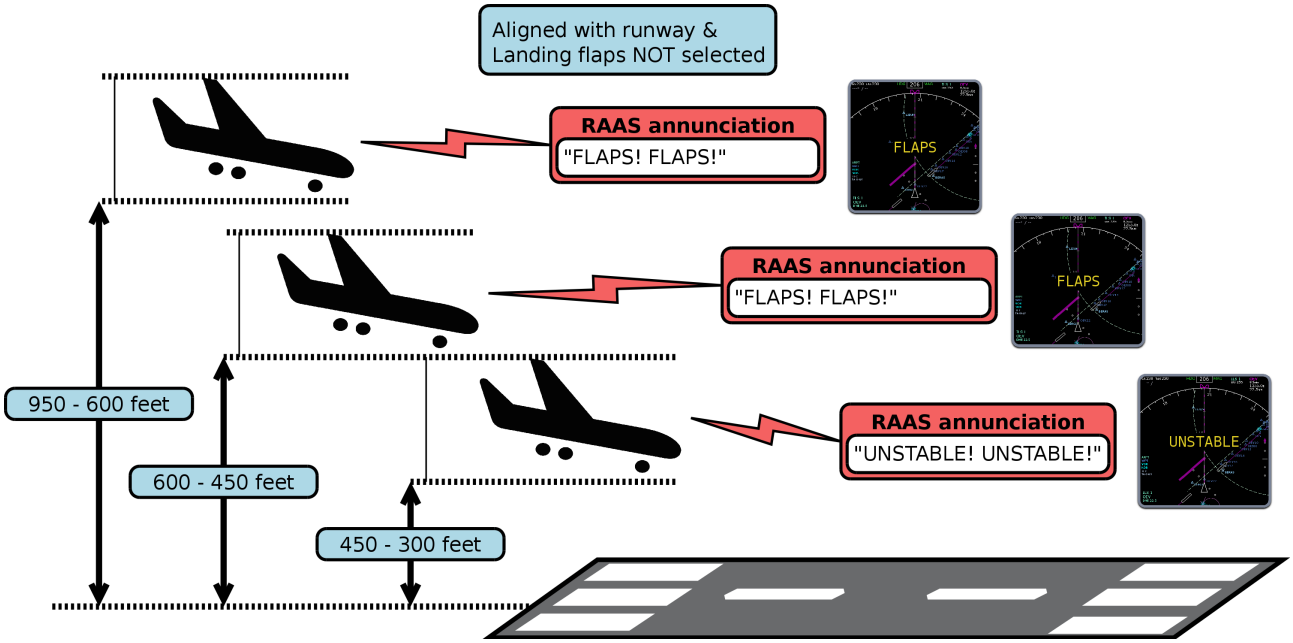

Illustration 11: Late flap selection during approach to land

8 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 1.5x the optimal angle (but no more than 8 degrees absolute glide path angle), X-RAAS issues advisories, depending elevation 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**

This annunciation is inhibited if:

- the aircraft descends below 300 feet above threshold elevation, or
- the GPWS terrain override mode is active, or
- gear is not down or the rate of climb exceeds 300 feet per minute.

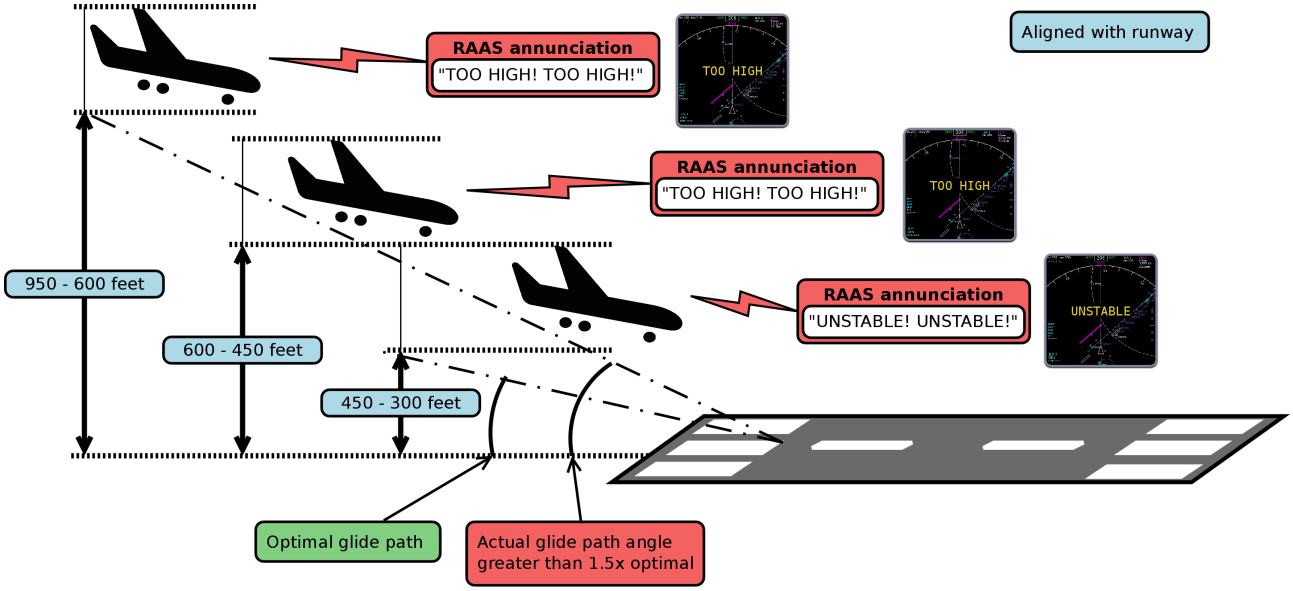

Illustration 12: Steep descent late in the approach to land

4.13 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).

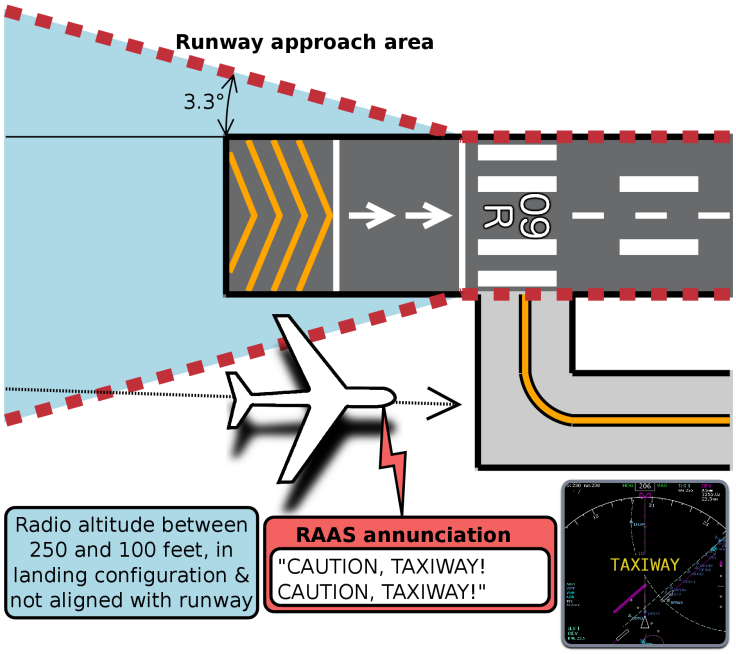

Illustration 13: Attempting to land on a parallel taxiway

The advisory is inhibited below 100 feet radio altitude[9] or if the GPWS terrain override mode is active. The aural advisory is accompanied by an amber visual advisory on the navigation display:

TAXIWAY

9 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.

4.14 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 past 2,000 feet past the approach runway end or remaining runway length is less than an operator-specified minimum.

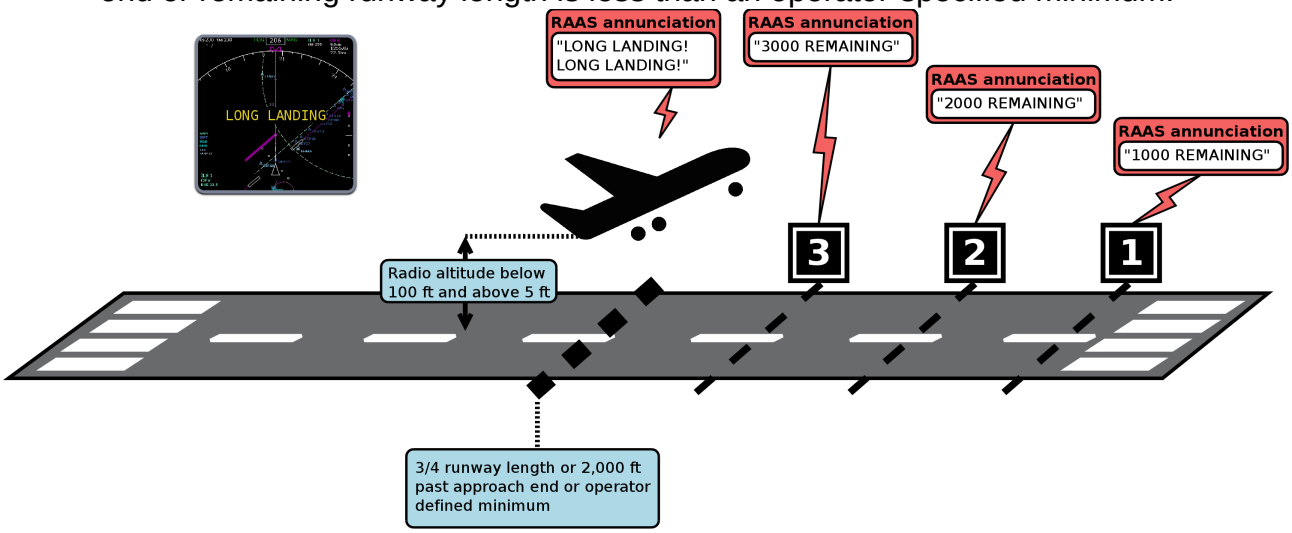

Illustration 14: Long landing

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[10]. 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 4.16 for conditions monitored during a go-around). The aural advisory is accompanied by an amber visual advisory on the navigation display:

LONG LANDING

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

4.15 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[10]), 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 meters 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[11]. No visual advisories are generated.

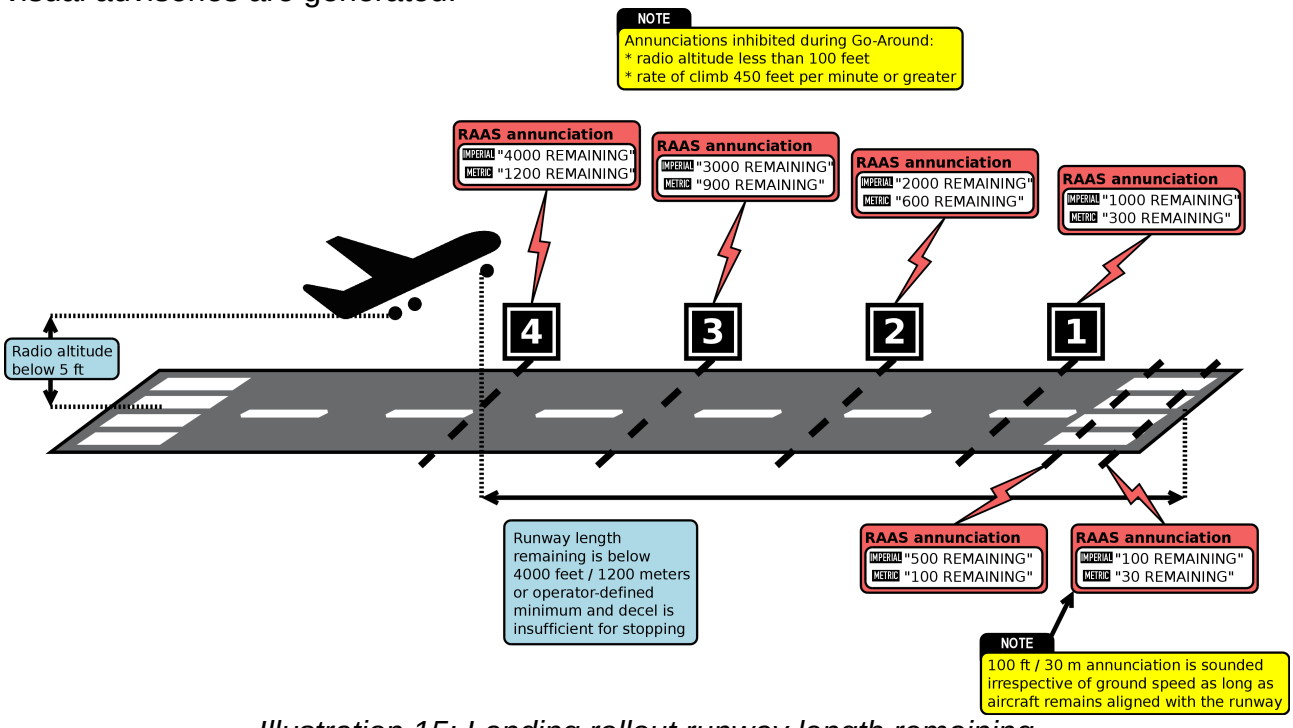

Illustration 15: Landing rollout runway length remaining

11 Stopways are normally designed for emergency use only.

4.16 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.

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

4.17 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.

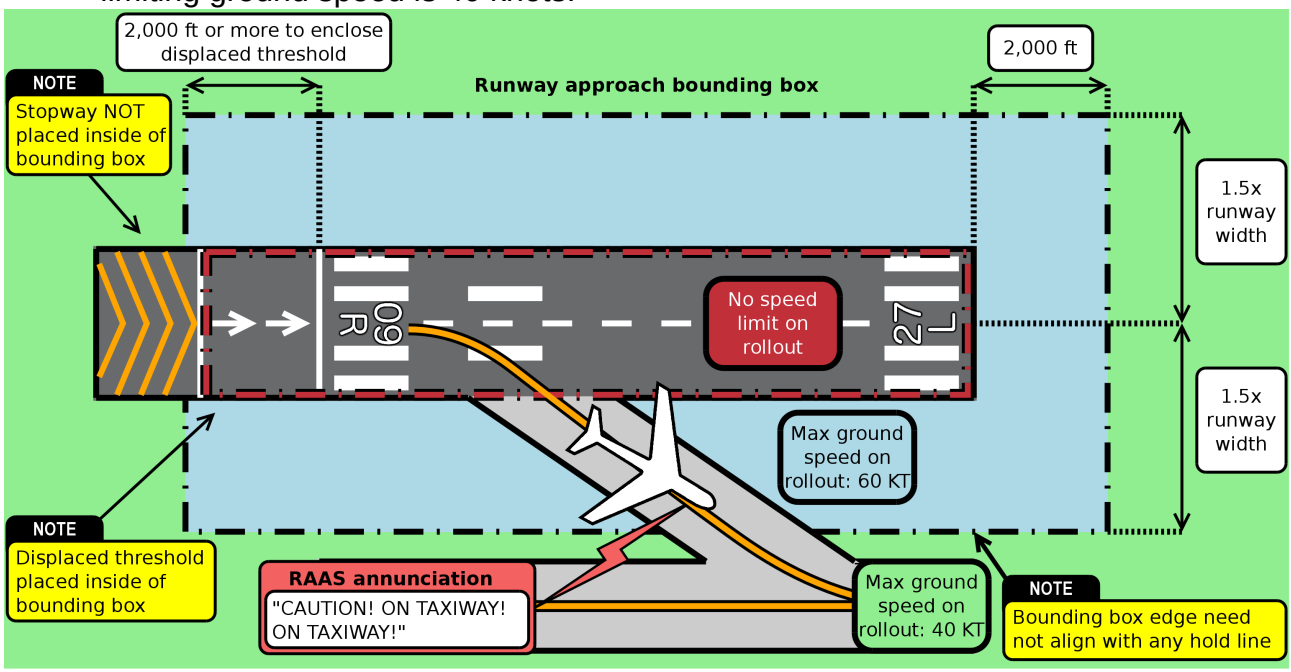

Illustration 16: Runway exit via high-speed exit taxiways

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 a text configuration file called `X-RAAS.cfg`. You can open it up in any text editor such as Notepad or TextEdit. 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 double-dash (--) 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 **Scripts** folder in **FlyWithLua** where X-RAAS is installed 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 **Scripts** 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 10 Folder>
- **Aircraft**
  - ***<Your Aircraft's Folder>***
    - **X-RAAS.cfg** ← overrides any global settings only for this aircraft
  - **Resources**
    - **plugins**
      - **FlyWithLua**
        - **Scripts**
          - **X-RAAS.cfg** ← global settings for X-RAAS shared by all aircraft

The default 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). For completeness' sake, the list of settable parameters is repeated here.

Parameter Name	Default Value	Description
RAAS_enabled	**true**	This is the master X-RAAS on/off switch. Setting this parameter to **false** will disable X-RAAS completely.
RAAS_min_engines **RAAS_min_MTOW**	**2** **5700**	RAAS is primarily designed for airliners and is a poor fit for light general aviation aircraft or special performance aircraft such as helicopters or aerobatic aircraft. Provided the master **RAAS_enabled** parameter is set to **true**, X-RAAS also checks the aircraft's number of engines and Maximum Take Off Weight (MTOW) to see if the aircraft fulfills certain minimum criteria to be considered an “airliner”. To enable X-RAAS on all aircraft just set both of these values to **0**.
RAAS_use_imperial	**true**	By default X-RAAS reads out runway length remaining in thousands of feet. By setting this parameter to **false**, X-RAAS will read out runway length remaining in

		increments of 300 meters. See section 4.15 for more details.
RAAS_voice_female	**true**	Set to **false** to make X-RAAS grow a pair.
RAAS_voice_volume	**1.0**	Sets the relative volume of the RAAS announcements from **0.0** (silence) to **1.0** (full volume).
RAAS_US_runway_numbers	**false**	In the United States, runways are allowed to have single-digit numbers, so runway “01” is simply referred to as runway “1”. By default, X-RAAS uses the ICAO standard and always pronounces runway numbers as two digits, prepending a “0” if necessary. If you only fly within the US, you can set this parameter to **true** to make X-RAAS pronounce single-digit runways without prepending a “0”.
RAAS_min_takeoff_dist	**1000**	This is the minimum runway length remaining (in meters) that X-RAAS will consider to be safe for conducting a takeoff. This affects the advisories in sections 4.3 and 4.4.
RAAS_min_landing_dist	**800**	This is the minimum runway length remaining (in meters) that X-RAAS will consider to be safe for conducting a landing. This affects the advisory in section 4.10.
RAAS_min_rotation_dist **RAAS_min_rotation_angle**	**400** **4**	Minimum runway length remaining (in meters) and pitch angle (in degrees) relative to the runway slope where X-RAAS will start to issue runway length remaining annunciations on takeoff to warn of the runway end approaching rapidly and the need to initiate rotation immediately. This affects the advisory in section 4.6.
RAAS_stop_dist_cutoff	**1500**	Defines an upper limit (in meters) on runway length remaining for “distance remaining” callouts during landing rollout (sections 4.7 and 4.15). If the distance remaining is greater than this value, X-RAAS will not generate annunciations until the distance remaining drops below this value. The maximum value is **3000**.
RAAS_min_landing_flap	**0.5**	Minimum flap setting (relative flap handle position from **0.0** for “flaps up” to **1.0** for full “flaps down”) that is considered a valid landing flaps setting. This affects the advisory in section 4.11.
RAAS_min_takeoff_flap **RAAS_max_takeoff_flap**	**0.1** **0.75**	The minimum and maximum valid flap setting for takeoff. This affects the supplemental “FLAPS! FLAPS!” callout when lining up on a runway for takeoff in section 4.2.
RAAS_on_rwy_warn_initial **RAAS_on_rwy_warn_repeat** **RAAS_on_rwy_warn_max_n**	**60** **120** **3**	The interval at which “ON RUNWAY” callouts for extended holding on a runway are issued (see section 4.2). The initial delay is for the first callout, whereas the repeat delay is for any subsequent callouts from the first. The “max_n” parameter defines the total maximum number of callouts that will be issued to limit annoyance to the crew. Setting **RAAS_on_rwy_warn_max_n** to **0** will disable any “ON RUNWAY” callouts after extended holding on the runway.
RAAS_too_high_enabled	**true**	Controls whether X-RAAS will monitor glidepath angle and warn against too high approaches using the advisory described in section 4.12.
RAAS_gpa_limit_mult **RAAS_gpa_limit_max**	**1.5** **8**	If glidepath angle monitoring is enabled, this defines what X-RAAS considers to be “too high” on the glidepath. **RAAS_gpa_limit_mult** controls the

		glidepath angle multiplier, so if for instance the optimal glidepath for a runway is 3 degrees (determined from the database) and the multiplier is 1.5, then the limit before X-RAAS will begin “TOO HIGH” annunciations will be 4.5 degrees (3 x 1.5). **RAAS_gpa_limit_max** provides an absolute upper boundary (in degrees) on the allowed glidepath angle limit. Even if the multiplier would calculate a higher limit, X-RAAS will cut the value off at this maximum threshold.
RAAS_alt_setting_enabled	**true**	Controls if altimeter setting monitoring is enabled, as described in sections 4.8 and 4.9.
RAAS_qnh_alt_enabled **RAAS_qfe_alt_enabled**	**true** **false**	When altimeter checks are enabled, when descending through transition level, these parameters determine what type of altimeter setting checks are preformed by X-RAAS. When QNH setting is allowed, X-RAAS checks to make sure that the barometric altimeter reading is within a pre-computed margin from GPS-computed elevation above mean sea level. When QFE setting is allowed, X-RAAS checks to make sure that the altimeter reading is within a pre-computed margin from above field elevation of the nearest airport. Setting both parameters to **true** allows either altimeter setting, whereas setting both parameters to **false** disables barometric altimeter checking on descent.
RAAS_disable_ext_view	**true**	X-RAAS mutes annunciations when it detects that the current view location is “external”, since these should only be audible when inside the cockpit. Setting this to **false** will allow annunciations to sound regardless if X-RAAS thinks your view is inside the cockpit or not.
RAAS_auto_disable_notify	**true**	To help users quickly determine that startup X-RAAS is auto-disabled due to aircraft size limitations or compatibility issues, by default X-RAAS prints a short notice at the bottom of the screen for 25 seconds. You can disable this notification by setting this parameter to **false**.
RAAS_override_electrical	**false**	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. If that's the case, you can set this parameter to **true** to make X-RAAS always turn on, even if it thinks electrical power isn't available.
RAAS_speak_units	**true**	X-RAAS will annunciate the units used for distance measurement during an initial distance remaining or available annunciation (e.g. "5000 FEET REMAINING" on landing). For brevity, subsequent annunciations will only annunciate the number (e.g. "4000 REMAINING"). By setting the parameter below to **false**, X-RAAS will never annunciate the units and instead always only annunciate the numeric value of the distance.
RAAS_long_land_lim_abs **RAAS_long_land_lim_fract**	**610** **0.25**	These values determine the fraction of the runway length from the approach end of the runway where a landing should be performed, before a long landing annunciation is made (refer to section 4.14). The parameter **RAAS_long_land_lim_abs** defines the absolute longest length (in meters) from the approach runway end. The **RAAS_long_land_lim_fract** parameter

		defines the runway length as a fraction of the runway length. The lesser of these two values is considered the “normal” landing range. The minimum and maximum values for **RAAS_long_land_lim_fract** are 0.0 and 1.0 respectively.
RAAS_ND_alerts_enabled	**true**	Controls whether X-RAAS will issue visual alerts on the aircraft's Navigation Display (ND) or the fallback screen overlay display. Setting this to **false** does not disable aural annunciations.
RAAS_ND_alert_overlay_enabled	**true**	Provided **RAAS_ND_alerts_enabled** is set to **true**, if the aircraft does not provide proper visual alert integration, X-RAAS will attempt to display visual alerts as an overlay near the top center of the screen. Setting this parameter to false disables that fallback mechanism. It does not disable display of visual alerts on an aircraft's ND, provided the aircraft has been integrated with X-RAAS's visual alert mechanism (refer to section 8 for details on how to do this).
RAAS_ND_alert_timeout	**7**	Defines how long (in seconds) visual advisories remain on the navigation display.
RAAS_GPWS_priority_dataref	***sim/cockpit2/annunciators/GPWS***	Defines which dataref X-RAAS monitors to determine if GPWS priority override should be in effect. Refer to section 8.3 for details on this feature.
RAAS_GPWS_inop_dataref	***sim/cockpit/warnings/annunciators/GPWS***	Defines which dataref X-RAAS monitors to determine if the GPWS computer (and by consequence X-RAAS) is inoperative. Refer to section 8.4 for details on this feature.

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 **RAAS_override_electrical** parameter described in section 5.

7 Known Compatibility Issues

The following aircraft are known to be incompatible with X-RAAS. X-RAAS will auto-disable if it detects the aircraft is loaded.

- Leading Edge Simulations SAAB 340A

8 Aircraft Integration Guide

This section is meant for add-on aircraft developers and describes how X-RAAS can be integrated with the navigation display (ND) and GPWS of an aircraft. It provides a detailed overview of the data format as well as references to sample code which can be readily integrated into existing aircraft to simplify data parsing.

8.1 Visual Alert Data Format

X-RAAS signals alerts that are to be displayed on the navigation display using the **`sim/multiplayer/position/plane19_taxi_light_on`**[12] dataref. This is an integer dataref which X-RAAS sets to special values for each different message that is to be displayed on the ND. The value will remain set in this dataref for as long as the alert is to be displayed. The value is treated as a bit field with the following sections:

Bits	Description
0 – 5	**Message type** Valid values: • 0: no message present • 1: 'FLAPS' message • 2: 'TOO HIGH' message • 3: 'TOO FAST' message • 4: 'UNSTABLE' message • 5: 'TAXIWAY' message • 6: 'SHORT RUNWAY' message • 7: 'ALTM SETTING' message • 8: 'APP' message • 9: 'ON' message • 10: 'LONG LANDING' message Message types 8 and 9 ('APP' and 'ON' messages) also fill the bitfields for the runway ID, runway ID suffix and distance available.
6 – 7	**Color** Valid values: • 0: message should display in a green color (normal message). • 1: message should display in an amber color (caution message). • 2: reserved • 3: reserved
8 – 13	**Runway ID** Used by message types 8 and 9. Valid values: • 0: 'TAXIWAY'. This is used to signal “ON TAXIWAY”, by passing message type 9 and a runway ID of 0. • 1 – 36: The runway ID for runway '01' through '36'. • 37: “RWYS” value. Used when multiple runways are being approached, e.g. “APP RWYS” (message type 8, runway ID 37).
14 – 15	**Runway ID suffix** Used by message types 8 and 9. Valid values: • 0: no suffix. ND should simply show the runway ID, e.g. “36”. • 1: 'RIGHT'. ND should show runway ID with abbreviated suffix, e.g. “36R”. • 2: 'LEFT'. ND should show runway ID with abbreviated suffix, e.g. “36L”. • 3: 'CENTER'. ND should show runway ID with abbreviated suffix, e.g. “36C”.
16 – 23	**Runway length available** Used by message types 8 and 9. Runway length rounded down to the nearest 100 feet or

12 The strange choice of dataref is due to an implementation quirk in FlyWithLua which does not allow X-RAAS to define custom datarefs. Therefore, X-RAAS has to reuse another dataref for this purpose.

	meters. A value of '0' in this field means '*no display*'. The ND should display the value (if non-zero) as a fixed two-digit number (printf-like format string “%02d”).

8.2 Visual Alert Sample Code And Message Encoding Examples

To assist in integrating X-RAAS into 3rd party add-on aircraft, the X-RAAS distribution package includes sample code in various languages to transform the raw dataref value into a formatted string suitable for display on the ND. Refer to the **`X-RAAS_api`** folder for the actual source files.
The following table shows sample ND message values and their decoded meaning.

Dataref value	Description	ND Display
`0x00000041`	Amber 'FLAPS' message	FLAPS
`0x00000042`	Amber 'TOO HIGH' message	TOO HIGH
`0x00000043`	Amber 'TOO FAST' message	TOO FAST
`0x00000044`	Amber 'UNSTABLE' message	UNSTABLE
`0x00000045`	Amber 'TAXIWAY' message	TAXIWAY
`0x00000046`	Amber 'SHORT RUNWAY' message	SHORT RUNWAY
`0x00000047`	Amber 'ALTM SETTING' message	ALTM SETTING
`0x00002308`	Green 'APP' message, runway ID **`0x23`** (35), runway suffix 0 (“”)	APP 35
`0x00006308`	Green 'APP' message, runway ID **`0x23`** (35), runway suffix 1 (“R”)	APP 35R
`0x00002508`	Green 'APP' message, runway ID **`0x25`** (37, 'RWYS')	APP RWYS
`0x00142348`	Amber 'APP' message, runway ID **`0x23`** (35), runway suffix 0 (“”), distance available **`0x14`** (2000 feet/meters)	APP 35 20
`0x00086348`	Amber 'APP' message, runway ID **`0x23`** (35), runway suffix 1 (“R”), distance available **`0x08`** (800 feet/meters)	APP 35R 08
`0x00000049`	Amber 'ON' message, runway ID **`0x00`** ('TAXIWAY')	ON TAXIWAY
`0x00002309`	Green 'ON' message, runway ID **`0x23`** (35), runway suffix 0 (“”)	ON 35
`0x00006309`	Green 'ON' message, runway ID **`0x23`** (35), runway suffix 1 (“R”)	ON 35R
`0x00002509`	Green 'ON' message, runway ID **`0x25`** (37, 'RWYS')	ON RWYS
`0x00142349`	Amber 'ON' message, runway ID **`0x23`** (35), runway suffix 0 (“”), distance available **`0x14`** (2000 feet/meters)	ON 35 20
`0x00086349`	Amber 'ON' message, runway ID **`0x23`** (35), runway suffix 1 (“R”), distance available **`0x08`** (800 feet/meters)	ON 35R 08
`0x0000004A`	Amber 'LONG LANDING' message	LONG LANDING

8.3 GPWS Audio Priority Override

Many aircraft models include a simulation of conventional GPWS features such as the low altitude gear/flaps or terrain ahead warnings. In the real implementation of RAAS, these warnings always have priority over RAAS annunciations. However, in the simulator, X-RAAS has no way of knowing if the aircraft's GPWS is currently issuing an alert, thus possibly sounding its own annunciations in parallel, making annunciations unintelligible. To resolve this, you can set X-RAAS up so that it watches a particular dataref to see if it should be quiet. By default, X-RAAS watches the **`sim/cockpit2/annunciators/GPWS`** dataref used by X-Plane 10's native GPWS. You are encouraged to contact X-RAAS's author to implement an aircraft-specific override so that manual tuning is not necessary. Should you however wish to, you can change the default value in `X-RAAS.cfg` using the

RAAS_GPWS_priority_dataref parameter. This should be a number (integer or float) dataref, which if set to **0**, means X-RAAS can issue annunciations. If set to anything else, X-RAAS will suppress annunciations. Suppressed annunciations will be restarted after the dataref is reset back to **0**. Please note that X-RAAS will never write to this dataref, only read from it. Therefore, your aircraft plugin is responsible for making sure the value is reset back to **0** once the GPWS annunciation is complete.

8.4 GPWS Inoperative

To support simulating faults on the GPWS system, X-RAAS monitors the **sim/cockpit/warnings/annunciators/GPWS** dataref. This is used by X-Plane's built-in GPWS to signal that the GPWS computer is inoperative. If this dataref is set to **1**, X-RAAS's functions are disabled. Similar to the GPWS audio priority override described in section 8.3, you should contact X-RAAS's author to set up an aircraft-specific override to implement this for your aircraft. However, should you wish to, this dataref can also be overridden in `X-RAAS.cfg` using the **RAAS_GPWS_inop_dataref** parameter.

9 Author and License

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