

AISmooth

AI Approach Traffic Manager for Microsoft® Flight Simulator 2004®

Release version 1.11

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AISmooth has been designed to drastically reduce the number of go-arounds that are performed by Artificial Intelligence (AI) planes at busy airports, and thus add some realism to this simulation.

AISmooth will instruct approaching AI planes to perform holding patterns if they are following the plane in front too closely.

In addition, AISmooth will check the distance and headings of AI planes in the vicinity of the user plane. If AI planes come too close to the user plane, are heading in the same general direction and are within an altitude range that suggests both planes are established on an approach path, those AI planes will be instructed to perform holding patterns as well.

Installation

The program consists of a single file, AISmooth.exe, which can be copied into any directory on the harddrive. It is good practice to place it into the "Modules" folder under the main Flight Simulator installation path.

For the first release version: Start AISmooth separately from Flight Simulator. It is best to do this before Flight Simulator is started, but it is also possible to start AISmooth while the simulator is running.

AISmooth will not change anything in your Flight Simulator installation. It does not read or write any files other than its own ini- and dat-files. If your AI traffic should screw up while using AISmooth, simply stop AISmooth or don't start it any more next time, and everything will be like it used to be before you started it (if you only stop AISmooth while it is controlling aircraft without shutting down Flight Simulator, of course these aircraft may act strange, but this will last only a few minutes).

This is what leads us to the usual

Disclaimer

While AISmooth was written in a way that it will not conceivably do any damage to your computer hardware or software installations, I will not accept any responsibilities for any damage actually caused by it.

You will use AISmooth entirely on your own risk.

Change Log

- **Release 1.11**
Settings are stored in a database now instead of an .ini file.
Settings dialog reworked to reflect this database.

Several bugs fixed:

* New setting "**Command Delay**":

This setting which defaults to 50 milliseconds is the time that AISmooth gives Flight Simulator to "digest" each and every command issued to AI planes. If set to 0, strange behaviour of AI planes may be encountered, like planes performing rolls because the commands issued to them are ignored by Flight Simulator.

This setting is rather sensitive in that it has an impact on AISmooth performance. If set to a high value, aircraft response may be sluggish especially at times when many commands are being issued, which is directly proportional to the number of planes under AISmooth control at any given time. The setting also may need adjustment to the individual system performance, but the default value of 50 milliseconds seems to be a reasonable compromise.

* New setting “**Reduce Speed on Approach**”:

This setting switches on or off a feature (which was included in previous versions but could not be switched off) that will reduce the approach of planes that are following the number one plane for landing. By doing this, AISmooth tries to separate the planes that are already established on final approach. The transition from slowed approach to landing flare is rather touchy though and may result in the plane crashing shy of the runway threshold, depending on the individual aircraft flight model. If switched off (which is now the default), those planes will now enter a holding pattern, which in turn may result in a disrupted landing sequence. A disrupted landing sequence may result in go-arounds which seem unlogical, e.g. a plane on short final will go around even if there is no plane in front.

- **Release 1.10**

New setting “**Minimum centerline distance**”, set to 3 NM as a default, is the distance measured perpendicular to the extended runway centerline, which a plane needs to be sent into a holding regardless of its distance from the airport or heading, if another plane has entered final approach. Increase this setting if you experience numerous “slowed approaches”.

New feature: voice output of ATC commands to AI planes (available on Windows 2000 when the Microsoft Speech Engine is installed, by default on WINDOWS XP machines). Note that AISmooth voice output is unaware of FlightSimulator ATC, and vice versa, so both voice outputs may interfere with each other.

- **Release 1.00**

* Adapted to new features of FSUIPC 3.480 . Now requires FSUIPC 3.480 or later. No registration of FSUIPC is required.

* Neither FSUIPC application registration nor AISmooth freeware license are runtime-limited.

* New motion control algorithm for AI planes under AISmooth control implemented. Unrealistic bank and pitch angles corrected

* Additional parameters user-adjustable: System poll interval for fine-tuning system timing and roll-out speed for recognition of landed planes

- **Beta 0.92**

* Distance separation replaced by time separation

* Airport and runway data are persistent, i.e. once a runway has been used successfully, its data are known to AISmooth and will be loaded from file on restart of AISmooth

* Improved integration of VFR traffic. VFR planes on downwind leg are handled like IFR traffic on final approach

* Enhanced data display: For planes in a holding pattern, the distance from their assigned runway is displayed, for planes on approach, their ETA is displayed, i.e. the estimated time remaining until touchdown. This is also the time used for traffic separation.

In addition to the destination airport, the runway designator is displayed as well.

* Support for “Mobile Tower” added (no user plane interaction)

* ATC messages can be switched off by the user

* Planes on final approach will not be sent into holding patterns but will be controlled by AISmooth until touchdown if a separation conflict is detected. Thus, landing sequences will remain intact.

Separation is insured by reducing airspeed which may result in very slow approaches in some cases.

* AI planes in holding patterns are controlled in a new way now which will avoid single planes performing erratic maneuvers like constant rolling, inverted attitudes and resulting hull losses.

* CPU load was further reduced.

* The loss-of-control problem with planes on final approach is resolved.

- **Beta 0.91:**

- * System timing reworked

- * “User aircraft on ground” recognition reworked

- * Added support for “TrafficViewBoard”

- * Added switch setting “AI plane responds to user plane”

- * Added initial approach fix feature:

- AISmooth records location of runways when AI planes make a successful landing and taxi to the gate subsequently. Then an initial approach fix location is calculated. The distance of this point from the runway is user selectable (if less than 5 NM, it will be ignored).

- Aircraft finishing a holding pattern will be guided toward this IAF point (if they are more than 3 NM from that point) and released from AISmooth-control when they are within 3 NM of this point.

- The feature can be switched off by setting an initial approach fix distance of less than 5 NM (as mentioned above).

- * Added switch “AI planes turn without banking”. When activated, AI planes will skid through turns without banking. While not being very realistic, this setting will avoid planes from crashing because bank commands were ignored by Flight Simulator, as sometimes happens during times of high workload.

Operations

AISmooth in the beta test version has a minimal user interface which only allows the user to stop the program at any time by clicking the “Cancel” button.

There are no parameters to adjust. In the release version, most parameters will be set individually by means of an enhanced user interface and an ini file. Most settings will be adjusted – as applicable – for individual airports and as general settings if no individual settings for a particular airport have been specified, and even for individual runways.

Prerequisites

The well-known and widespread FSUIPC by Pete Dowson is necessary for AISmooth to operate. It is recommended to install the latest version of this utility. It can be downloaded from www.schiratti.com. AISmooth now requires FSUIPC version 3.480 or later.

Functions

As suggested by the minimalistic user interface, all AISmooth functions are fully automatic and are running as background tasks.

As soon as an AI plane is established on final approach to a runway, AISmooth will check for conflicting traffic. If another AI plane has the same final destination, is heading in the same general direction (+/- 60°), and comes closer to the plane on final than the minimum separation distance, or will land within a user-adjustable timeframe, it will be directed to perform a holding pattern.

The direction the plane will turn is determined by the bearing of the runway as seen from the plane.

The plane will turn approximately 180°, then go straight for about 3 nautical miles, and then turn back to its original heading.

As soon as this final turn of the holding pattern is finished, the plane will be released again to continue its approach under Flight Simulator AI control.

Holdings will be performed regardless of the location of the plane (exception: planes have to be closer than 30 NM to the airport); whenever it is deemed eligible for a holding pattern, the pattern is immediately initiated.

In a later release, you will be able to define holding patterns in fixed locations for each runway, and the planes will first turn toward these locations and fly to a fixed starting point for the particular holding pattern.

It is possible for one plane to perform multiple consecutive holding patterns, depending on the traffic situation. In fact, some planes have been observed to be circling for over an hour before they got a chance to land.

In this preliminary version, AISmooth will neither check separation of planes in holding patterns nor distances between cruising planes that are not on approach to a runway.

Normally, AISmooth will make sure that only one plane is on final approach to a particular runway at the same time (of course two planes can be approaching the same airport at the same time on parallel runways).

If two or more planes are on approach, e.g. if AISmooth is started while the simulation is running, it will try and separate these planes as well.

In this case, the sequence of the planes is vital, otherwise planes landing out of sequence will go around for no apparent reason.

AISmooth will try to keep that sequence intact.

Once a plane is below 500 ft AGL, it will not be interfered with by AISmooth.

In order to determine ground level, though, AISmooth needs to determine the ground level of the airport. It can only do so if one plane lands successfully. So some of the rules mentioned above will only apply after the first plane has touched down and begun its taxi roll to the stand. The setting used for determining the landing of a plane is the roll-out speed (user-adjustable): a plane that has a vertical speed of zero and an airspeed of less than the roll-out speed will be considered landed.

For technical reasons, it is not possible to retract the landing gear of planes that are on final approach and have to perform a holding pattern.

If the user plane is approaching an AI plane, or is approached by an AI plane from behind, and both are heading roughly in the same direction ($\pm 60^\circ$), AISmooth will check if the planes seem to be on an approach path (i.e. more than 300 ft/min sinkrate), are below 10000 ft AGL and if the AI plane is within a ± 2500 ft altitude range with the user plane in the middle.

If all that is true, the AI plane will be instructed to perform a holding pattern.

System settings

You will find a menu item called "Settings" in the "File" menu.

Here you can adjust three global items:

Intercept radius: The distance between a landing and an approaching airplane at which the approaching plane will be sent into a holding pattern. Default value is 7 NM.

The smaller this value, the greater the danger of losing track of landing aircraft and thus malfunctions in the form of go-arounds.

It is suspected that AFCAD data of the runway in use has an influence on the point at which aircraft join the landing pattern. This in turn influences behaviour of AISmooth in conjunction with the intercept radius.

Intercept radius user plane: The distance between a landing airplane and the user plane at which the landing plane will be sent into a holding pattern. Default value is 5 NM. Enter smaller values to make your approaches more challenging.

Heading tolerance: AISmooth has to determine whether two planes are flying in the same general direction, and which one is in front.

This is done by comparing their headings and the bearing from one to the other.

This comparison is done using a tolerance field of bearing +/- an adjustable value, which you can set with this option. The default is 60°, which means if a plane has a heading of 270°, any other plane with a heading between 210° (270° - 60°) and 330° (270° + 60°) is considered heading in the same general direction.

Play around with this value and watch its impact on system behaviour.

In a later release of AISmooth, it will be possible, in addition to the global settings, to specify individual settings for each airport, and in fact for each single runway and runway direction (including parallel runways) for each airport.

What AISmooth will not (yet) do

AI planes can from time to time be observed performing kamikaze approaches to runways with breakneck sinkrates, and sometimes crashing in the process, or declaring a missed approach and going around.

This behaviour is not addressed in this release of AISmooth and is still prone to happen.

A later version will guide all approaching planes to a predetermined initial approach fix at a certain altitude range which thus will avoid such kamikaze landing attempts.

AISmooth has no way of influencing the AI flight planner or the AI autopilot. This means that the destination runway cannot be changed, and that AI planes that are guided by AISmooth will in no way care about weather. Head wind, crosswind and turbulence will have no effect on planes being controlled by AISmooth.

AISmooth has no access to any scenery data. This means that AI planes being controlled by AISmooth will in fact fly through mountains if they are stupid enough to be standing in the flight path.

This problem will be addressed in a later release by defining holding patterns to be performed in fixed locations.

There is only so much data available on AI-planes. For example, at this point in time, there is no way to find out about bank angle and pitch angle. As a result, AISmooth can only guess at the current bank angle, and it has no way of checking if the AI plane is doing what it's supposed to be doing. In order to make flying holding patterns as realistic-looking as possible, AISmooth will bank the plane, hoping they will respond correctly.

In the next beta version, this problem will hopefully be resolved with help from a new version of FSUIPC, courtesy Pete Dowson.

AISmooth is not democratic, nor does it have a sense of justice. Planes will not necessarily land in the same sequence that they arrived in the vicinity of their destination. It can very well happen that some planes are kept in holding patterns for an hour or more, while others simply pass through without a single holding. It all depends on timing. The plane to first enter final approach will be first to land. Please note that the term "final approach" is not exactly the same for AI planes than for real-world planes. AI planes can enter final approach even if they are several miles beside the extended runway center line.

If a plane arrives from cruise flight at its initial approach fix, and ten other planes are busy doing their holding patterns, this plane, although the last to arrive, will land first.

Outlook

The next AISmooth beta version will – hopefully – feature:

- Stacked holding patterns. Planes will be assigned separate altitudes at which to hold.

In addition, I have a lot more ideas that are waiting to be cast in program code.