Stability Augmentation System (SAS)

SAS is an attitude-based flight control system that provides a significant reduction in pilot workload from takeoff to landing. SAS may be engaged or left engaged during any phase of flight from before liftoff to after touchdown. The autopilot modes become available at air speeds above 44 Kts. SAS makes it possible to fly with hand-off the cyclic. However, it is important that the pilot understand that the unstable nature of helicopters is such that a SAS disconnect due to a system failure requires that the pilot assume immediate control.

The existence of stability augmentation and rotor RPM governing does not relieve the helicopter pilot of the necessity to closely monitor aircraft attitude and rotor RPM at all times. The SAS will be in standby without any pilot action as it is wired to the avionics bus without an on-off switch. This is done so that the SAS can be engaged immediately if needed. With the SAS in standby mode, pushing and holding the force trim button for 1.25 seconds will engage the SAS. If the FTR button is activated (pressed and released) while SAS is engaged, SAS input will be interrupted and trims reset.

The indicator lights will flash as soon as the master switch is turned on. This indicates that the FCC is initializing. When the lights stop flashing and a steady white SAS indicator light is displayed, the system is in standby mode indicating that the SAS may then be engaged by the pilot. When the SAS is initially engaged, it will maintain the current rotor craft attitude. If the SAS is engaged from standby (SAS light white) it will recover to a level attitude.

The trim hat switch on the cyclic allows the pilot to proportionally modify the trim pitch and roll attitudes in SAS mode. This is a four-way momentary switch on the cyclic grip. Holding the switch aft results in a steadily increasing change in trim pitch attitude (nose up). Pushing it forward results in a steadily decreasing trim pitch attitude (nose-down). Holding it right causes the trim roll attitude to increase right wing down, and holding it left causes the trim roll attitude to increase in a left-wing down direction.

Since it's programmatically impossible to physically center the majority of springless hardware, such as a joystick/cyclic, SAS will hold the attitude the hardware is positioned to. If using a self centering joystick/cyclic (with springs), letting go of the grip will cause the helicopter will recover to a level attitude. These are limitations of most simulation hardware and apply to both SAS and Force Trim.

Autopilot Modes

The autopilot system will become available at speeds above 44kts. A mode may be engaged or disengaged by pressing the associated button on the HCP. If any of the autopilot modes are armed or active, pressing the cyclic-mounted Autopilot Disconnect button once disengages all autopilot modes but leaves the underlying SAS mode active.

Heading Mode (HDG)

Set the heading bug to the desired heading on the HSI and then press the HDG mode button on the HCP to engage the heading mode. The LED above the HDG button will illuminate green when HDG is engaged. The helicopter will turn to selected heading. When making heading changes, it is acceptable to fly-through the system to achieve larger or smaller bank angles.

Navigation Mode – VLOC (NAV)

NAV tracks the course on the HSI if the CDI mode on the navigation receiver is VLOC and tracks the active GPS course if the CDI mode is GPS.

Navigation Mode – GPS (NAV)

NAV mode requires that an active course has been programmed into the GPS as a flight planned route, instrument approach procedure, or a direct-to a waypoint. The navigation receiver must be selected to GPS. The autopilot does not use the selected course on the HSI for this mode. If an HSI is installed, it is useful to set the selected course arrow to the desired track angle to maintain situational awareness. However, this has no effect on autopilot performance. The selected course on an EFIS display will generally auto-slew to the desire GPS course.

Speed Hold Mode (SPD)

The SPD mode provides pitch attitude commands to hold IAS (Indicated Airspeed). Pressing the SPD button holds the Indicated Airspeed that exists when the SPD mode is selected. This is the stand-alone SPD mode indicated by a green SPD light. Pressing the ALT button on the HCP will cause ALT to engage and SPD to disengage.

Altitude Hold Mode (ALT)

Altitude Hold Mode may be engaged at any time above 200ft off the ground and is annunciated by a green LED above the ALT button. ALT holds barometric altitude at the altitude where the mode is engaged. If the helicopter is in a climb or descent, when ALT is engaged, it will gently initiate a pitch rate to stop the rate of climb or descent. It will then command a rate of climb or descent to return to the altitude where the mode was engaged. Because of lags in the altimeter, the helicopter may not return to the exact indicated altitude where ALT was engaged, especially if the climb or descent rate is large. The autopilot uses pitch attitude to control altitude so airspeed will vary with power setting. To accomplish an airspeed change while ALT is engaged, slowly move the collective to the new power setting. A rapid change in collective will cause the helicopter to deviate from the target altitude. That is because collective is a powerful control of vertical rate and it is not possible for the autopilot to counter rapid power changes with pitch attitude. Nonetheless, the autopilot will gradually return to the reference altitude, albeit at a different airspeed.

Vertical Mode (VRT)

The Vertical Navigation Mode (VRT) allows the autopilot to track an ILS glideslope or GPS VNAV, LNAV + V, or LPV glidepath. VRT must be armed prior to intercepting the glidepath. An armed VRT mode is indicated by a white LED. NAV must be armed or active and the GPS must be in the approach mode (e.g., LPV) for VRT to arm. If NAV is not armed or active (annunciation white or green) or the GPS has not transitioned to an approach mode, pushing the VRT button will have no effect.

It is necessary to wait for the GPS to transition from TERM to an approach mode such as LPV or LNAV/VNAV to arm VRT. SPD mode cannot remain active with VRT armed. Pressing VRT while in SPD mode, will activate ALT (green) and arm VRT (white) until glidepath intercept. For an ILS approach the navigation receiver must be selected to VLOC, and a valid ILS signal must be present to arm VRT.

For GPS approaches, the autopilot will track the VNAV glidepath without an HSI, albeit with no visual indication of the glideslope error. De-selecting and re-selecting ALT while VRT is armed will cause VRT to dis-arm. It is therefore necessary to re-arm VRT if ALT is cycled while setting up for an ILS or VNAV approach. VRT will switch from armed to active (LED from white to green) at glidepath intercept. This transition can occur with the pitch axis in the SAS or ALT modes. If in ALT mode, ALT will transition from green to dark when VRT becomes active.

The recommend technique is to slowly reduce collective prior to glidepath intercept to a power setting that will cause the autopilot to track the glideslope at the desired airspeed. It is important to minimize changes in collective during glideslope tracking as this can result in excursions from the glideslope. If collective changes are necessary to change airspeed, make them very slowly. With collective held fixed, airspeed will change to maintain glideslope in the presence of vertical atmospheric disturbances.

Glideslope tracking will become less accurate at low airspeeds because the helicopter is approaching the backside of the power required curve. The VRT mode will automatically disengage if the airspeed decreases below 44 kts.

Mapping Hardware

These are the commands to use to map all the buttons to your hardware:

Force Trim Release on Cyclic: SAS/force_trim_release

Autopilot Disconnect: SAS/autopilot_disconnect

SAS: sim/systems/artificial_stability_toggle

HDG: sim/autopilot/heading

NAV: sim/autopilot/NAV

SPD: sim/autopilot/speed_hold

ALT: sim/autopilot/altitude_hold

VRT: sim/autopilot/approach