Advanced Avionics Workshop

Autopilot Safety & Tips

Presentation Outline

- General Autopilot Usage
  - Autopilot Safety
  - Automation Levels
  - General Tips
- Stec 55X
  - Stec Overview
  - Heading & Nav Modes
  - Vertical Modes
    - ST-360 Operation
  - Coupled Approaches
- Break
- Autopilot Scenarios
  - Pre-flight
  - Takeoff
  - Enroute
  - Approach/Landing
- Wrap-Up

Autopilot Safety

Autopilot Safety

- Know all of the ways to disconnect the autopilot
  - Yoke-mounted disconnect switch (if installed)
  - Autopilot master switch OFF
  - Pull the autopilot circuit breaker
- Know how to stop runaway pitch trim
  - Disengage the electric pitch trim
  - Pull the electric pitch trim circuit breaker
  - Disconnect the entire autopilot (see above)
- Always be prepared for an out-of-trim condition when disengaging the autopilot

Autopilot Safety

- *Always be ahead of the autopilot, and ready to hand-fly if necessary*
- Do not use the autopilot in moderate to severe turbulence, or while in icing conditions*
- Practice in VFR conditions, or with a safety pilot who is fully proficient in its operation

** Never intentionally fly in icing conditions in a non-FIKI approved aircraft!*

Automation Levels

- Use the concept of automation "levels"

L1: Fully-coupled	• Autopilot does all of the work, including intercepting and tracking the localizer and glideslope
L2: Basic Mode	• Simple heading and/or altitude hold – autopilot doesn't change heading/altitude unless directly command to by the pilot
L3: Flight Director	• (If applicable) Hand-flying the aircraft based on flight director guidance
L4: No automation	• All automation turned off

Automation Levels (cont.)

- The pilot can move up and down the different levels as the need arises
  - Example) Disengaging all automation to avoid a midair (L4), then reengaging the autopilot for level flight and manual course interception (L3/L2), and finally reengaging GPSS mode to reestablish the assigned course and altitude (L1).

- Autopilot usage isn't all-or-nothing
  - Even basic HDG or NAV/GPSS modes will free up a lot of mental bandwidth

Avoiding the WIDN Syndrome

- WIDN: What's it doing now?
  - In resolving un-commanded pitch changes, most pilots' (correct) initial reaction is to disconnect the autopilot and then troubleshoot
  - However, their first reaction to an un-commanded roll is often to try and troubleshoot what it's doing
    - FIRST disconnect the autopilot and THEN troubleshoot

Avoiding the WIDN Syndrome

- **Learn the autopilot**
  1. Study and understand how all of the autopilot modes that you intend to use are designed and function
  2. Be ready for the autopilot to do something different than you expect
  3. Move up and down the automation levels as necessary to resolve a WIDN situation

- **When in doubt, disconnect!**
  - **Don't let the autopilot do something you weren't expecting. If it does, either disconnect it, or revert back to basic heading hold.**

General Autopilot Tips

How to make the autopilot work for you

General Usage

- Using the autopilot vs always hand-flying…
  - Consider that single-pilot charter operations require an operational autopilot for IFR dispatching
  - Learn the capabilities of the autopilot installed, and practice to proficiency

- Use the autopilot en-route when you are reaching *task saturation* (such as copying a new IFR clearance, reviewing the weather to make a diversion decision, etc

Autopilot Monitoring

- After initially engaging the autopilot, *monitor the autopilot* to make sure it's doing what you expect it to do

- Whenever there is a course or altitude change coming up, *monitor the autopilot* to ensure it does what you expect

- **Carefully monitor your altitude whenever using V/S hold!**
  - Keep your hand near the autopilot as a reminder when you near your level off altitude
  - Even better, set an altitude alerter in case you miss the level-off altitude (GI-275 in 07B, ST-360 in 55H)

Heading

- **Basic heading (HDG) mode is your friend**
  - If in doubt, control the autopilot with the heading bug
- Make heading adjustments in 90° or less increments to ensure a turn in the desired direction
- Use course interception angles of ≤45° of desired course
  - Greater intercept angles will likely result in a course overshoot

Approaches

- *Only use coupled approaches (LOC+GS capture) if you are fully proficient in the autopilot's operations*

- Non-Precision Approaches
  - Continue to use the autopilot beyond the FAF
    - Use it to maintain altitude and nav tracking beyond the FAF, so you don't unintentionally descend below MDA or drift off course while looking for the runway
- Precision Approaches
  - When beyond the FAF, if the aircraft was stable and on glideslope and localizer, minimal trim and power changes will be necessary for landing
    - The autopilot has already done the work for you

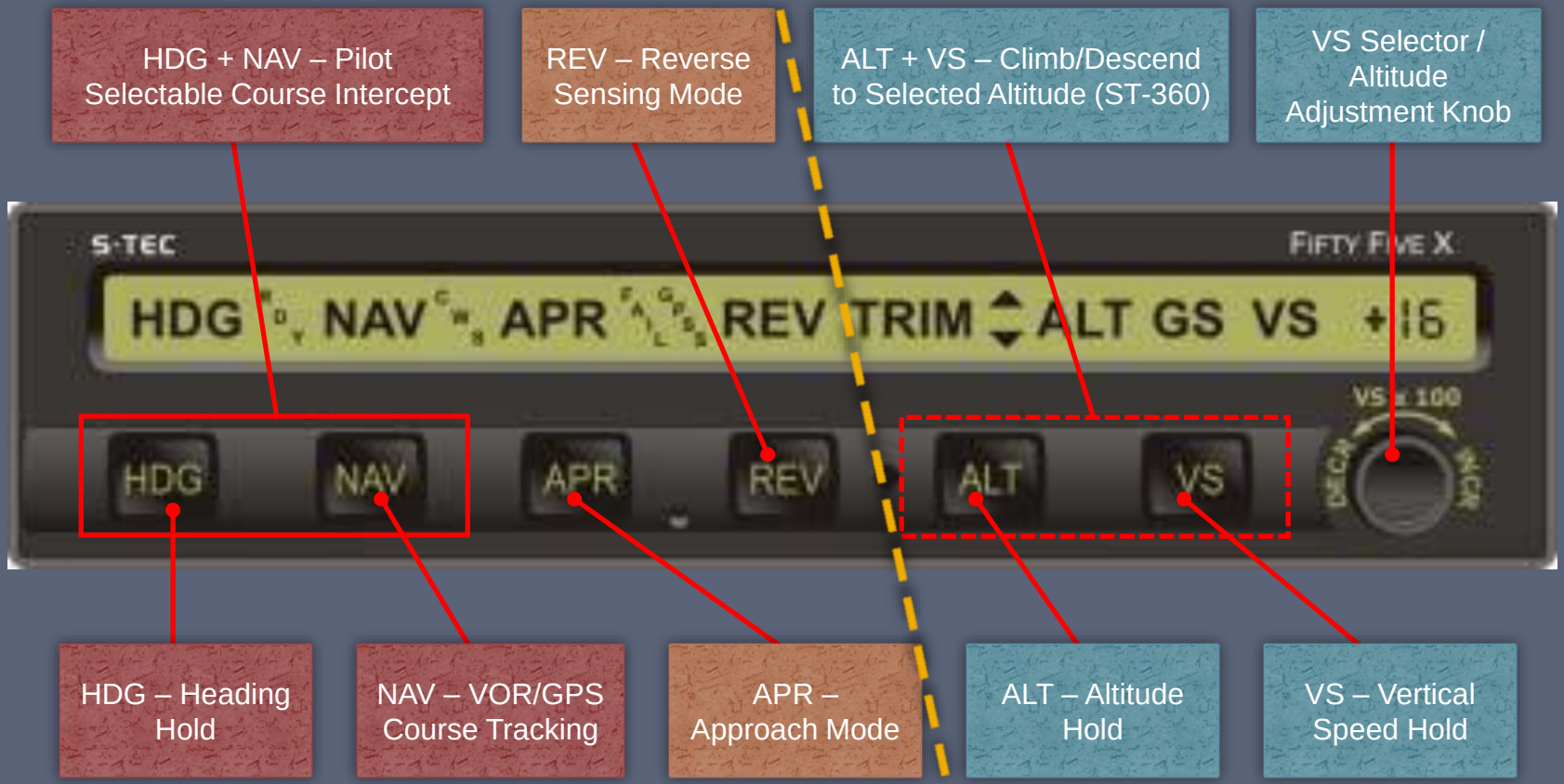
Stec 55X

Rate-based 2-axis autopilot

Overview

- Rate-based autopilot
  - Derives attitude information from the turn coordinator
  - GPSS mode operational even with a complete vacuum failure
- Two-axis autopilot – controls pitch and roll
- GPSS mode – all course guidance derived from the GPS, including turn initiation

Buttonology – Stec 55X



One of the lateral modes (HDG, NAV, APR/REV) must be engaged *before* any vertical mode (ALT, VS, GS) can be engaged

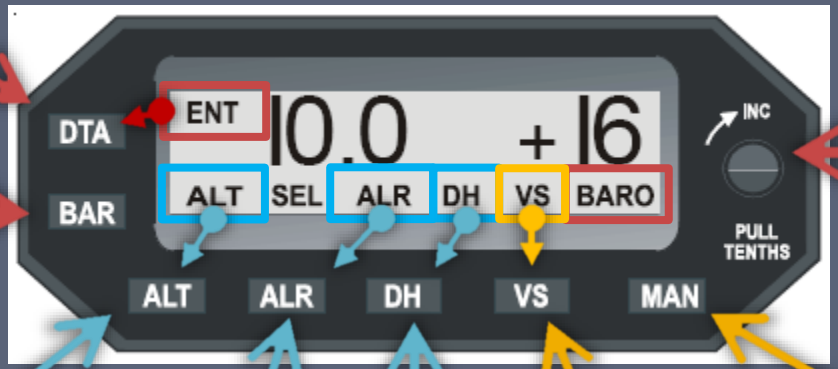
Heading & Nav Modes

- Heading (HDG) Mode
  - Tracks the heading set with the heading bug
- NAV Tracking
  - Tracks the selected OBS course
  - The heading bug must also be set to the course heading
- GPSS (GPS Steering)
  - Activated by pressing NAV twice
  - Same as NAV mode, but all course guidance is derived from the GPS, including turn lead-ins and holding patterns
- Automatic Course Intercept (HDG+NAV)
  - Same as NAV mode, but the heading bug is used to set the initial intercept course
  - Need to reset the heading bug once the course is captured
- Approach (APR) Mode
  - Same as NAV mode, but with increased sensitivity
  - Required mode to track a glideslope
- Back-course (REV) Mode
  - Same as APR mode, but for tracking the localizer back-course inbound

Altitude Modes

- Altitude Hold (ALT)
  - Holds the current pressure altitude when the mode is engaged
  - Altitude adjustments in 20 foot increments made with VS selector knob
- Vertical Speed Hold (VS)
  - Hold a set vertical speed
    - When level, set the desired V/S with the VS selector knob
    - While climbing or descending. engagement will hold the current V/S
  - Adjustments made in 100 fpm increments made with VS selector knob
- Automatic climb/descent
  - ST-360 (next slide)
- Automatic pitch trim
  - Unit will auto-trim and annunciate "TRIM ^" or "TRIM v" while trimming
  - "TRIM" will flash if the trim is run for more than 7 seconds
  - Auto trim will be disabled any time a fault is detected
  - Using the electric pitch trim while ALT or VS modes are selected will disconnect the autopilot

Buttonology – ST-360



Data Entry Button

Barometric Entry Button

Input Selector Knob

Altitude Read Out / Selector

Altitude Alerter

DH Alerter

V/S Selector

Manual Mode Button*

* Disconnects the ST-360 from the 55X

ST-360 Altitude Selector/Alerter

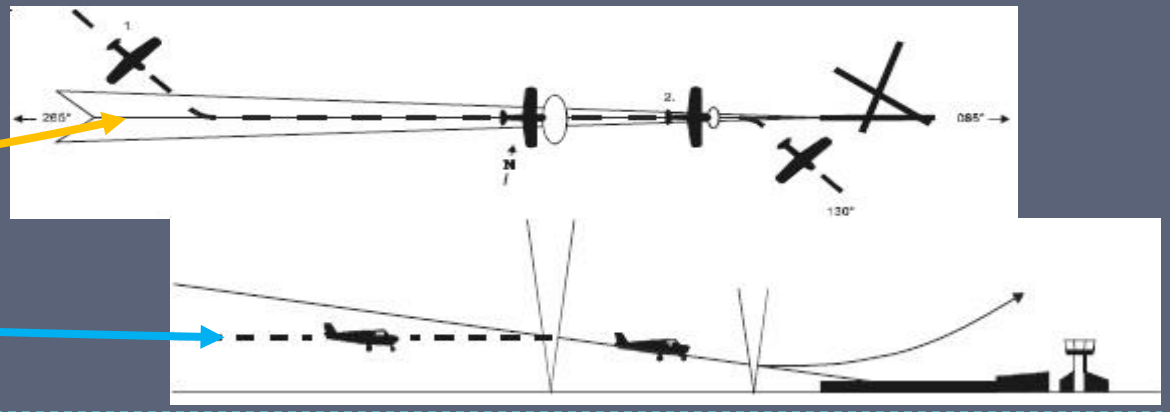
- Setting the barometric pressure
  1. Verify "ENT" is displayed and "BARO" is flashing
     - If not, press DTA followed by BAR
  2. Set the baro pressure
     - Pull the knob to set the tenths, push to set the tens
  3. Press DTA to accept the set pressure
- Setting the level-off altitude
  1. Press DTA until "ENT" and "ALT" are displayed, and "SEL" is flashing
  2. Set the desired level-off altitude
     - Pull the knob to set in 100s, push to set in 1000s
  3. Press DTA to accept the altitude
- Enabling automatic climb/descent mode
  - Press ALT+VS on the 55/55X head unit

ST-360 Altitude Selector/Alerter (Cont)

- Setting the decision height
  1. Press DTA to annunciate "ENT"
  2. Press DH – The "DH" annunciation will flash
  3. Set the decision altitude
     - Set to the nearest 100' rounded *up*
  4. Press DTA to activate
     - An audible alert will sound at 50' above and 50' below the set DH
- Setting the altitude alterter
  1. Set the altitude as described previously
  2. Press ALR to arm the alerter function
     - An audible alert will sound at 1000' and 300' from the selected altitude
     - Following altitude capture, alerts will be generated when altitude is off by 300'

Glideslope Intercept & Tracking

- Conditions necessary to arm automatically
  - NAV flag out of view
  - GS flag out of view
  - Autopilot must be in NAV+APR & ALT mode
  - Aircraft must be within
    - 50% of CDI needle deflection of LOC centerline
    - 60% or more <u>below</u> the GDI needle deflection of GS path
      - Manual GS capture still possible while within 20% or less <u>above</u> GS path



Glideslope Intercept & Tracking

- Mode progression
  1. NAV+APR + ALT
     - Approach mode armed
  2. NAV+APR + ALT+GS
     - Glideslope mode armed
  3. NAV+APR + GS
     - Glideslope captured

- Manually arming GS capture
  1. Press ALT…
     - …*once* if in ALT mode
     - …*twice* if in VS mode

Stec 55X Tips

- NAV vs NAV\GPSS Mode
  - NAV mode: Course guidance is determined by *both* the heading bug & OBS selector
  - NAV\GPSS mode: Course guidance is provided directly by the GPS unit
- Using HDG+NAV or HDG+APR mode
  - When the HDG annunciation extinguishes, reset the heading bug to the desired enroute/approach course.
- Any *flashing mode annunciator* means that feature has been selected but there is a condition preventing it from activating.
- When disconnecting the autopilot, if you press and hold (or double-press) the disconnect switch, it will stop the disconnect warning beep from continuing.

Break Time!

Real-World Scenarios

Placeholder

- Preflight checks
- Departure
- Enroute
- Arrival

Wrap-Up

Final Take-Aways

- Treat the autopilot like a crew member
  - A crew member who is a great stick and very obedient, but very dumb.
  - Keep an eye on your "crew member" and be ready for them to occasionally quit on you.

Final Take-Aways

- Advanced technology can be used to *maintain the same utility of the aircraft with an increased level of safety*, or *maintain the same level of safety with increased utility*.
  - It's up to you as PIC to determine which viewpoint to take.
- Beware of "risk compensation": taking greater risks when a safety device exists, thereby offsetting the safety gains.

- In order to take advantage of the advanced capabilities of the available technology…
  1. You must understand what is available and how to use it.
  2. You must continually practice using the available features to maintain proficiency.

More Information

- Flying 20 Club "Library"
  - Stec 55X Manual
- AOPA Safety Advisors
  - Single-Pilot IFR
- FAA
  - Advanced Avionics Handbook (FAA-H-8083-6)

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