Loss-of-Control In-Flight Mitigation through Installation of Stability Augmentation and Autopilot Systems in Light Helicopters

Report

Helicopter Safety Enhancement No. 70
Output No. 3

Prepared by H-SE-70 Team in partial fulfillment of USHST efforts to encourage use of technologies that can reduce the risk of fatal helicopter accidents

February 9, 2021

USHST
United States
Helicopter Safety Team

Prepared for the USHST for promotion through industry stakeholders and safety advocates

USHST All Hands Webinar

March 31, 2021

HSE-70-3

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Context

USHST Accident Data 2009-2014:

50% of fatal helicopter accidents are from 3 causes

- Loss-of-Control In-Flight
- Inadvertent IMC
- Low-Level Ops

THIS DISCUSSION

Promote Stability Augmentation & Autopilots in Light Helicopters

(2021)

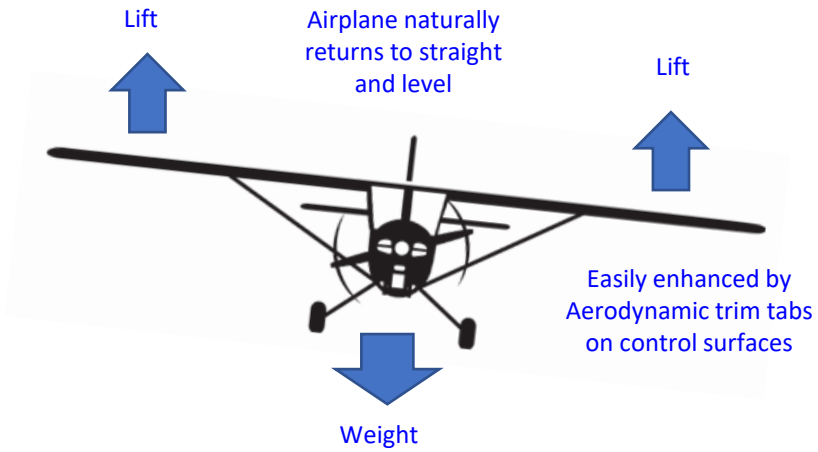
AUTO PILOTS

Promote IFR Capability in Light Helicopters

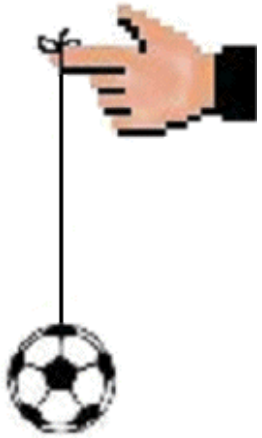
HAI / AEA / GAMA / VFS white paper (2015)

- **Prevent LOC**
- **Shift culture from low-level Wx avoidance**
- **Provide ability to better survive unintended IMC**

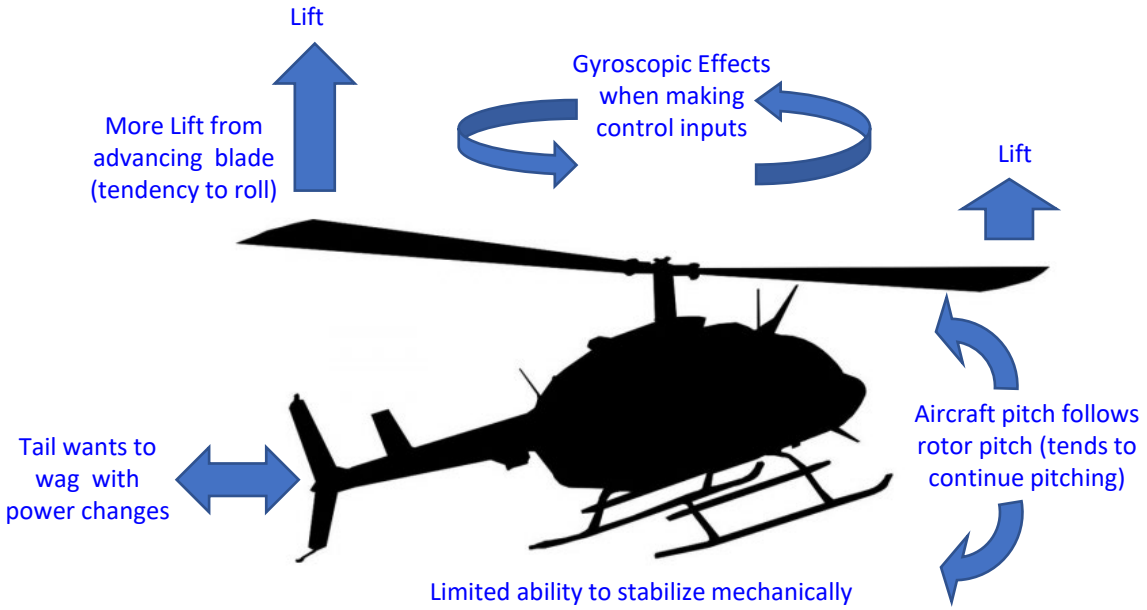
Providing Stability – Key ingredient



Naturally Stable

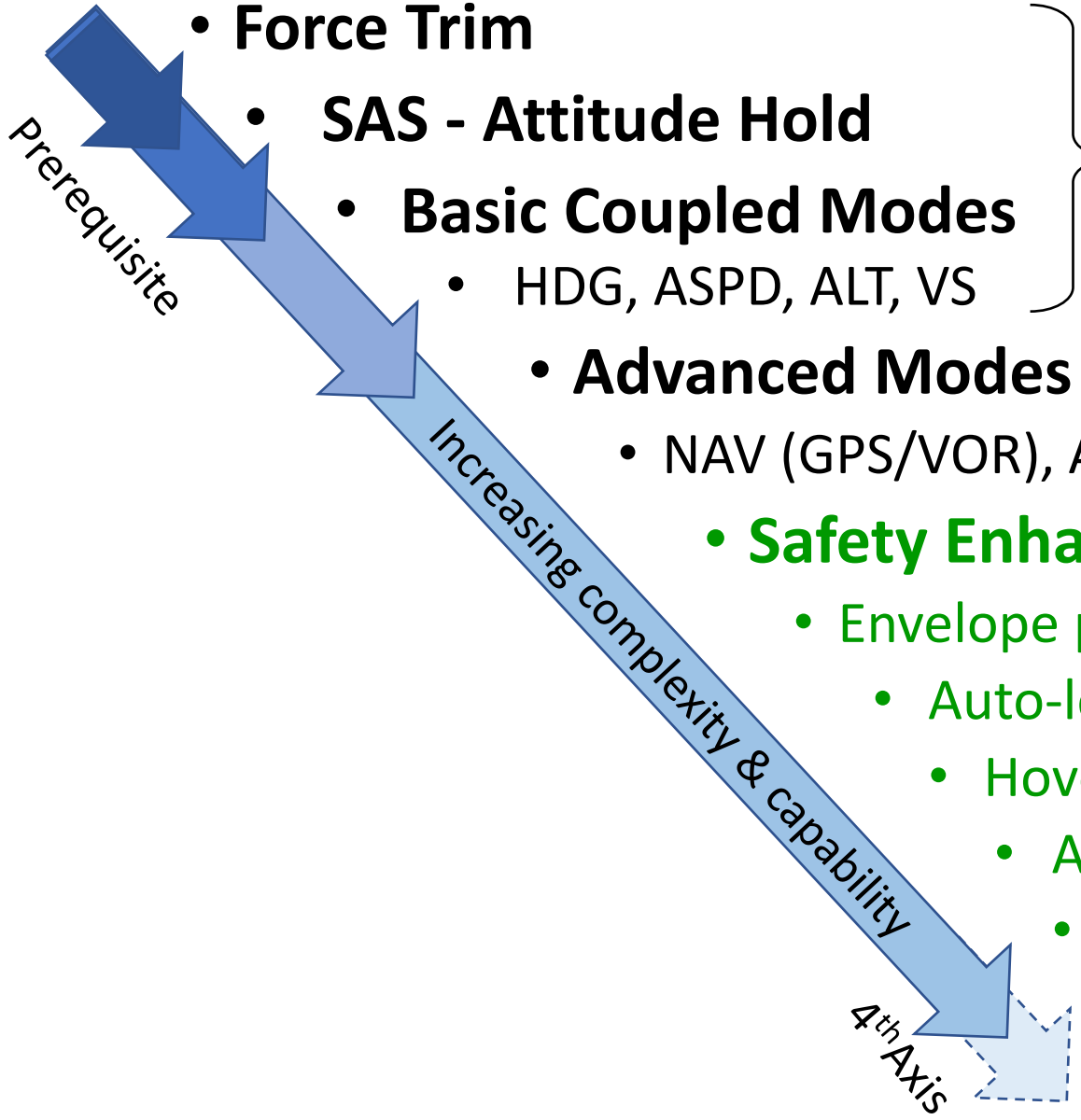


Stability improves ability to deal with distractions, momentary disorientation, and reduced visibility situations



Naturally Unstable

Function and Capability

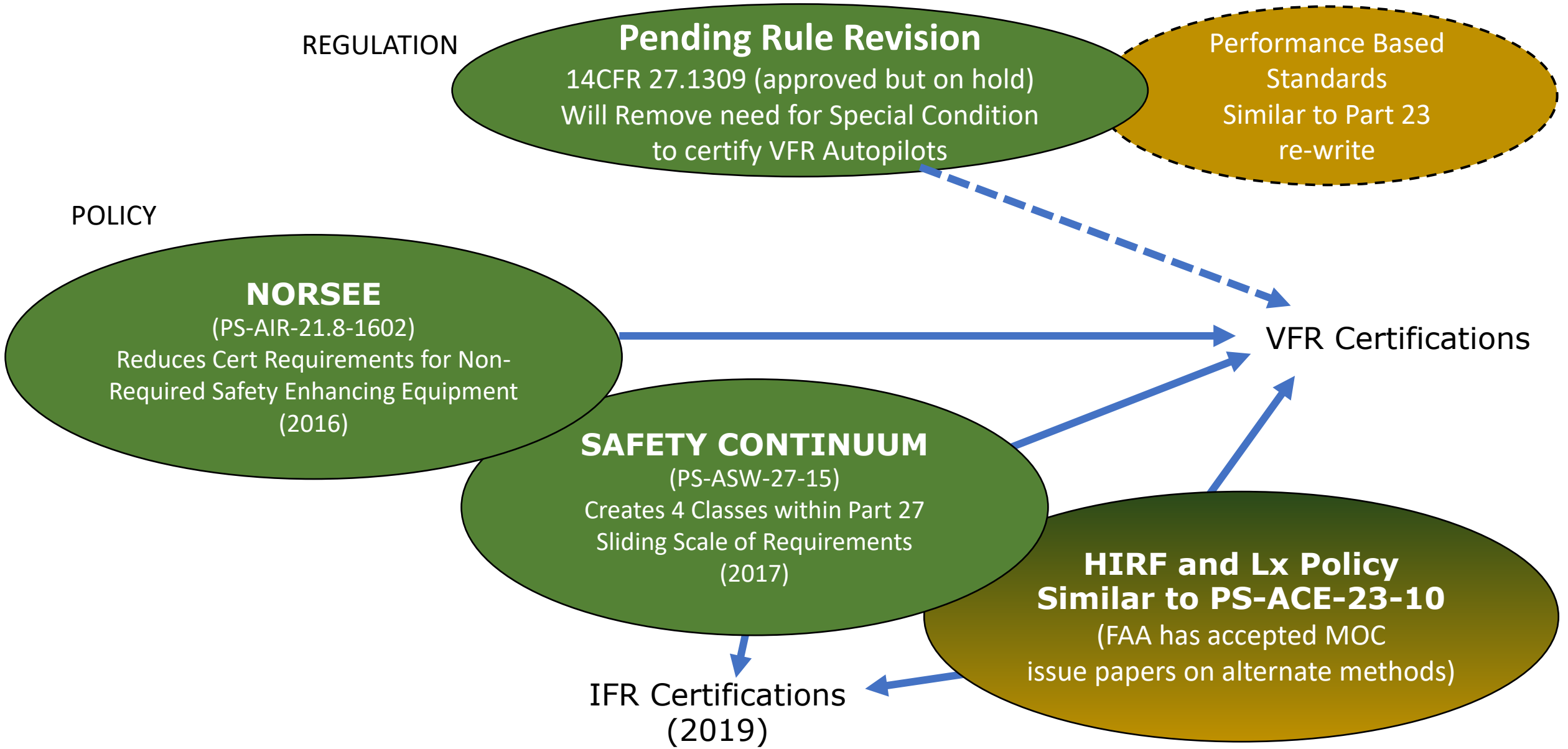


- **Force Trim**
- **SAS - Attitude Hold**
- **Basic Coupled Modes**
  - HDG, ASPD, ALT, VS

Bulk of LOC-I safety improvement
(Value often requires additional features)

- **Advanced Modes** (typically found in IFR / Specialized)
  - NAV (GPS/VOR), APPR (ILS/LPV), GA, HOLD, Approach to Hover)
- **Safety Enhance Modes**
  - Envelope protection
    - Auto-level / Save me attitude recovery
      - Hover Assist
        - Automatic Hover Departure
          - Autorotation Assistance
            - Integration with safety systems (TAWS / TCAS)
              - Auto-Land (incapacitated pilot)

Certification Environment



Currently Available (at time of White Paper)

OEM:

- Bell: 407GXi VFR / IFR 3-axis (Bell AP)
  407GX VFR 2-axis (Bell AP)
  505 (Genesys 2-axis)
- Leonardo: TH-119 IFR 3-axis
  (Honeywell AP / Genesys integration)
- Robinson: R44/R66 new
  R44 field retrofit kits
  (Genesys AP w. Robinson-Specific features)*
- Airbus:
  (Partnered with 3rd party solutions)

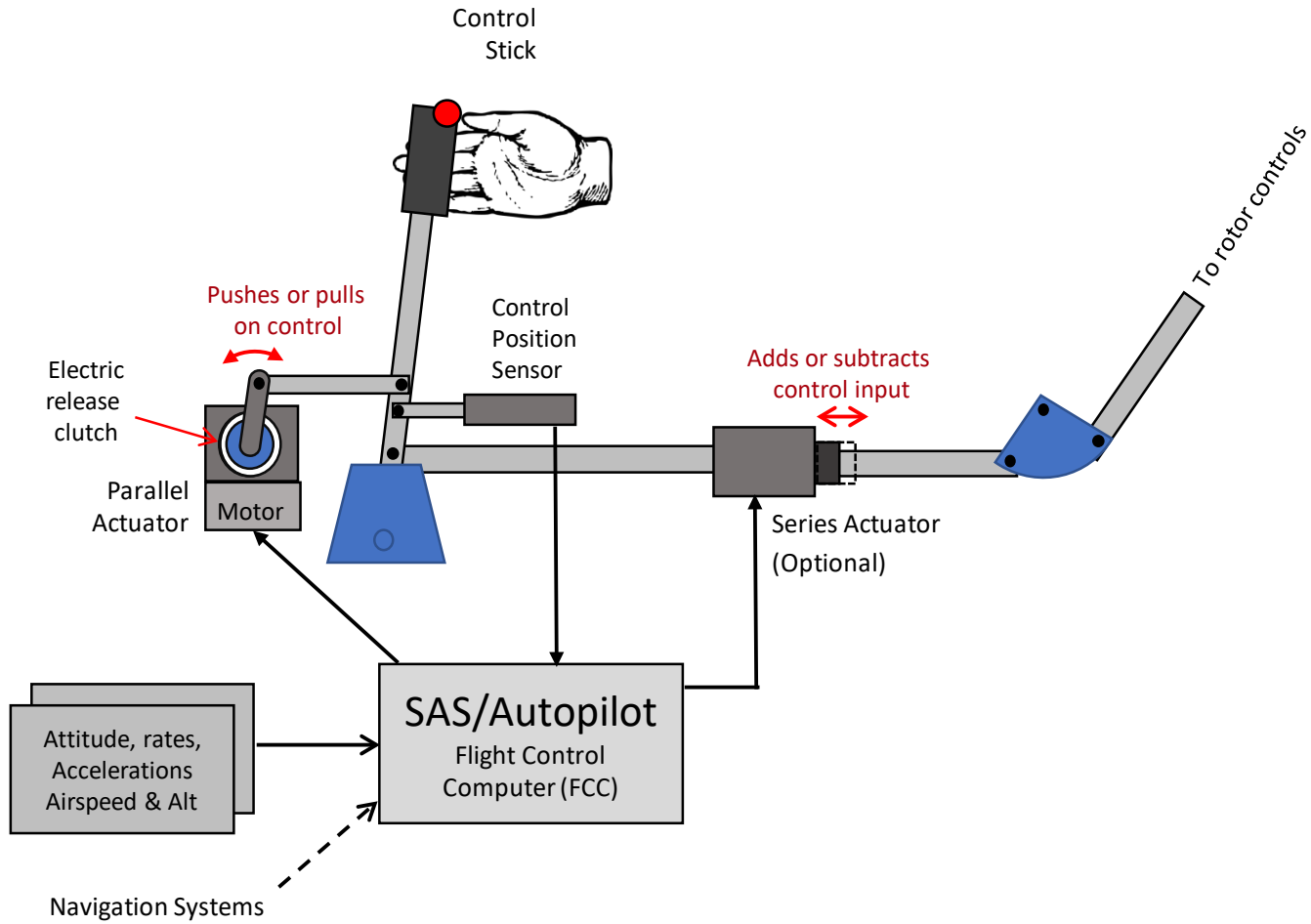
3rd Party Solutions:

- Genesys: HeliSAS 2-axis and 3-axis autopilot available in multiple aircraft
- Thales: Compact Autopilot System (CAPS)
- Garmin: GFC-600H—recently certified in the H125
- SAFRAN: Formerly SFIM helicopter AFCS

* Currently VFR – IFR variant in work

Technology / Terminology

- MEMS AHRS (micro-electromechanical system)
  - Has greatly reduced cost of sensors
- Force Trim
  - Spring & clutch vs Geared EMF
- Series/Parallel vs Parallel only
  - Series → Hands-on SAS & perf. benefit
  - Parallel only → cost/ installation ease
    (Pilot feels AP input as pressure when hands-on)
- 2-axis (pitch & roll)
- 3-axis (yaw)
  - Yaw damp in power changes
  - Turn coordination
  - Heading at low speed
- 4-th axis (collective)
  - Airspeed control in precision approach
  - Allows advanced features



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Questions?