
Flight dynamics — Vocabulary —
Part 11:
Control system

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Contents

	Page
Foreword.....	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
3.1 Basic concepts.....	1
3.2 Basic elements.....	3
3.3 Control system classification.....	6
Index	10

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Flight dynamics — Vocabulary —

Part 11: Control system

1 Scope

This document establishes the terms and definitions of the basic concepts applied in science, engineering and manufacturing in the field of flight control systems of aircraft (airplane and helicopter).

2 Normative references

There are no normative references in this document.

3 Terms and definitions

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Basic concepts

3.1.1 system

combination of components, parts, and elements that are interconnected to perform one or more specific functions

3.1.2 control system

set of mechanical or electronic devices that manages, commands, directs or regulates the behaviour of other devices or systems (3.1.1) by controlling the output

3.1.3 flight control system

complex of mechanical and electronic devices of aircraft (airplane and helicopter) providing its stability and controllability to allow the pilot to control the movement and attitude of aircraft at all stages and the modes of flight by changing the external forces or moments acting on aircraft

3.1.4 automatic flight control system AFCS

type of flight control system (3.1.3) which provides aircraft control by measuring controlled variables and comparing them with reference input to reach the goal defined over measured values in terms of quality

Note 1 to entry: The AFCS is composed of several sub-systems that work together to provide automatic flight control. The main components of the AFCS are the *autothrottle system (3.3.9)*, *flight director system (3.3.10)*, *autopilot system (3.3.11)*, *flight management system (FMS) (3.3.12)*.

Note 2 to entry: The crew can select whether to put the aircraft under *autopilot* (3.3.9) or manual control mode. Under the autopilot mode, the aircraft *flight control surfaces* (3.1.7) move automatically; under the manual control mode, the pilot follows the displayed *flight director* (3.3.10) commands to achieve the desired status.

3.1.5
effector

control effector

external device that directly changes forces and/or moments acting on aircraft to control aircraft position and attitude

3.1.6
inceptor

control inceptor

cockpit controller

cockpit device for enabling pilot input through direct linkage or a *flight control system* (3.1.3) or computer to *control effectors* (3.1.5)

3.1.7

control surface

flight control surface

aerodynamic control surface

movable airfoil that provides reactive force when in motion relative to the surrounding air for guiding or controlling an aircraft in flight

3.1.8

primary flight control surface

primary control

control surface (3.1.7) used as *effector* (3.1.5) providing force or moment for aircraft stability or manoeuvring control

3.1.9

secondary flight control surface

secondary control

control surface (3.1.7) used to modify an aerodynamic characteristic of aircraft

3.1.10

actuator

device for producing motion of *effector* (3.1.5) and/or force acting on effector

3.1.11

sensor

physical device for detection of *inceptor* (3.1.6) positions, feedback measurements or scheduling information

3.1.12

longitudinal control

control of airplane's pitching about the lateral axis

3.1.13

lateral control

control of airplane's rolling about the longitudinal axis

3.1.14

directional control

control of airplane's yawing about the normal or vertical axis

3.1.15

control effectiveness

measure of the effect of utilizing a *control effector* (3.1.5), either moment, moment coefficient, or angular acceleration produced for a given *control surface* (3.1.7) deflection

3.1.16**control power**

aircraft angular acceleration per unit of *control effector* (3.1.5) deflection

3.1.17**authority**

permissible maximum amplitude of a signal or physical parameter

3.1.18**control authority**

aggregate effect of the effectiveness of all the *control effector* (3.1.5) in whatever combination

3.1.19**control sensitivity**

magnitude of aircraft response to forces applied on the *control inceptor* (3.1.6) or *control effector* (3.1.5)

3.1.20**attitude control**

control of the orientation of aircraft with respect to inertial frame of reference

3.1.21**trim system**

part of a *flight control system* (3.1.3) that adjusts the aerodynamic forces on the *primary flight control surfaces* (3.1.8) to maintain the aircraft at the set altitude without control input

3.2 Basic elements**3.2.1****aileron**

primary flight control surface (3.1.8), movable airfoil at the trailing edge of an airplane wing used as *effector* (3.1.5) to change rolling moments for *lateral control* (3.1.13) about the longitudinal axis of the aircraft

3.2.2**elevator**

primary flight control surface (3.1.8), movable (auxiliary) airfoil hinged to the rear of the left and right *horizontal stabilizer* (3.2.17) of the aircraft tail used as *effector* (3.1.5) to change pitching moments for *longitudinal control* (3.1.12) about the transversal axis of the aircraft

3.2.3**rudder**

primary flight control surface (3.1.8), movable (auxiliary) airfoil hinged to the rear of the vertical stabilizer (fin) of the aircraft tail used as *effector* (3.1.5) to change yawing moments for *directional control* (3.1.14) about the normal axis of the aircraft

3.2.4**elevon**

control surface (3.1.7) on an airplane that combines the functions of *elevator* (3.2.2) and *aileron* (3.2.1) to control both roll and pitch attitudes

3.2.5**ruddervator**

control surface (3.1.7), usually a on 'V' or 'butterfly' tail airplane, that combines the functions of *elevator* (3.2.2) and *rudder* (3.2.3) to control both yaw and pitch attitudes

3.2.6**canard**

horizontal control surface (3.1.7) mounted ahead of the wing to provide longitudinal stability and control and to control pitch attitude

3.2.7

flap

secondary control (3.1.9), movable airfoil usually attached to the trailing edge of a wing on an airplane that changes its camber to increase both its lift and its drag

3.2.8

leading-edge flap

secondary control (3.1.9), movable element of an airplane wing attached near its leading edge that changes its camber to increase both its lift and its drag

3.2.9

slat

secondary control (3.1.9), movable element of an airplane wing attached near its leading edge that produces a slot aft of the leading edge in order to allow air from below the wing to pass through and maintain laminar flow at high angle-of-attack

3.2.10

spoiler

uncambered *control surface* (3.1.7) deflected symmetrically upward above the aft surface of the wing for reducing the wing lift during landing and for increasing drag to act as *speed brakes* (3.2.11) or deflected on one side only to act as *aileron* (3.2.1) for roll control

3.2.11

speed brake

uncambered *control surface* (3.1.7) deflected symmetrically upward above the aft surface of the wing for increasing drag to reduce aircraft speed during final approach to touchdown

3.2.12

stabilator

stabilizer elevator

airplane *control surface* (3.1.7) that combines the functions of an *elevator* (3.2.2) and a *horizontal stabilizer* (3.2.17)

3.2.13

balance tab

auxiliary hinged airfoil on the trailing edge of the aircraft *control surface* (3.1.7) used to balance, either fully or partially, the aerodynamic loads on the control surface, thus reducing stick loads

3.2.14

servo tab

Flettner tab

auxiliary hinged airfoil (movable surface) on the trailing edge of the aircraft *control surface* (3.1.7) to assist the movement of the control surface

Note 1 to entry: A servo tab is integrated into the flight control's operating components in such a way as to drive, or help to drive, the control surface during normal control inputs.

Note 2 to entry: The pilot controls the tab not the control surface. The movement of the tab makes the control surface move.

3.2.15

anti-servo tab

anti-balance tab

movable surface on the trailing edge of the *stabilator* (3.2.12) providing force acting against the movement of the stabilator to reduce the sensitivity to pilot input

3.2.16**drag-rudder****split drag rudder**

control device for *directional control* (3.1.14) on tailless or flying wing type airplane designed as assembly of two *flaps* (3.2.7) mounted together on each wing

Note 1 to entry: Deflection of drag-rudder means that both flaps are symmetrically deflected at a certain angle in opposite directions.

3.2.17**horizontal stabilizer****tailplane**

horizontal surface, fixed or adjustable, of an aircraft empennage, to provide angular stability for rotations about the lateral axis

3.2.18**trimmable horizontal stabilizer****adjustable horizontal stabilizer**

fully moving horizontal tail surface, not in response to *inceptor* (3.1.6) movement but in response to the *trim system* (3.1.21) settings depending on flight mode

3.2.19**taileron**

left and right *tailplanes* (3.2.17) used as *primary flight control surfaces* (3.1.8) in both pitch and roll

3.2.20**main rotor collective control**

<rotary wing aircraft> changing the pitch of all the main rotor blades by the same amount (or collectively) with respect to the main rotor shaft to control the magnitude of the main rotor thrust vector

3.2.21**main rotor cyclic control**

<rotary wing aircraft> changing the pitch of the rotor blades individually with respect to azimuth as they move around the rotor disk to control the direction of the main rotor thrust vector for *longitudinal control* (3.1.12) or *lateral control* (3.1.13)

3.2.22**tail rotor collective control**

<rotary wing aircraft> changing the pitch of all the tail rotor blades by the same amount (or collectively) with respect to the tail rotor shaft to adjust the magnitude of the tail rotor thrust for *directional control* (3.1.14)

3.2.23**thrust vectoring**

rotation of a vehicle's thrust axis to control its trajectory or support its weight

3.2.24**yoke**

type of *control inceptor* (3.1.6), movable column on which an airplane control wheel is mounted

Note 1 to entry: A yoke movement in or out is used to control the *elevators* (3.2.2) or other *effectors* (3.1.5) related to *longitudinal control* (3.1.12) and control wheel rotation is used to control the *ailerons* (3.2.1) or other effectors related to *lateral control* (3.1.13).

3.2.25**control stick**

type of *control inceptor* (3.1.6), vertical stick in the flight deck to control the *ailerons* (3.2.1) or other *effectors* (3.1.5) related to *lateral control* (3.1.13) by side-to-side movement and to control the *elevators* (3.2.2) or other effectors related to *longitudinal control* (3.1.12) by fore-and-aft movement

3.2.26

sidestick

side arm controller

type of *control inceptor* (3.1.6), control column in the form of a short handgrip beside the pilot, with the same function as *control stick* (3.2.25)

3.2.27

pedal

rudder pedal

type of *control inceptor* (3.1.6) operated by pushing with feet, primary for *directional control* (3.1.14) via *rudder* (3.2.3) in fixed wing aircraft

3.2.28

antitorque pedal

tail rotor control

type of single rotor helicopter *control inceptor* (3.1.6) operated by pushing with feet, for *directional control* (3.1.14) via thrust to *tail rotor collective control* (3.2.22)

3.2.29

collective lever

collective

type of helicopter *control inceptor* (3.1.6) usually operated with pilot left hand for main rotor thrust control through simultaneous engine power control and *main rotor collective control* (3.1.20)

3.2.30

hydraulic actuator

actuator (3.1.10) made as hydraulic cylinder or fluid motor that uses hydraulic power from external supplier to facilitate mechanical operation

3.2.31

electro-hydrostatic actuator

EHA

self-contained *hydraulic actuator* (3.2.30) that integrates a cylinder, feedback unit, variable speed pump, servo motor, electric drive and control electronics, into a compact unit requiring only an electrical connection

3.2.32

electromechanical actuator

EMA

mechanical *actuator* (3.1.10) where the control knob or handle has been replaced by an electric motor that converts electrical energy into mechanical motion

3.3 Control system classification

3.3.1

manual flight control system

mechanical flight control system

flight control system (3.1.3), in which *inceptors* (3.1.6) in pilot desk are mechanically connected directly to the corresponding *effectors* (3.1.5) [*control surfaces* (3.1.7)] of the aircraft by a system of rods, levers, cables and pulleys, so all the inputs are done manually by the pilot, giving the pilot all the control of the aircraft

3.3.2

hydro-mechanical flight control system

flight control system (3.1.3), in which *inceptors* (3.1.6) in pilot desk are mechanically connected directly to the valve of *hydraulic actuators* (3.2.30), output of which in its turn mechanically connected with corresponding *effectors* (3.1.5)

3.3.3**electro-hydraulic flight control system**

flight control system (3.1.3), in which electric signal (analogue or digital) from *sensors* (3.1.11) of *inceptors'* (3.1.6) movement in pilot desk and signal from *automatic flight control system* (3.1.4) pass through electrical cables to the electric valve of *hydraulic actuators* (3.2.30), output of which in its turn mechanically connected with corresponding *effectors* (3.1.5)

3.3.4**electrical flight control system**

flight control system (3.1.3), in which electric signal (analogue or digital) from *sensors* (3.1.11) of *inceptors'* (3.1.6) movement in pilot desk and signal from *automatic flight control system* (3.1.4) pass through electrical cables to the *electro-mechanical actuators* (3.2.32), output of which in its turn mechanically connected with corresponding *effectors* (3.1.5)

3.3.5**fly-by-wire****FBW**

flight control system (3.1.3) with electric signal connection between *inceptors* (3.1.6) and *actuators* (3.1.10)

EXAMPLE *Electro-hydraulic flight control system* (3.3.3) or *electrical flight control system* (3.3.4).

3.3.6**fly-by-light**

flight control system (3.1.3) with fibre-optic connection between *inceptors* (3.1.6) and *actuators* (3.1.10)

EXAMPLE *Electro-hydraulic flight control system* (3.3.3) or *electrical flight control system* (3.3.4).

3.3.7**stability augmentation system****SAS**

type of *automatic flight control system* (3.1.4) which provides or enhances stability for specific aerodynamic characteristics of an airplane providing short-term rate damping

3.3.8**autostabilizer**

simple *stability-augmentation system* (3.3.7), usually to provide increased damping and often with limited *authority* (3.1.17)

3.3.9**autopilot****automatic pilot****AP**

airborne *automatic flight control system* (3.1.4) that automatically maintains aircraft on a path in space pre-determined by *flight director* (3.3.10) without any action being required by the pilot

3.3.10**flight director****automatic flight director system**

instrument system (3.1.1) consisting of electronic components that computes and indicates the aircraft attitude required to attain and maintain a preselected flight condition without direct connection to *actuators* (3.1.10)

3.3.11**autothrottle****autothrust**

system (3.1.1) setting engines thrust automatically depending on the selected mode to meet speed targets from pilot or from *flight management system* (3.3.12)

3.3.12

flight management system

FMS

on-board computerized *system* (3.1.1) used for multi-purpose navigation, performance computations, and aircraft operations enabling the flight crew to program a route from takeoff to landing, consisting of *automatic flight control system* (3.1.4), flight management computer, aircraft navigation system and electronic flight instrument system

Note 1 to entry: The crew can select whether to put the aircraft under *autopilot* (3.3.9) or manual control mode. Under the autopilot mode, the aircraft *flight control surfaces* (3.1.7) move automatically; under the manual control mode, the pilot follows the displayed *flight director* (3.3.10) commands to achieve the desired status.

3.3.13

full authority automatic flight control system

automatic flight control system (3.1.4) having access to the maximum useable range of *effectors* (3.1.5)

3.3.14

limited authority automatic flight control system

partial authority automatic flight control system

automatic flight control system (3.1.4) having access to only part of the full available range of *effectors* (3.1.5)

3.3.15

robust flight control system

flight control system (3.1.3), which maintains acceptable performance in the presence of significant model uncertainty, disturbances and noise

3.3.16

fault

unpermitted deviation of at least one characteristic property (feature) of the *system* (3.1.1) from the standard condition which may cause a reduction in, or loss of, the capability of the *system* (3.1.1) to perform a required function

3.3.17

failure

permanent interruption of a *system's* (3.1.1) ability to perform a required function under specified operating conditions

3.3.18

fault-tolerant flight control system

flight control system (3.1.3) capable of controlling the aircraft with satisfactory performance even if one or several *faults* (3.3.16), or more critically, one or several *failures* (3.3.17) occur in this system

3.3.19

redundancy

presence of more than one independent means for accomplishing a given function or flight operation

3.3.20

redundant flight control system

overactuated flight control system

flight control system (3.1.3) equipped with more *effectors* (3.1.5) than axes to control

3.3.21

quadruplex flight control system

flight control system (3.1.3) having four hardware lanes for detection and isolation of up to two identical *failure* (3.3.17)

3.3.22

adaptive flight control system

flight control system (3.1.3) capable to modify its own operation to achieve the best possible mode of operation through real-time parameter identification and controller update