

## FSX Helicopter Auto Pilot Gauge Tutorial

By Ronald Vermeij

Version 1.0

## **FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial**

### **Management Summary:**

This is an in-depth “How-do-I-use-the-HAP-gauge” tutorial for the Microsoft Flightsimulator X **Helicopter Auto Pilot (HAP)** gauge. This gauge was created by:

- Annti Pankonen. who did the gauge programming © 2007
- Dirk Fassbender, who did the graphics design © 2007

These are the 2 wonderful persons who created this gauge for the Microsoft FS9/FSX community, for which I wanted to express my thanks to both of them. Without them, the FS9/FSX community was still flying “helicopters on “trimmers”.

But.. since the documentation that came with this gauge was – to my opinion - not complete, I decided to write a brand new, crystal clear installation manual and 5 training missions about this gauge. Starting from the very basics, all the way up to be able to explore all build-in possibilities of this HAP-Gauge.

I hope you like this tutorial and have many fun helicopter flying hours with it.

Regards,

Ronald Vermeij

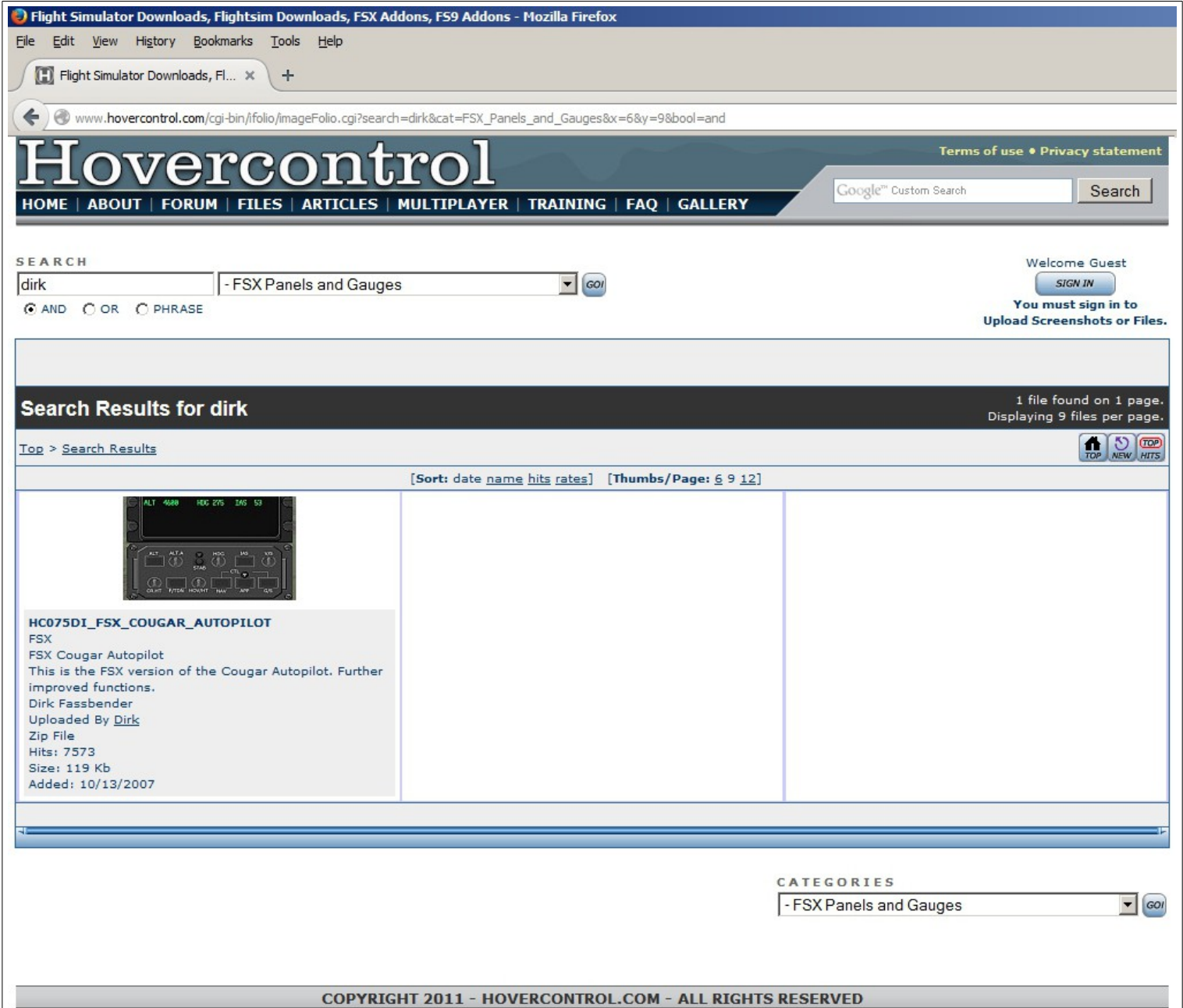
Date: 26-June\_2015

## Table of Contents

By Ronald Vermeij Version 1.0.....	1
1. - Where can I get this gauge?.....	4
2. - What are the contents of the downloaded zipfile package?.....	5
3 - How do I instal this gauge into any FSX Helicopter?.....	6
4 - How do I install the HAP gauge into the FSX Standard BELL206B Helicopter?.....	7
4.1 - Enable the Autopilot feature (in the aircraft.cfg file).....	7
4.2 - Add the HAP Gauges to the BELL206B panel (in the panel.cfg file).....	8
5 - Configuration of the HAP-keyboard bindings-file AFCP.CFG.....	9
6 – The AP1.CFG file.....	11
6.1 - TIP to find out what parameter does what:.....	11
7 - How can I check if the HAP gauges have been correctly added to the BELL206B panel?.....	12
7 - This is not a “how-do-i-learn-to-fly-a-helicopter” tutorial!.....	15
8 - Basic Helicopter Components and Concepts summary:.....	21
8.1 – Helicopter parts (in essential... ).....	21
8.1.1 – Engine.....	21
8.1.2 – Main Rotor.....	21
8.1.3 – Tail Rotor.....	21
8.2 - Helicopter Forces – Horizontal and Vertical.....	22
8.2.1 - Lift.....	22
8.2.2 - Gravity.....	22
8.2.3 - Trust.....	22
8.2.4 - Drag.....	22
8.3 - Helicopter Forces – Rotating.....	22
8.3.1 - Torque.....	22
8.3.2 - Anti-Torque.....	22
8.4 – Helicopter Flight Controls:.....	23
8.4.1 – Yoke.....	23
8.4.2 – Pedals.....	23
8.4.3 – Throttle.....	24
8.4.4 – Collective (Liver).....	24
8.5 – Helicopter Movements:.....	25
9 - The various stages of a regular helicopter flight.....	26
9.1 - Parked on the ground, full stop.....	26
9.2 - Transition from ground to hover.....	26
9.3 - Transition from hover to climb.....	26
9.4 - Transition from climb to level (cruise) flight.....	26
9.5 - Transition from level (cruise) flight to descent.....	26
9.6 - Transition from descent to hover.....	26
9.7 - Transition from hover to full stop.....	26
10 - The HAP Gauge and its functions.....	27
10.1 - HAP Gauge functions overview:.....	27
11 - HAP Gauge – trainings lessons overview: @@.....	28
Appendix A – Background material on Helicopter AutoPilots.....	29
Appendix B – APCF.CFG - Keycodes for bindings:.....	30

# FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial

## 1. - Where can I get this gauge?



**Fig. 1 – Hover Control, Files section**

Surf to the website [http:// www.hovercontrol.com](http://www.hovercontrol.com) → look in the Files section.  
Search for “dirk” in the [FSX Panels and Gauges section].  
Download the gauge called “HC075DI\_FSX\_COUGAR\_AUTOPILOT” to your hard-disk.

2 - What are the contents of the downloaded zipfile package?

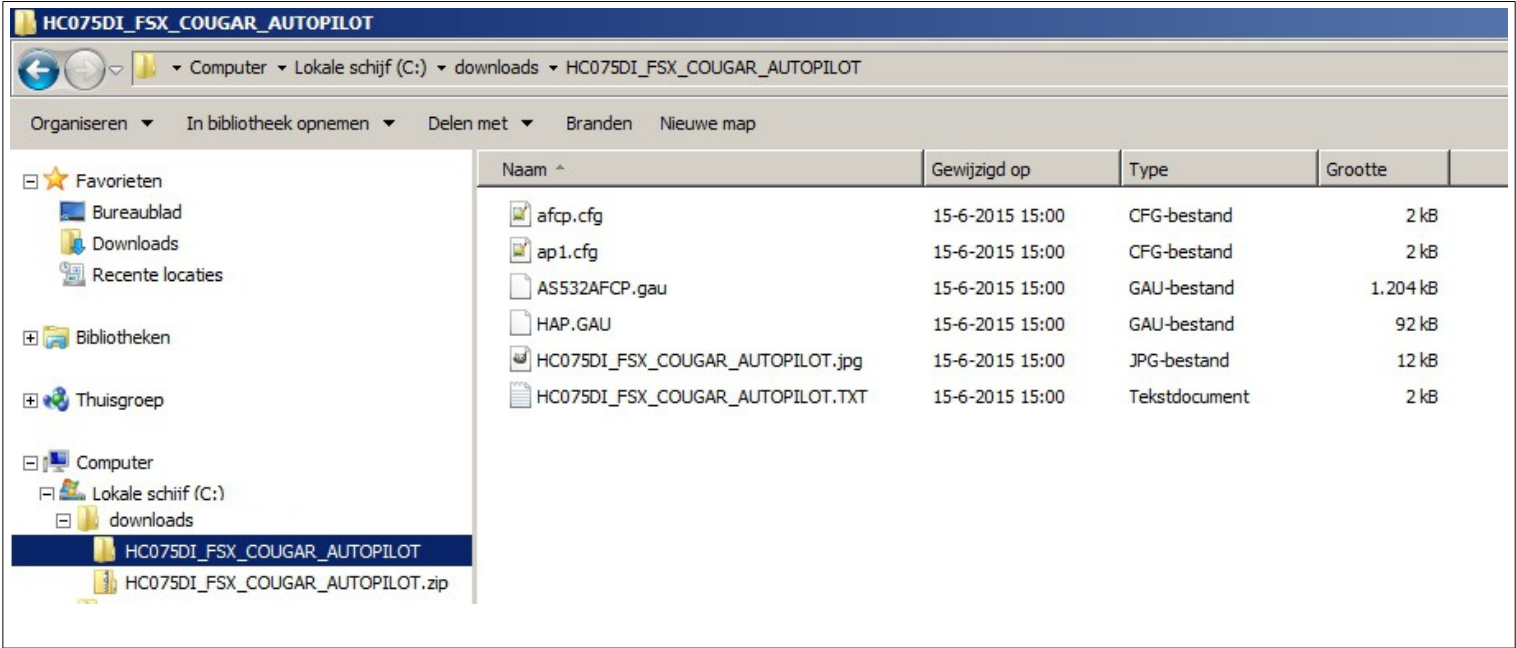


Fig. 2 – Contents of the [www.hovercontrol.com](http://www.hovercontrol.com) download zipfile after unzipping.

Filename:	Functionality of the files (inside this autopilot system):
afcp.cfg	Keyboard bindings configuration file, telling the gauge which keyboard presses are bound to which internal functions of the gauge.
ap1.cfg	Autopilots internal settings file.
as532afcp.gau	The Autopilot gauge file.
Hap.gau	Annunciator window gauge file, that shows the settings of this autopilot.
hc075di_fsx_couger_autpilot.jpg	(little) Image of the gauges from-panel.
hc075di_fsx_couger_autpilot.txt	The README file for this download package.

# FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial

## 3 - How do I install this gauge into any FSX Helicopter?

- A - Copy afcp.cfg to your main FSX (root) folder.
- B - Copy ap1.cfg to your main FSX (root) folder.

On my system that is the “C:\Program Files (x86)\Microsoft Games\Microsoft Flight Simulator X” folder.

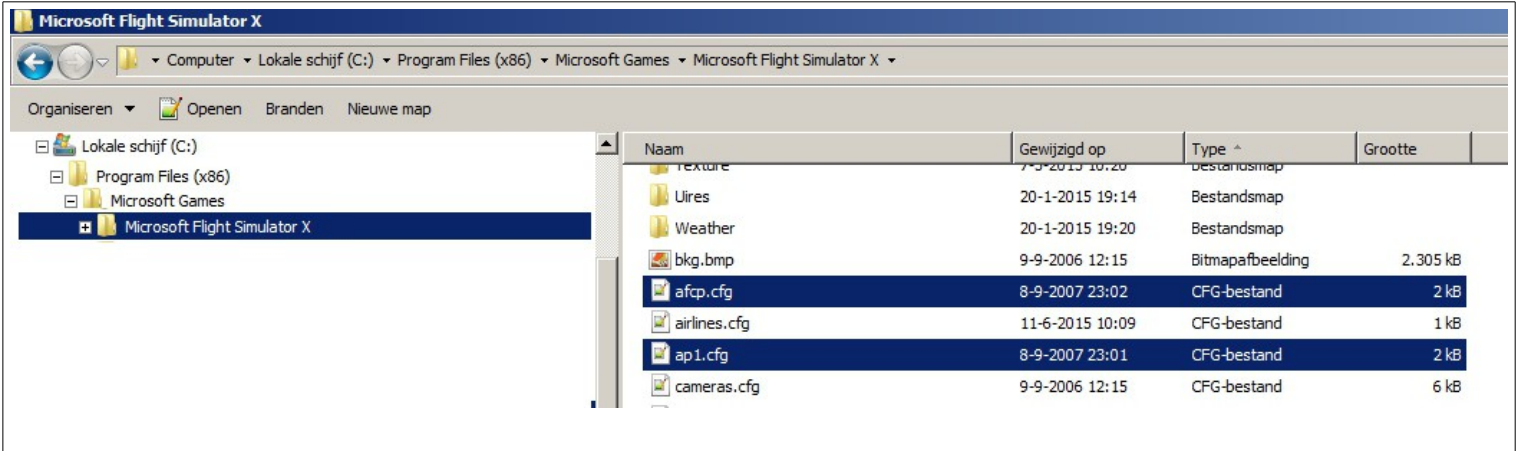


Fig. 3 – Location of the .CFG files.

- C - Copy both AS532AFCP.GAU and HAP.GAU to the FSX Gauges folder.

On my system that is the “C:\Program Files (x86)\Microsoft Games\Microsoft Flight Simulator X\Gauges”

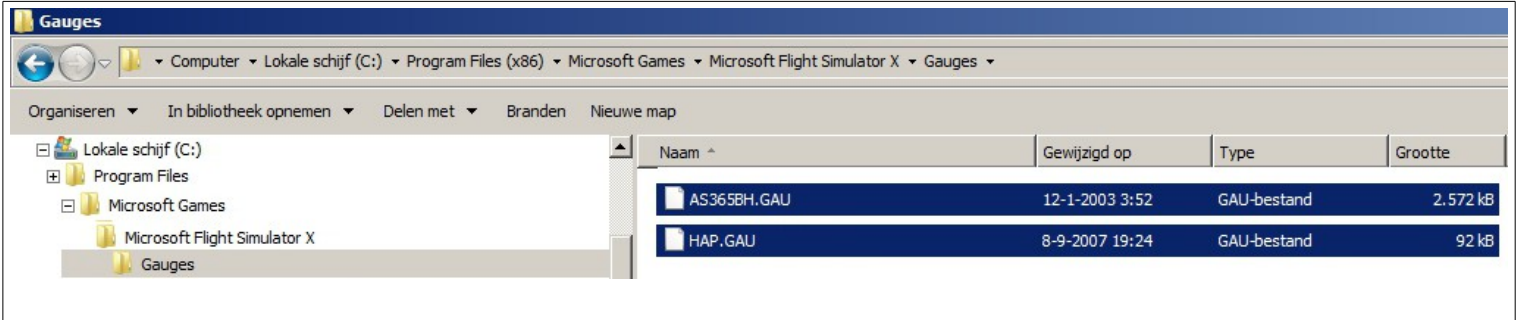


Fig. 4 – Location of the .GAU files.

Now that all relevant files have been installed in the correct FSX folder, we are ready to add this beautiful Helicopter Auto Pilot (HAP) gauge into any FSX helicopter-panel we would like to use it in.

**NOTE:**  
As an example I'm going to use the **Standard, Default FSX BELL206B Helicopter**.  
This helicopter is present on everyone's FSX installations, so it should not give any difficulties at all.

## FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial

### 4 - How do I install the HAP gauge into the FSX Standard BELL206B Helicopter?

#### 4.1 - Enable the Autopilot feature (in the aircraft.cfg file)

For the autopilot to function, you first need to enable the autopilot in the flightmodel of the BELL206B helicopter.

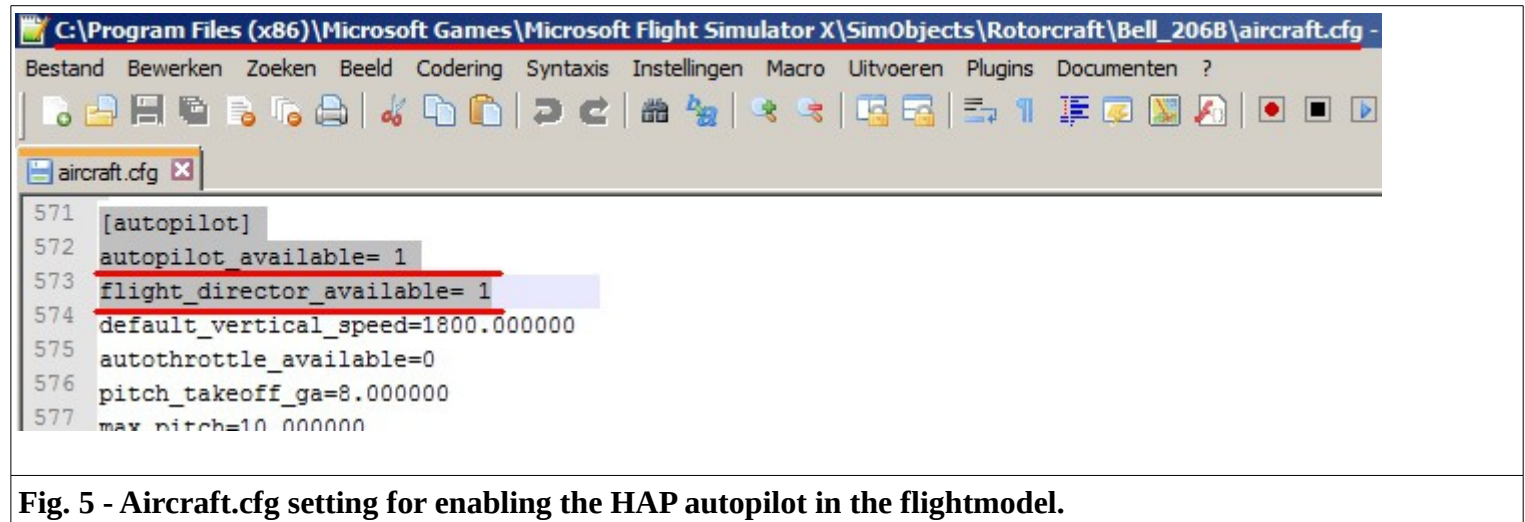
A - Go to the BELL206B aircraft.cfg file.....*On my computer that is:*

**C:\Program Files (x86)\Microsoft Games\Microsoft Flight Simulator X\SimObjects\Rotorcraft\Bell\_206B**

B - Open the aircraft.cfg with an editor (e.g. notepad.exe)

C - Check if the following lines are present under the header [autopilot]:

- autopilot=1
- flight\_director=1



**Fig. 5 - Aircraft.cfg setting for enabling the HAP autopilot in the flightmodel.**

D – Save the aircraft.cfg file and close the editor.

Now we have enabled the autopilot feature in the BELL206B's flightmodel, so that the HAP gauge can control it.



## FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial

### 4.2 - Add the HAP Gauges to the BELL206B panel (in the panel.cfg file).

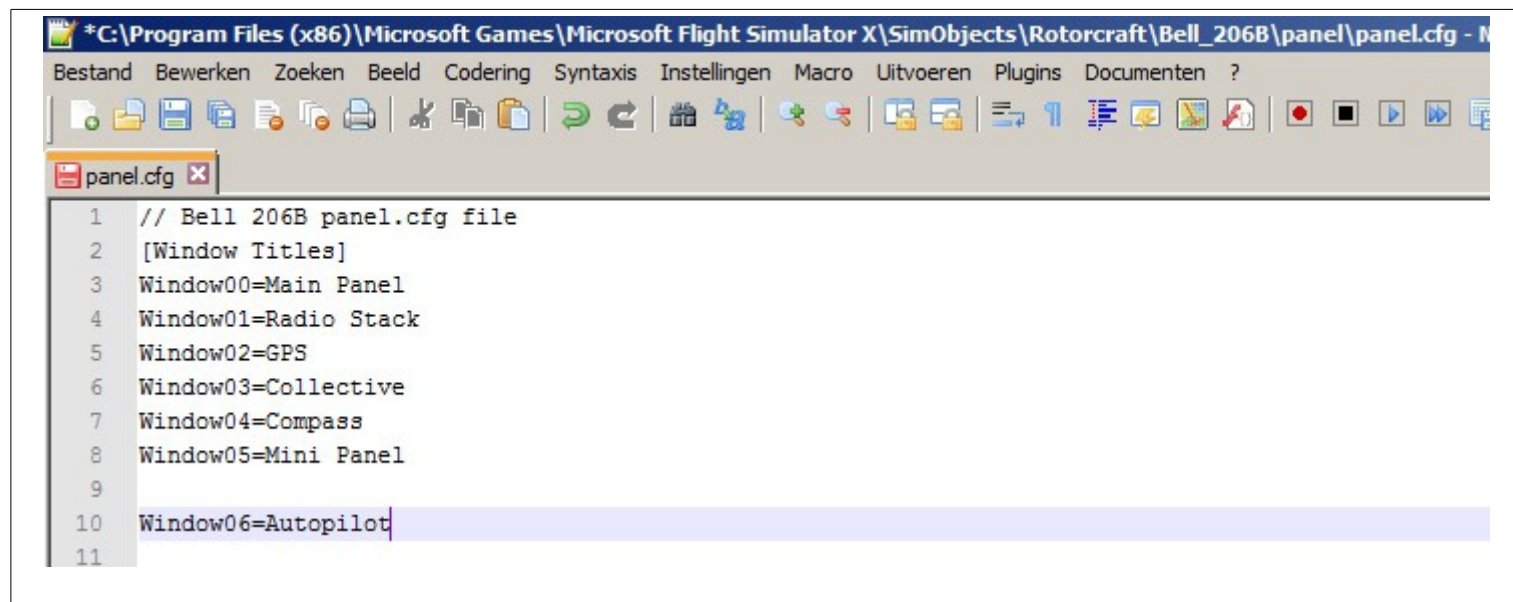
To add the autopilot to the existing BELL206B panel, we need to add another panel-window for it.

A – Go to the BELL206B's *panel.cfg* file..... On my computer that is:

**C:\Program Files (x86)\Microsoft Games\Microsoft Flight Simulator X\SimObjects\Rotorcraft\Bell\_206B\panel**

B - Open the panel.cfg with an editor (e.g. notepad.exe).

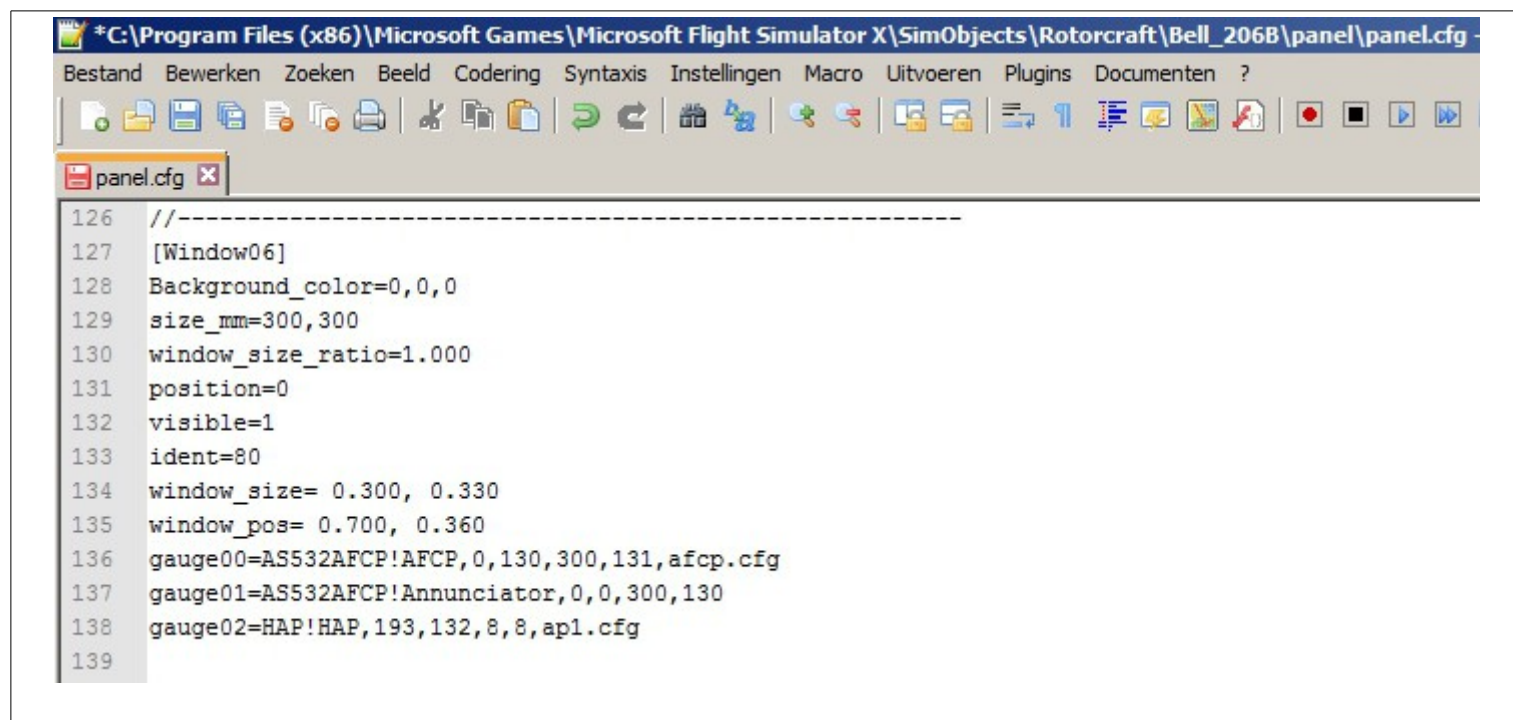
C - Go to the [Windows Titles] section:



**Fig.6 – Panel.cfg [Windows Titles] section**

D - Add an extra “Windowxx=Autopilot”line to the [Windows Titles] section

E – Scroll down to the [Windows] section and add these lines of code (see fig. 7 below)



**Fig. 7 – Panel.cfg – extra Autopilot window added**

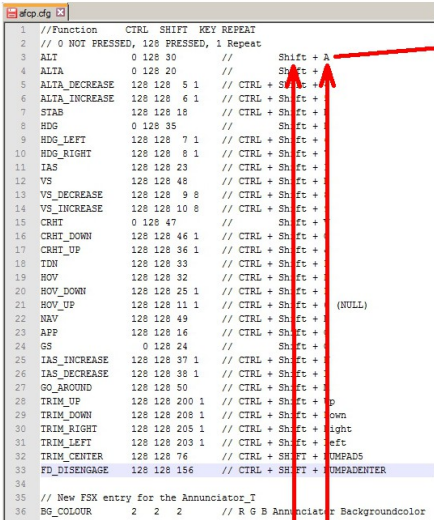
F – Save the panel.cfg file and close the editor.




5 - Configuration of the HAP-keyboard bindings-file AFCP.CFG

In order for the HAP-gauge to function correctly, you need to “connect” it to your keyboard first. When this is done successfully, you can control all functionalities of the HAP-gauge via your keyboard, by assigning different “key presses” and/or ”key combinations” to different HAP-gauge functions. See this graphic below how this works.

2. HAP matches the pressed key combination against her internal functionalities table (binding)



3. HAP then activates the corresponding function of the autopilot gauge.



1. The [shift] and the [A] key are pressed simultaneously on keyboard


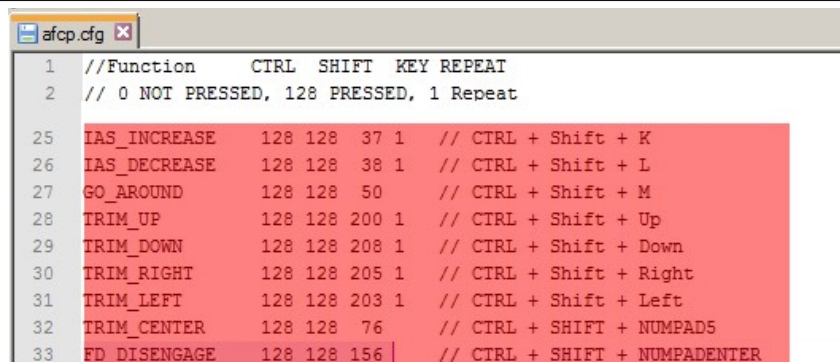


Fig. 8 - The function of the AFCP.CFG file for the HAP-gauge.

Function	Key_combination	Function	Key_Combination
ALT OF/OFF	Altitude lock (on/off)	TDN	Transition (on/off)
ALT_INCREASE	Increase Acquire Altitude height	HOV	Hover mode (on/off)
ALT_DECREASE	Decrease Acquire Altitude height	HOVUP	Increase hover height
STAB	HAP gauge on/off (master switch)	HOVDN	Decrease hover height
HDG	Heading lock on/off	NAV	Nav mode (on/off)
HDG_LEFT	Increase Heading direction	APP	Approach mode (on/off)
HDG_RIGHT	Decrease Heading direction	GS	Glideslope mode (on/off)
IAS	Indicated AirSpeed lock (on/off)	GO_AROUND	Go around switch
IAS_INCREASE	Increase AirSpeed lock speed	TRIM_UP	Trim Up
IAS_DECREASE	Decrease AirSpeed lock speed	TRIM_DOWN	Trim Down
VS	Vertical Speed mode (on/off)	TRIM_LEFT	Trim Right
VS_INCREASE	Increase vertical speed	TRIM_RIGHT	Trim Left
VS_DECREASE	Decrease vertical speed	TRIM_CENTER	Trim Centered
CRHT	Terrain follow mode (on/off)	FD_DISENGAGE	Flight Director (on/off)
CRHT_DOWN	Decrease terrain follow height		
CRHT_UP	Increase terrain follow height		

## FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial



**Fig. 9 - HAP-gauge functionalities overview which are NOT connected to its front-panel!**

Note that not all HAP-gauge's internal functions are directly connected to the HAP-gauge's front panel!

*Some HAP-gauge's internal functions can only be accessed by keypresses! Remember that when using it.*

Lets take a look at different lines inside of the AFCP.CFG file:

```
// Function    CTRL  SHIFT  KEY REPEAT
// 0 NOT PRESSED, 128 PRESSED, 1 Repeat
ALT            0   128 30    // Shift + A
ALTA_DECREASE 128 128  5 1   // CTRL + Shift + 4
VS_DECREASE   128 128  9 8   // CTRL + Shift + 8
```

**Fig. 10 – Keyboard binding lines.**

Lets look at the 1<sup>st</sup> //non commented line:

**ALT** - HAP internal functionality ALTitude hold/lock - **[ALT]** button  
**0** - tells HAP that NO [CTRL] key needs to be pressed to activate ALT.  
**128** - tell HAP that a [SHIFT] key needs to be pressed to activate ALT.  
**30** - is the ASCII code for the letter A that needs to be pressed to activate ALT.  
So the **[ALT]** function is turned (on/off) by pressing the [SHIFT] + [A] key.

Lets look at the 2nd //non commented line:

**ALT\_DECREASE** - HAP internal functionality for decreasing the ALT.Acquire Height – **[ALT.A]** button.  
**128** - tells HAP that a [CTRL] key needs to be pressed to activate ALT.A  
**128** - tell HAP that a [SHIFT] key needs to be pressed to activate ALT.A  
**5** - is the number [4] key that needs to be pressed to activate ALT.A  
**1** - tells HAP that this needs to be executed one once.

So the **ALT.A height value** is lowered by pressing the [CTRL]+[SHIFT] + [4] key.

Lets look at the 3rd //non commented line:

**VS\_DECREASE** - HAP internal functionality for decreasing the Vertical Speed – **[V/S]** button  
**128** - tells HAP that a [CTRL] key needs to be pressed to decrease V/S  
**128** - tells HAP that a [SHIFT] key needs to be pressed to decrease V/S  
**9** - is the number [5] key that needs to be pressed to decrease V/S  
**8** - tells HAP that this needs to be executed 8 times internally

So the **V/S Vertical Speed value** is lowered by pressing the [CTRL]+[SHIFT] + [5] key.

And so on...

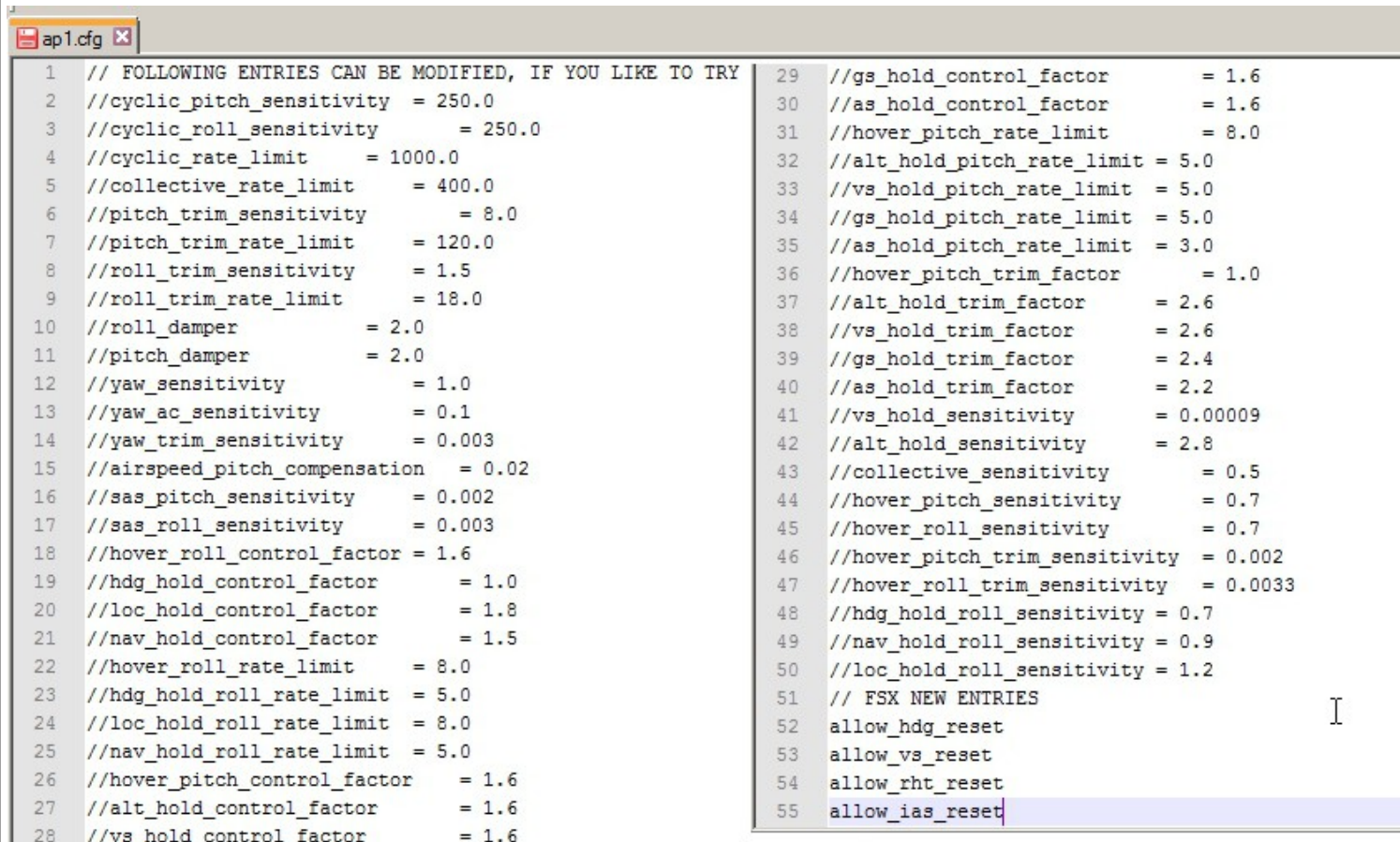
See Appendix B for the which codes that belong to which key..

## 6 – The AP1.CFG file

I have not (yet) found any detailed documentation about this file on Dirks & Antti 's website other than these pages:

- <http://www.dirkfassbender.de/AFCP/ap1cfg.html>
- <http://www.dirkfassbender.de/AFCP/ap2cfg.html>
- [http://www.dirkfassbender.de/AFCP/fsx\\_issue.html](http://www.dirkfassbender.de/AFCP/fsx_issue.html)

My educated guess it that these parameter-value-pairs are internal settings that are used by the HAP-gauge itself.



```

1 // FOLLOWING ENTRIES CAN BE MODIFIED, IF YOU LIKE TO TRY
2 //cyclic_pitch_sensitivity = 250.0
3 //cyclic_roll_sensitivity = 250.0
4 //cyclic_rate_limit = 1000.0
5 //collective_rate_limit = 400.0
6 //pitch_trim_sensitivity = 8.0
7 //pitch_trim_rate_limit = 120.0
8 //roll_trim_sensitivity = 1.5
9 //roll_trim_rate_limit = 18.0
10 //roll_damper = 2.0
11 //pitch_damper = 2.0
12 //yaw_sensitivity = 1.0
13 //yaw_ac_sensitivity = 0.1
14 //yaw_trim_sensitivity = 0.003
15 //airspeed_pitch_compensation = 0.02
16 //sas_pitch_sensitivity = 0.002
17 //sas_roll_sensitivity = 0.003
18 //hover_roll_control_factor = 1.6
19 //hdg_hold_control_factor = 1.0
20 //loc_hold_control_factor = 1.8
21 //nav_hold_control_factor = 1.5
22 //hover_roll_rate_limit = 8.0
23 //hdg_hold_roll_rate_limit = 5.0
24 //loc_hold_roll_rate_limit = 8.0
25 //nav_hold_roll_rate_limit = 5.0
26 //hover_pitch_control_factor = 1.6
27 //alt_hold_control_factor = 1.6
28 //vs_hold_control_factor = 1.6
29 //gs_hold_control_factor = 1.6
30 //as_hold_control_factor = 1.6
31 //hover_pitch_rate_limit = 8.0
32 //alt_hold_pitch_rate_limit = 5.0
33 //vs_hold_pitch_rate_limit = 5.0
34 //gs_hold_pitch_rate_limit = 5.0
35 //as_hold_pitch_rate_limit = 3.0
36 //hover_pitch_trim_factor = 1.0
37 //alt_hold_trim_factor = 2.6
38 //vs_hold_trim_factor = 2.6
39 //gs_hold_trim_factor = 2.4
40 //as_hold_trim_factor = 2.2
41 //vs_hold_sensitivity = 0.00009
42 //alt_hold_sensitivity = 2.8
43 //collective_sensitivity = 0.5
44 //hover_pitch_sensitivity = 0.7
45 //hover_roll_sensitivity = 0.7
46 //hover_pitch_trim_sensitivity = 0.002
47 //hover_roll_trim_sensitivity = 0.0033
48 //hdg_hold_roll_sensitivity = 0.7
49 //nav_hold_roll_sensitivity = 0.9
50 //loc_hold_roll_sensitivity = 1.2
51 // FSX NEW ENTRIES
52 allow_hdg_reset
53 allow_vs_reset
54 allow_rht_reset
55 allow_ias_reset
  
```

**Fig. 11 – The AP1.CFG file.**

### 6.1 - TIP to find out what parameter does what:

- Make a backup of this file.
- Go by trail and error.
- Un-comment (remove the leading // in) a certain line to active its settings inside the HAP-gauge.
- Modify the value of the parameter.
- Save the AP1.CFG file.

and try it out / flight-test this new configuration for yourself inside FSX.



FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial

7 - How can I check if the HAP gauges have been correctly added to the BELL206B panel?.

For this check, all we have to do is start-up the FSX flightsimulator program.  
During FSX start-up, the program notices the 2 new (HAP) gauges that have been added to the Gauges folder.

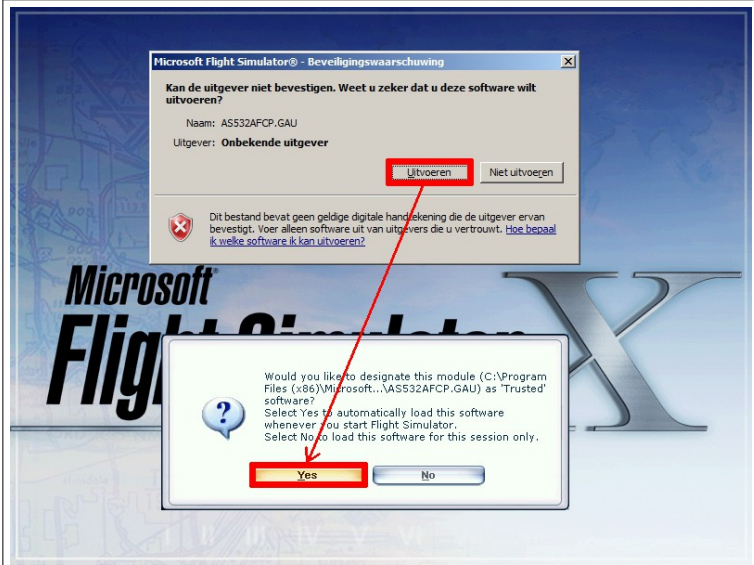


Fig. 8 – Confirm AS532AFCP.GAU as “trusted file”.

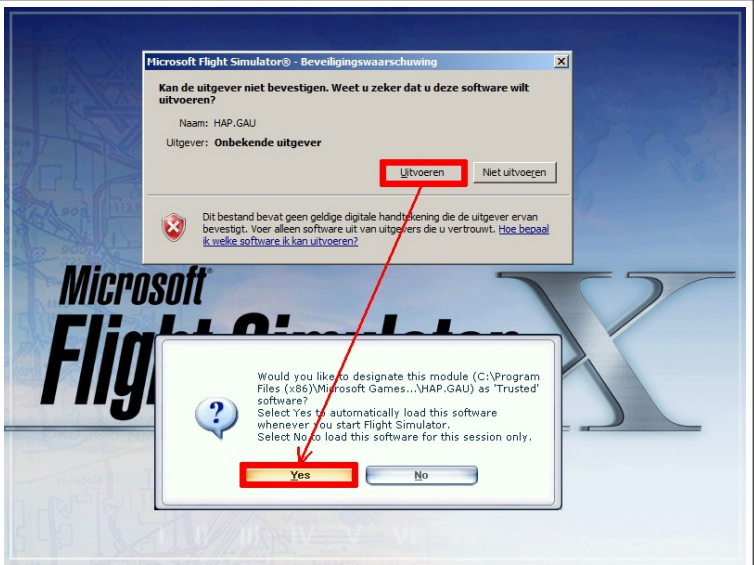


Fig. 9 - Confirm HAP.GAU as “trusted file”.

- FSX asks you now, what shall I do with it?
- 1<sup>st</sup> the AS532.GAU file → Click on [Execute] and then answer [Yes] to the trusted question.
  - 2<sup>nd</sup> the HAP.GAU file → Click on [Execute] and then answer [Yes] to the trusted question.

Now FSX stores these choices and adds the newly added gauges to the [Trusted] Section of FSX.CFG  
*The location of FSX.CFG is on my computer:*

C:\Users\<windows\_logon\_name>\AppData\Roaming\Microsoft\FSX\FSX.CFG

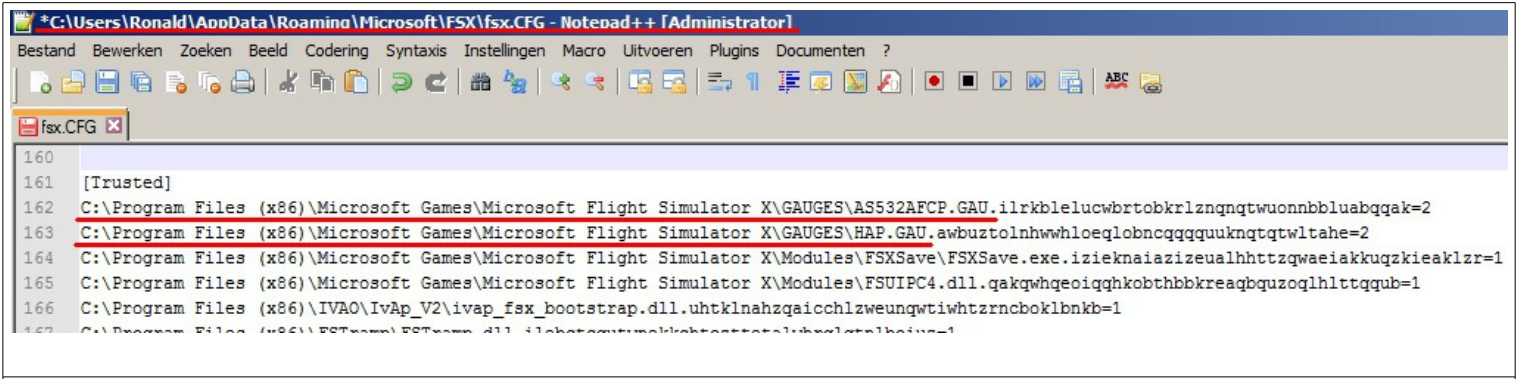


Fig. 10 – The new Gauges files have been added to the FSX.CFG [Trusted] section.

FSX start up and the Intro Screen appears,  
Select the [Free Flight] menu choice,  
Choose [Aircraft] to select the BELL206B Helicopter,



Fig. 11 - Select a(ny) Bell206B helicopter and click [OK]



Fig. 12 – Location [KMXF -> HELIPAD], Weather [Clear skies], Time [any Day-time] and click [Fly now]

FSX starts up and now loads the Blue Bell206B onto the Helipad of Maxwell Airforce Base in Alabama USA for a test ride. This is the (KMXF) airport were we are going to conduct our 5 tutorial lessons.



FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial

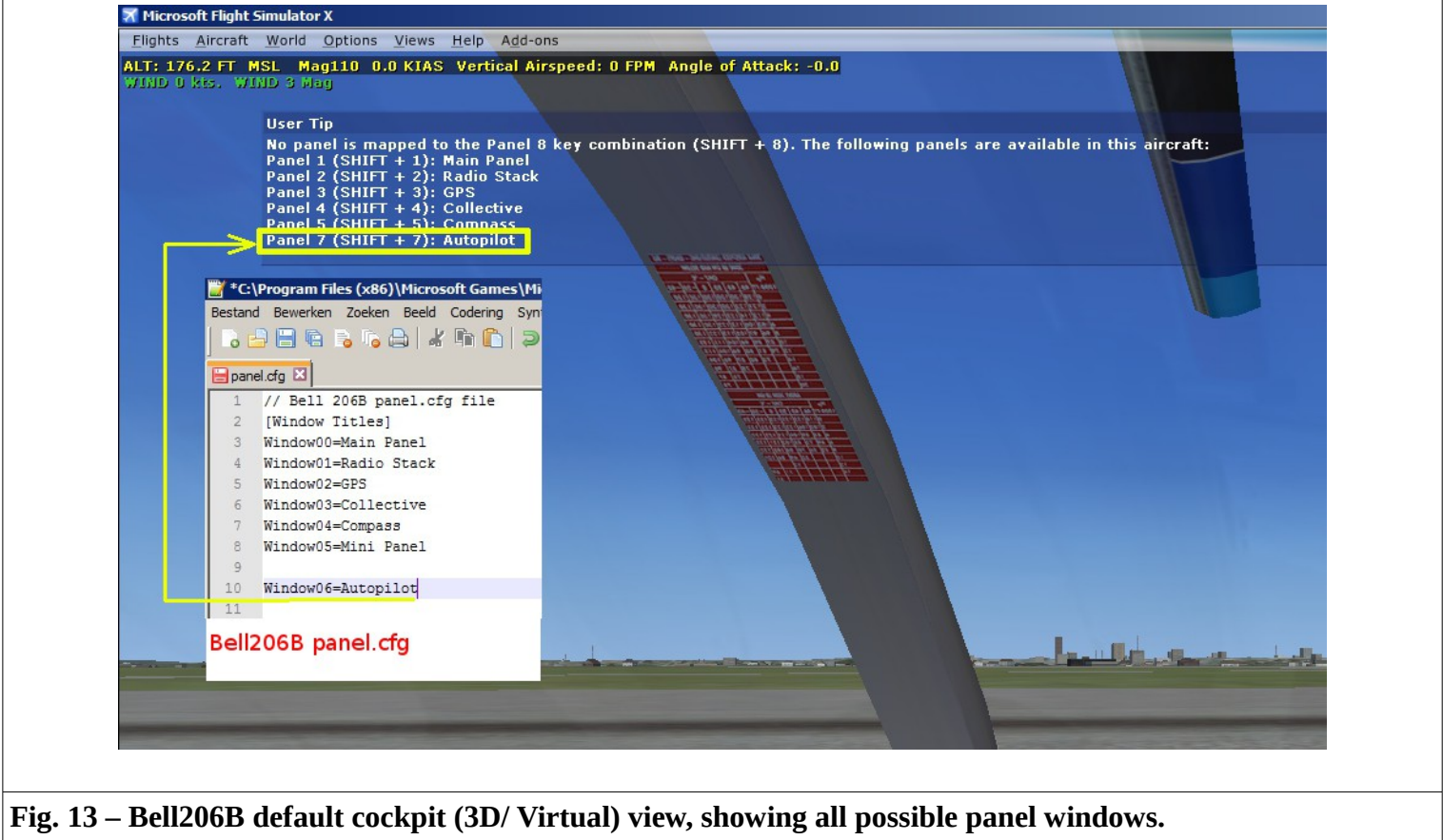


Fig. 13 – Bell206B default cockpit (3D/ Virtual) view, showing all possible panel windows.

Press [Shift][8] to see a list of all available cockpit panels on board.  
Press [Shift][7] to see the newly added HAP gauge on screen.

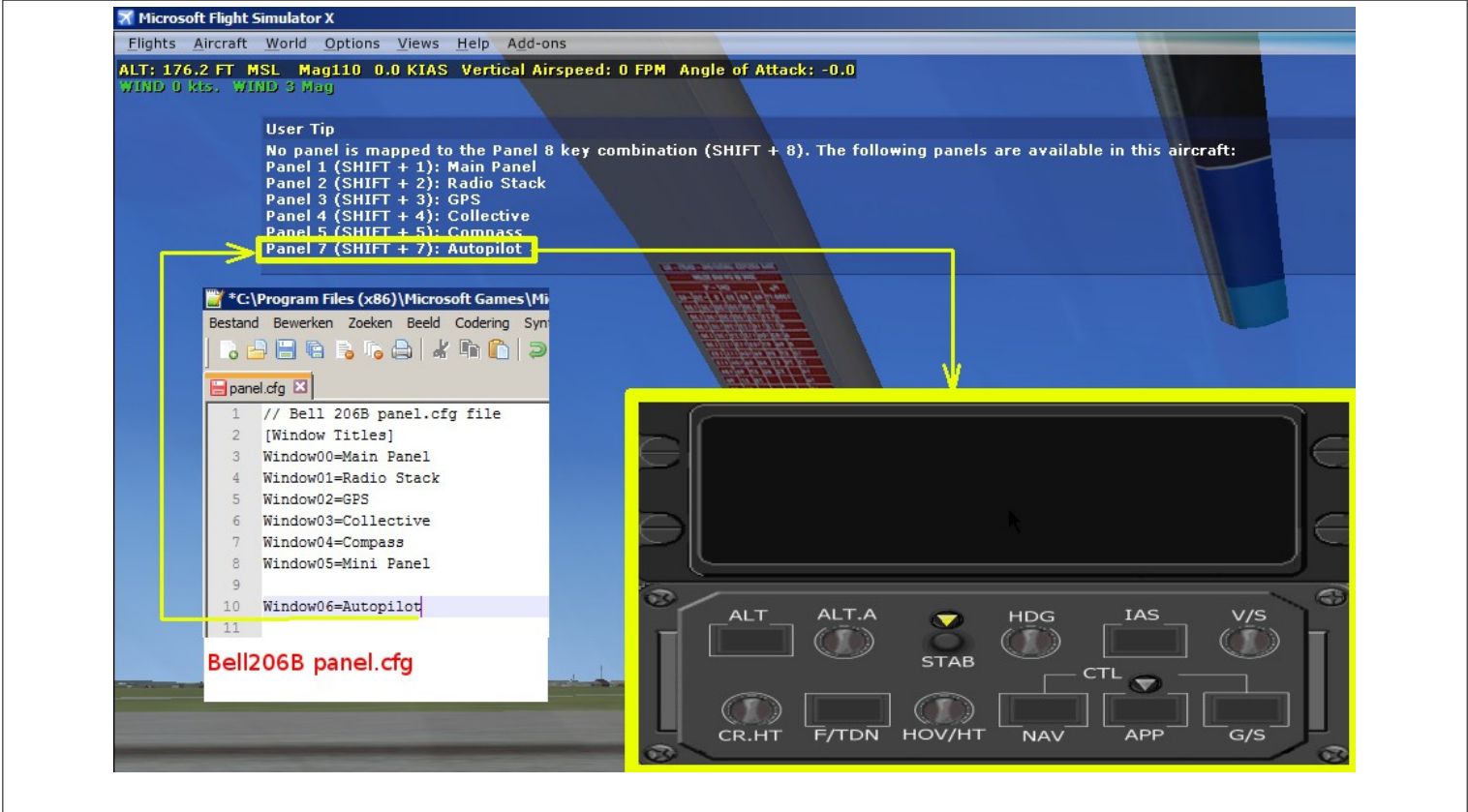


Fig. 14 – Congratulations! You have successfully added the HAP gauge to the BELL206B panel!

Now lets see if the HAP-gauge is working properly... But before that.. i'll explain some “helicopter basics” first to help you understand how-stuff-works-under-the-hood.



## **FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial**

### **7 - This is not a “how-do-I-learn-to-fly-a-helicopter” tutorial!**

Before we continue, I would like to point out that this is NOT a how-do-I-learn-to-fly-a-helicopter tutorial!!!!

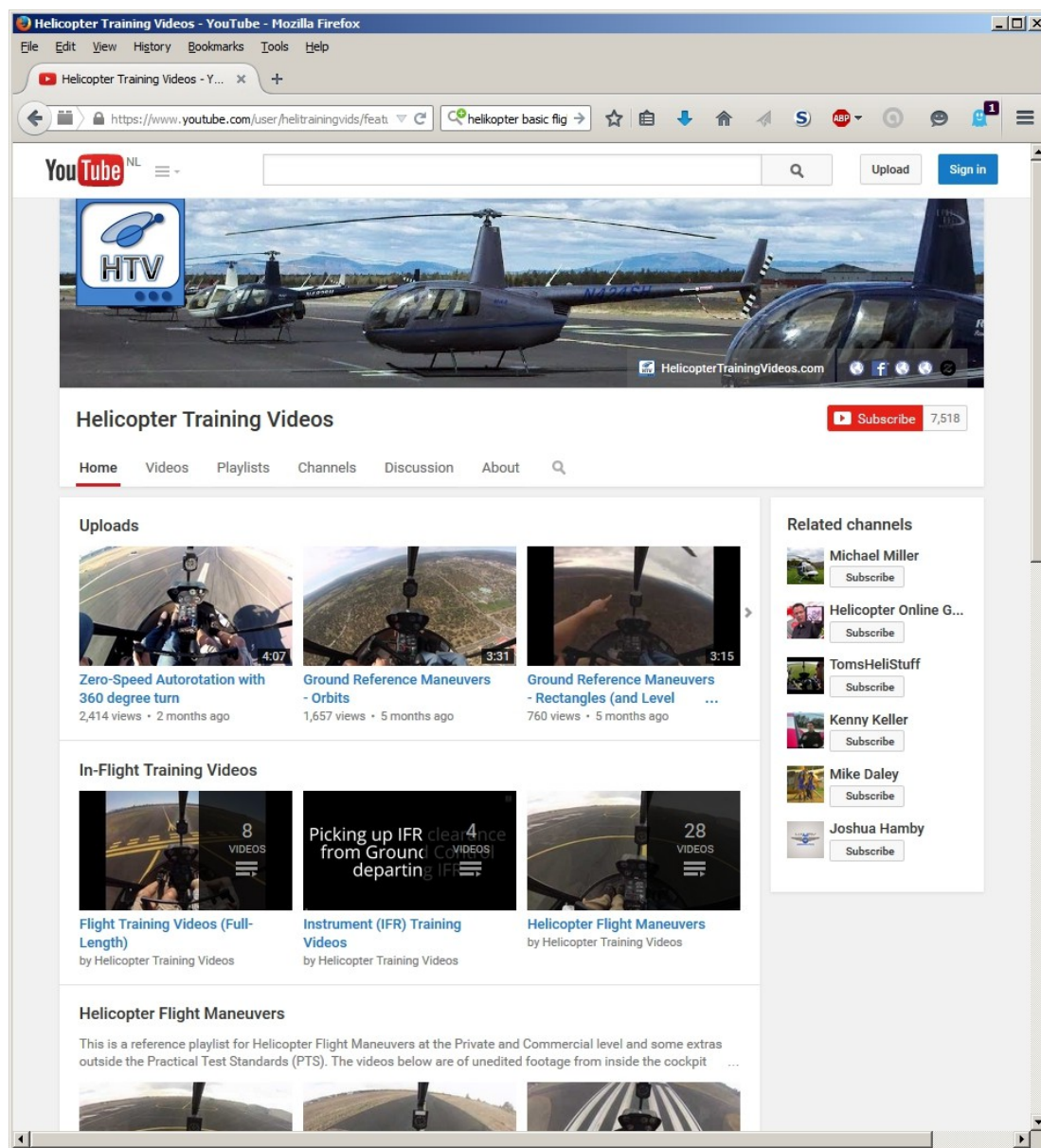
For those readers who have absolutely no previous (flight-simulator) helicopter flight experience, I hereby present you a couple of free Internet resources that you can use to learn the basics of helicopter flight (in FSX and in real-life).

Please read and watch these free resources, so you can understand the rest of my HAP-gauge tutorial better. These materials give you (a lot of) background information about all the stuff you need to know to fly a chopper.

This background helicopter knowledge helps you to understand how to operate the HAP-gauge to the max!

Are you ready? Let's go!

## FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial



**Fig. 15 – Helicopter Training Videos – By Jason Wilson and Jay Bunning of Bend, Oregon**

*Youtube channel description:*

*Helicopter Training Videos - FREE instructional helicopter videos (with emphasis on the Robinson R22 and R44 helicopters) by Certified Flight Instructors (CFIs) Jason Wilson and Jay Bunning of Bend, Oregon. Go to [www.HelicopterTrainingVideos.com](http://www.HelicopterTrainingVideos.com) to view more about each video subject, including an overview, references, related videos and relevant books along with ongoing blog entries related to Helicopter Training. [link below]*

***Covers Groundschool, Theory and practice in a real-life Robisons R22 and R44 Helicopters.***

Link to the Helicopter Training Videos Youtube Channel:

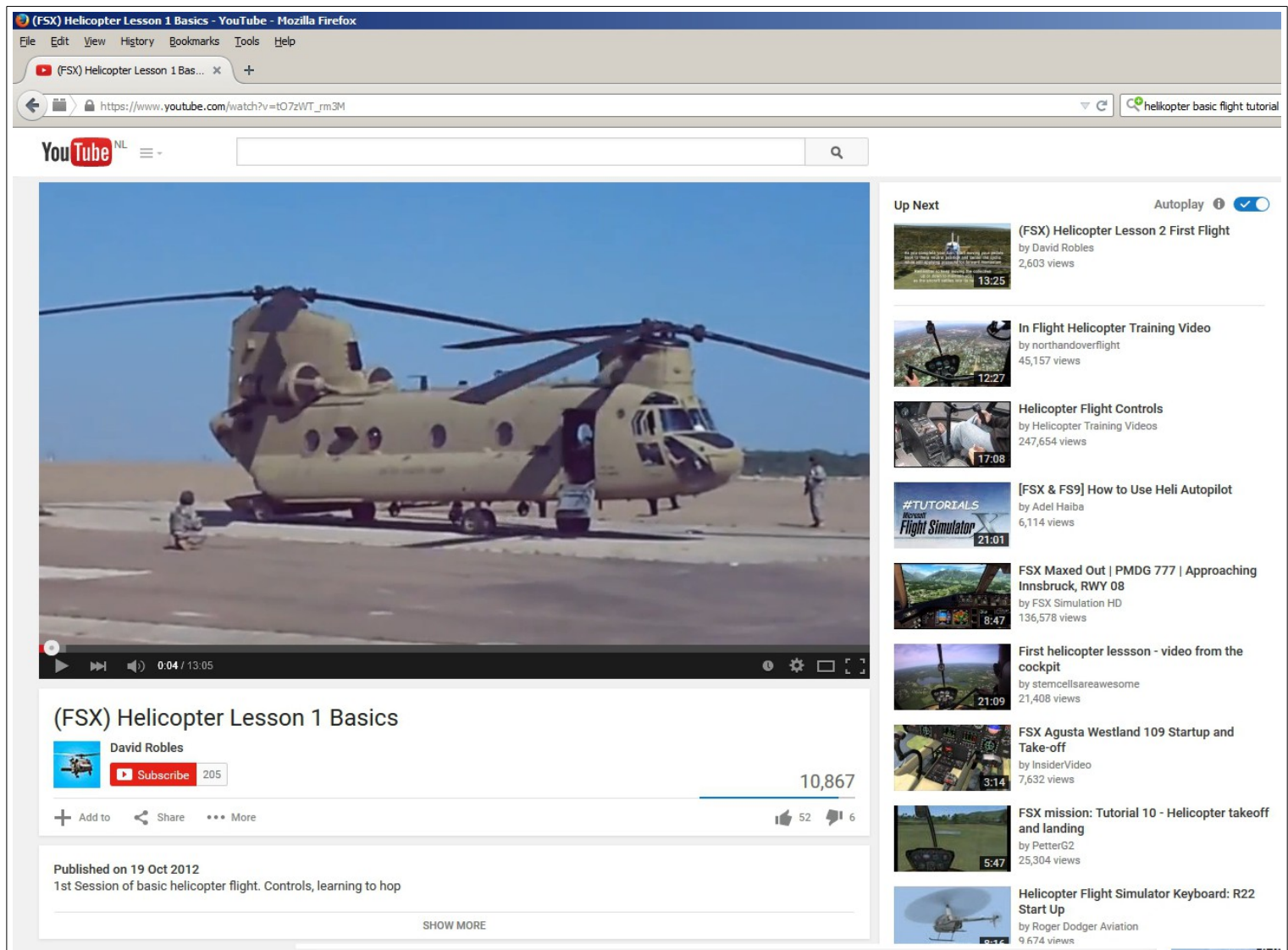
<https://www.youtube.com/user/helittrainingvids/>

Website of Jason and Jay – Helicopter Trainings Videos:

<http://www.helicoptertrainingvideos.com/>



## FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial



**Fig. 16 - David Robles, (FSX) Helicopter Lessons (1 and 2)**

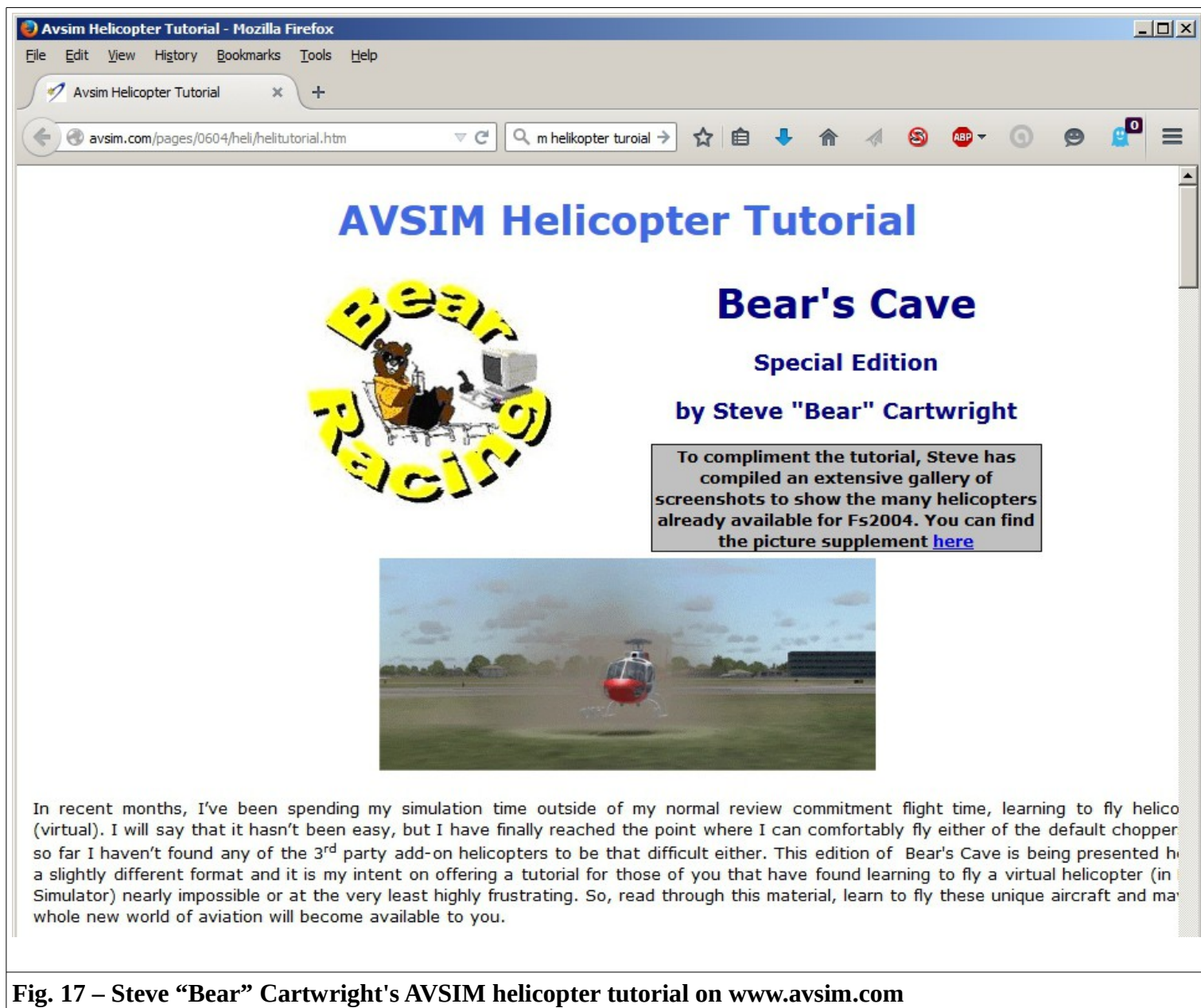
Links to the David Robles (FSX) Helicopter lessons on Youtube:

Part 1 - “Controls, learning to hop”

- [https://www.youtube.com/watch?v=tO7zWT\\_rm3M](https://www.youtube.com/watch?v=tO7zWT_rm3M)

Part 2 - “Cyclic, pedals, first flight”

- <https://www.youtube.com/watch?v=UekPi5qjP1o>

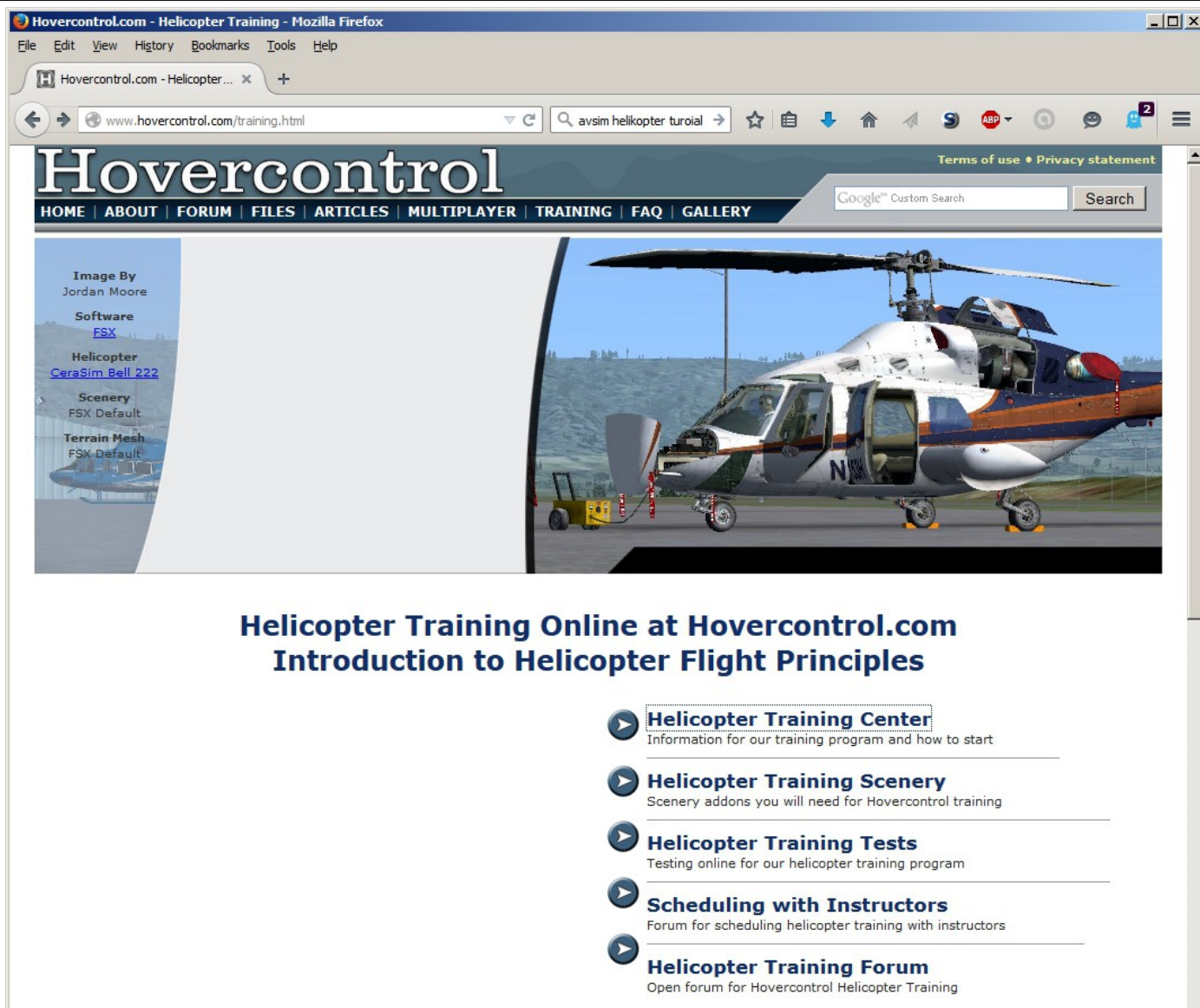


**Fig. 17 – Steve “Bear” Cartwright's AVSIM helicopter tutorial on [www.avsim.com](http://www.avsim.com)**

Link to the AVSIM Helicopter Tutorial:

<http://avsim.com/pages/0604/heli/helitutorial.htm>





**Fig. 18 – Hover Control – training section**

Link to the Hover Control website... The place to be for serious helicopter flightsim pilots.

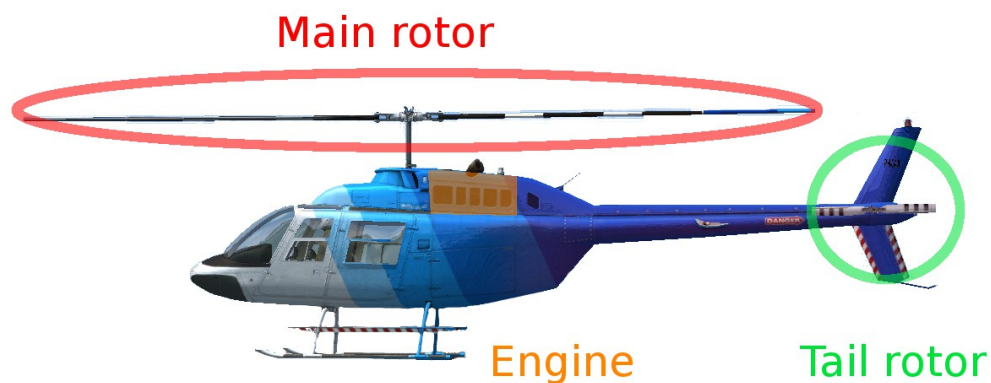
<http://www.hovercontrol.com>

All these fine and free videos and website tutorials will assist you in becoming a fine (FSX) helicopter pilot.

Before I continue with the HAP gauge, I first want to summarize the most basic helicopter related concepts from these tutorials. These concepts helps me to create a layer of “Basic helicopter understanding”, on which I can continue to build my HAP-gauge tutorial and trainings missions.



### 8 - Basic helicopter components and concepts summary:



**Fig. 19 - Helicopter main parts (main rotor, tail rotor, engine)**

#### **8.1 – Helicopter parts.**

##### **8.1.1 – Engine.**

The engine is the main power source that drives the main and tail rotor.

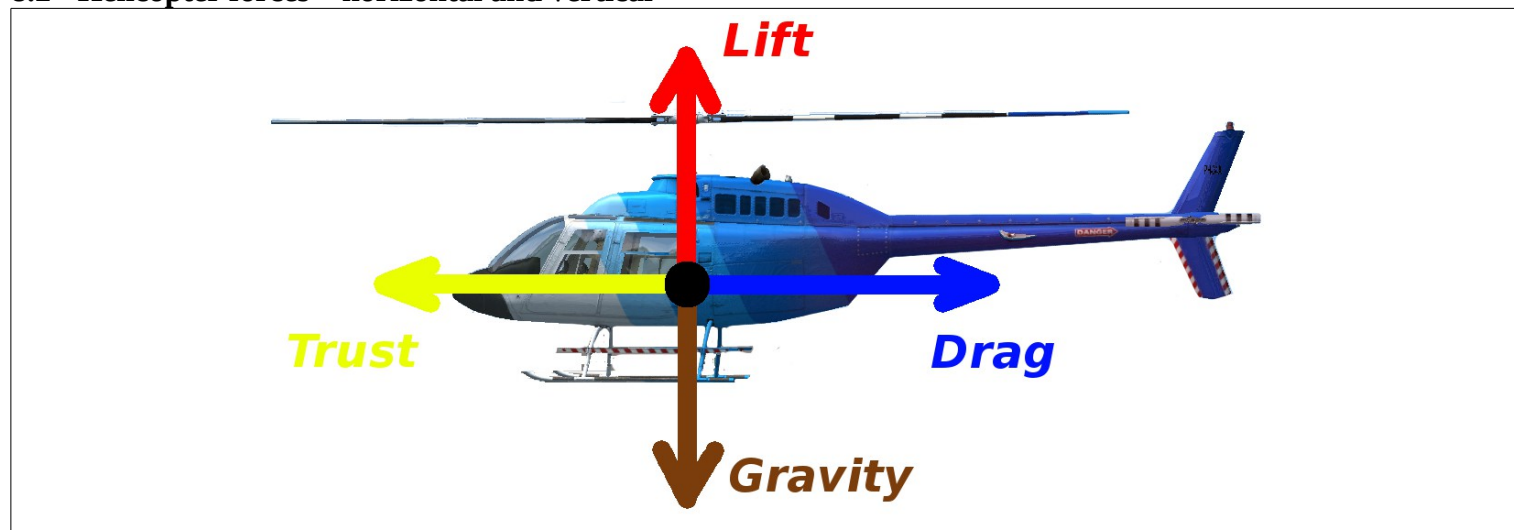
##### **8.1.2 – Main Rotor.**

The main rotor lifts the helicopter up in the air, helps her to hover and to descent her down to the ground.

##### **8.1.3 – Tail Rotor.**

The tail rotor keeps the helicopter flying in a straight line/enables the pilot to turn a sharp corner in flight direction.

### 8.2 - Helicopter forces – horizontal and vertical



**Fig. 20 – Helicopter forces (horizontal / vertical) – Lift vrs Gravity, Trust vrs Drag**

#### 8.2.1 – Lift.

“Lift” is the force generated by the main rotor, when its blades are pitched (more upwards) via the collective liver.

#### 8.2.2 – Gravity.

“Gravity” is a force generated by Mother Earth, pulling the helicopter back down to her surface.

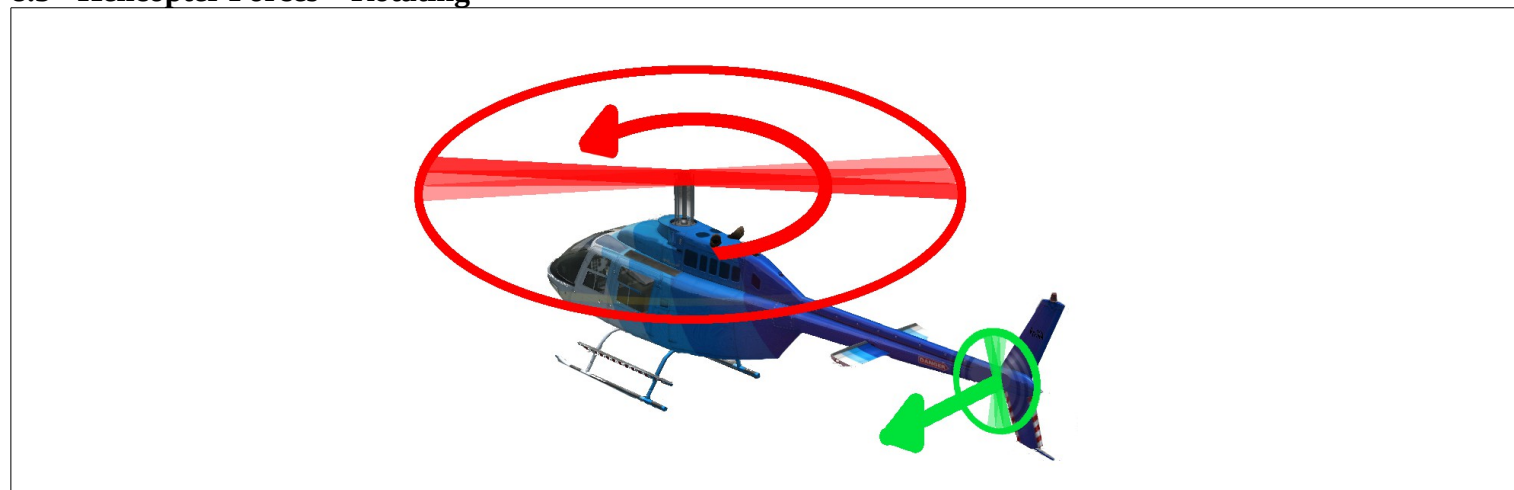
#### 8.2.3 – Trust.

“Trust” is the force generated by tilting the main rotor forward with the yoke.

#### 8.2.4 – Drag.

“Drag” is the force created by the helicopter “nose” bumping into air-molecules when flying forward.

### 8.3 - Helicopter Forces – Rotating



**Fig. 21 – Helicopter forces – Torque (Main Rotor) and “Counter Torque” (tail rotor)**

#### 8.3.1 – Torque.

This is a momental force that is generated when the main rotor is rotating around its vertical axis.

#### 8.3.2 – Anti-Torque.

This is force generated by the tail rotor, to counter-act the torque created by the main rotor.

- When these 2 forces are in balance with each other, the helicopter flies in a straight line.
- When these 2 forces are out of balance – the helicopter turns left/right around its vertical axis

## 8.4 – Helicopter flight controls

Yoke  
Collective  
Throttle  
Pedals



**Fig. 22 – Helicopter controls (Yoke, Pedals, Throttle, Collective Liver).**

Every helicopter uses 4 basic devices to control its flight behavior: *Yoke*, *Collective (liver)*, *Throttle* and *Pedals*.

Yoke



**Fig. 23 – Yoke.**

### 8.4.1 – Yoke.

The yoke controls the direction in which the main rotor is tilted (forward, backward, left side way, right side way). The direction in which the main rotor is tilted, is the way your chopper will be flying soon.

Pedals



**Fig. 24 – Pedals.**

### 8.4.2 – Pedals.

The pedals control the pitch angle of the tail rotor blades. The pedals enable the pilot to either:

- fly in a straight line,
- or make a turn to the left/right. (like a fixed wing aircraft)
- or make a turn on the spot around its main rotor / vertical axis. (as only helicopters can do).

### Throttle



**Fig. 25 – Throttle.**

#### 8.4.3 – Throttle.

The throttle controls the amount of Rotations-Per-Minute (RPM) of the helicopters engine.

The faster the engine rotates, the more power is produced and the more lifting-force is created by the main rotor.

### Collective



**Fig. 26 – Collective Liver.**

#### 8.4.4 – Collective (Liver).

The collective liver changes the pitch angle of the main rotor blades and thereby controls the amount of lift generated. The higher the pitch-angle, the more lifting-force is produced by the main rotor blades.

Now that we know all (static/ in-flight) forces that work on a helicopter, lets see how they are used to fly.

8.5 – Helicopter Movements.



Fig. 27 – Yoke Forward/Backward - Left/Right movement.

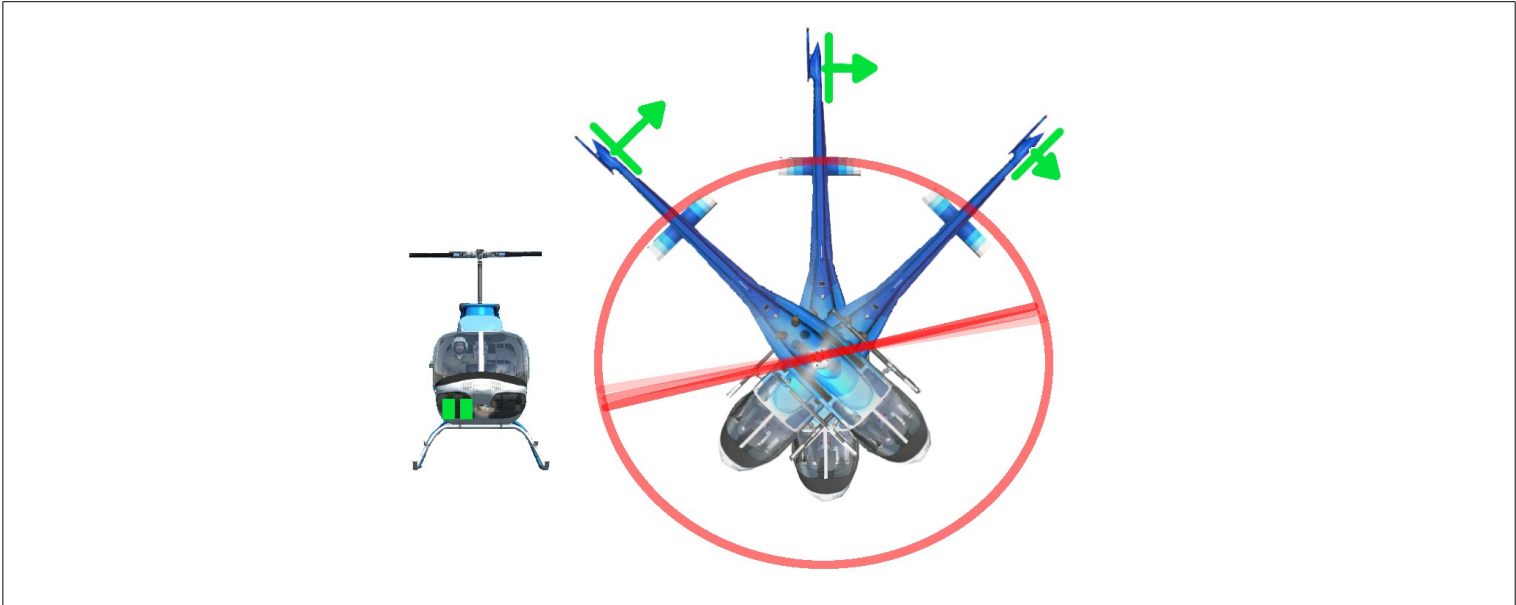


Fig. 28 – Pedal movement Left/Right movement.

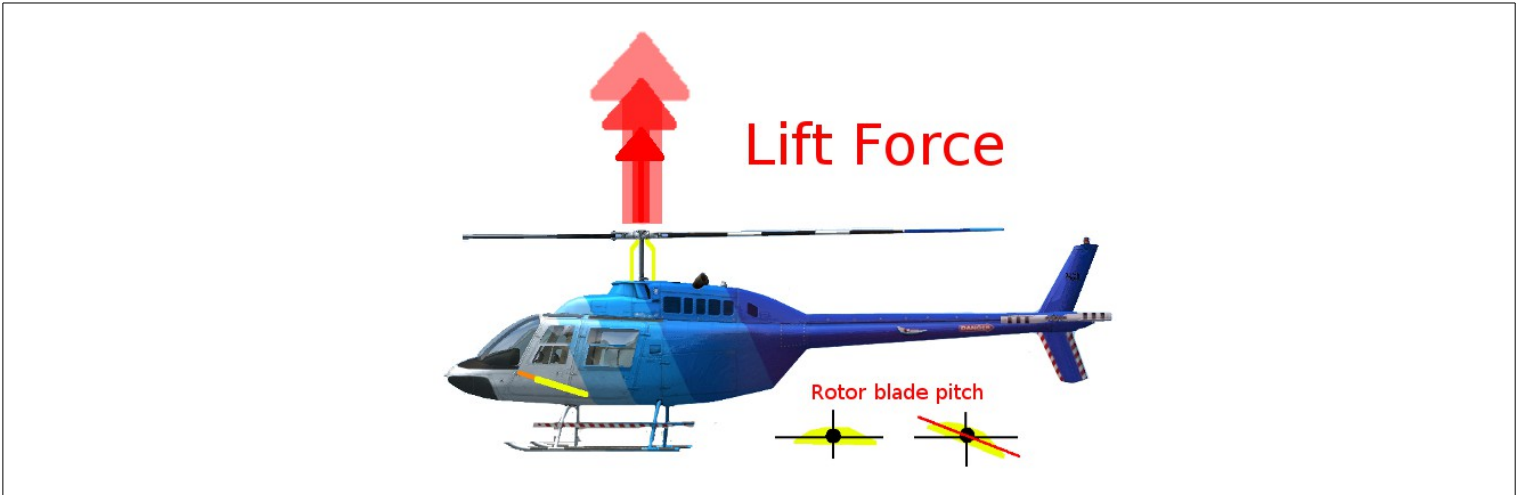
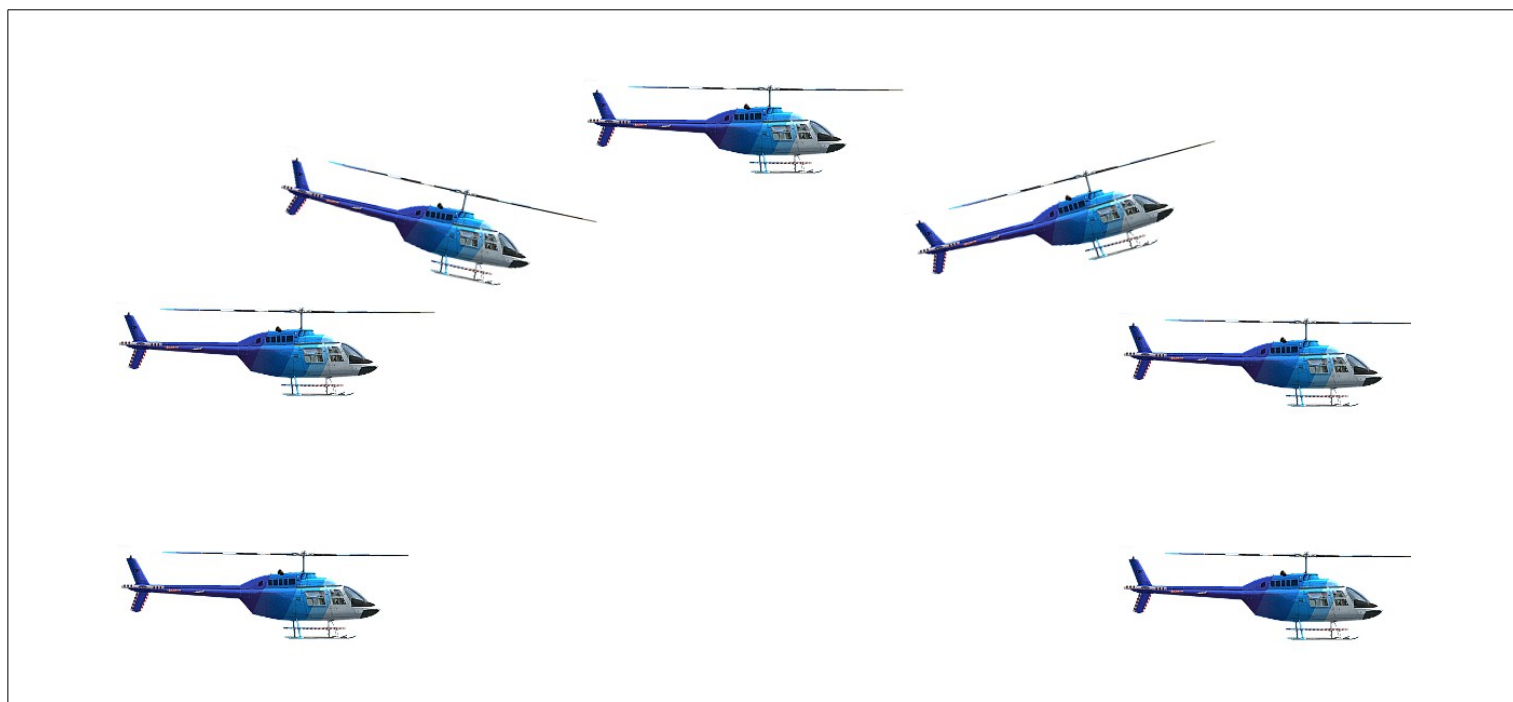


Fig. 29 – Collective lever movement = increase/decrease blade pitch = more/less lift force.

### 9 - The various stages of a regular helicopter flight.

In order to fully understand the operation of the HAP-gauge, we need to identify all the stages of a regular helicopter flight. The HAP-gauge has various “modes” to support each different stage of a helicopter flight.



**Fig. 30 – The various stages of a regular helicopter flight**

#### 9.1 - Parked on the ground, full stop.

Helicopter on the ground, with only the engine running at low RPM, no collective.

#### 9.2 - Transition from ground to hover.

Increased collective and increased engine RPM for more lift power.

Helicopter takes off vertically, without any forward speed, to “hover”.

#### 9.3 - Transition from hover to climb.

Helicopter leans forward to gain horizontal speed and climbs to cruise altitude.

#### 9.4 - Transition from climb to level (cruise) flight.

Helicopter stops climbing, moves almost horizontally on cruise altitude.

Collective is adjusted to gain/keep a certain speed and height.

#### 9.5 - Transition from level (cruise) flight to descent.

Helicopter leans backward to slow down in horizontal speed, while still moving forward.

Collective is adjusted/reduced to descent to “hover altitude”.

#### 9.6 - Transition from descent to hover.

Helicopter has no more horizontal speed.

Collective is adjusted to keep hovering (“hanging in mid-air, on the same altitude and direction”).

#### 9.7 - Transition from hover to full stop.

Helicopter has no more horizontal speed.

Collective is adjusted to descent back to ground level.

This is what you need to know about the various stages of a regular helicopter flight, since the Helicopter Auto Pilot gauge uses them to control the helicopter in any given phase of her flight.



10 - The HAP Gauge and its functions.

The Helicopter Auto Pilot gauge is a very complex piece of equipment, a true masterpiece of FSX gauge-coding, which is going to make your daily life as a chopper-pilot a lot easier, once you learn to truly master it.

10.1 - HAP Gauge functions overview:



Fig. 31 - HAP Gauge's front panel – Image(c) Dirk Fassenbender and Annti Pankonen

[STAB]	STAB(ilizer) ON/OFF switch. This is the master on/off switch of the entire HAP gauge.
[F/TDN]	Flight/Transition Up/Down switch. Used to tell the HAP gauge that you want to proceed with the next “stage-of-helicopter flight”
[HOV/HT]	HOVer Height setting knob. Used to set the Radar Altitude (in foot Above Ground Level, AGL) on which you want to hover.
[V/S]	Vertical Speed setting knob. Used to set the rate of climb/descent while in flight
[ALT.A]	ALTitude Aquire button. Use to set the Radar Altitude Height (in foot, ALG) to which the autopilot climbs the helicopter.
[ALT]	ALTitude LOCK. Used to switch on/off Altitude LOCK mode
HDG]	HeaDinG setting knob. Used to switch on/off Heading LOCK mode. Used to set the current heading/direction of flight.
[IAS]	Indicated Air Speed setting knob. Used to switch on/off Indicated Air Speed LOCK mode.
[CR.HT]	“Cruise HeighT” or Terrain following mode! Used to switch on/off Terrain Following mode! Used to set the current Radar Altitude Height (in foot, ALG).
[NAV]	Navigation Mode Knob. Used to switch on/off Navigation mode (to use a VOR beacon as flight-direction).
[APP]	Approach LOCalizer Arming knob. Used to switch on/off “Approach mode” to capture an ILS LOCalizer beacon.
[G/S]	Approach Glide/Slope Arming knob. Used to switch on/off “Approach mode” to capture an ILS GlideSlope beacon.

## **FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial**

As you can see, an impressive piece of machinery, that will assist you in your daily helicopter operations.

Enough helicopter basics and flight theory for now, lets climb on the pilots-seat of the Blue BeLL206B and learn things through my favorite method:

### **LEARN-ING BY DO-ING!**

**Lots and lots of hands-on-yoke-practice supported by a just little theoretic background.**



**Are you ready to fly with the Helicopter-Auto-Pilot gauge?  
Then proceed to the KMXF Helipad and climb on board of the Blue Bell206B!  
There are 5 training missions waiting for you, that help you to master the HAP-gauge.**

**End of this HAP-gauge installation tutorial**

## **FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial**

### **Appendix A – Background material on Helicopter AutoPilots.**

For those pilots who are interested in finding out more about how-helicopter-autopilots-work, I have included a number of links to online resources.

#### **THEORY behind helicopter autopilots:**

1. “No Hands” - Article on the basics of Helicopter Autopilots - written by Rob Bower.

[http://www.aviationtoday.com/rw/training/ratings/No-Hands\\_1458.html](http://www.aviationtoday.com/rw/training/ratings/No-Hands_1458.html)

2. “Understanding your (helicopter) Autopilot” article series 1,2,3,4 - Vertical Magazine

<http://www.verticalmag.com/news/article/understanding-your-autopilot-pt--1.html>

<http://www.verticalmag.com/news/article/understanding-your-autopilot-pt-2.html>

<http://www.verticalmag.com/news/article/understanding-your-autopilot-pt-3.html>

<http://www.verticalmag.com/news/article/understanding-your-autopilot-pt-4.html>

#### **REAL-LIFE TRAINING DOCUMENTS:**

3. US Army, Fort Rucker Alabama – Student handout about the “UH60 Helicopter AFCS” (21 pages, pdf)

<http://aasf1-ny.org/4-Standards/Documents/PUBLICATIONS/StudentHandouts/UH60%20AFCS.pdf>

4. US Army, Fort Rucker Alabama – Student handout about the “CH47 Chinook” AFCS (42 pages, pdf)

- <http://www.usarmyaviation.com/studyguides/index.php?folder=Documents/CH-47%20Chinook%20Specific&download=AFCS.pdf>

## Appendix B – APCF.CFG - Keycodes for bindings:

ESCAPE 1	N 49	PREVTRACK 144	AT 145
1 2	M 50	AT 145	COLON 146
2 3	COMMA 51	COLON 146	UNDERLINE 147
3 4	PERIOD 52	UNDERLINE 147	KANJI 148
4 5	SLASH 53	RSHIFT 54	STOP 149
5 6	RSHIFT 54	MULTIPLY 55	AX 150
6 7	MULTIPLY 55	LMENU 56	UNLABELED 151
7 8	LMENU 56	SPACE 57	NEXTTRACK 153
8 9	SPACE 57	CAPITAL 58	
9 10	CAPITAL 58	F1 59	NUMPADENTER 156
0 11	F1 59	F2 60	RCONTROL 157
MINUS 12	F2 60	F3 61	MUTE 160
EQUALS 13	F3 61	F4 62	CALCULATOR 161
BACK 14	F4 62	F5 63	PLAYPAUSE 162
TAB 15	F5 63	F6 64	MEDIASTOP 164
Q 16	F6 64	F7 65	VOLUMEDOWN 174
W 17	F7 65	F8 66	VOLUMEUP 176
E 18	F8 66	F9 67	WEBHOME 178
R 19	F9 67	F10 68	NUMPADCOMMA 179
T 20	F10 68	NUMLOCK 69	DIVIDE 181
Y 21	NUMLOCK 69	SCROLL 70	SYSRQ 183
U 22	SCROLL 70	NUMPAD7 71	RMENU 184
I 23	NUMPAD7 71	NUMPAD8 72	PAUSE 197
O 24	NUMPAD8 72	NUMPAD9 73	HOME 199
P 25	NUMPAD9 73	SUBTRACT 74	UP 200
LBRACKET 26	SUBTRACT 74	NUMPAD4 75	PRIOR 201
RBRACKET 27	NUMPAD4 75	NUMPAD5 76	LEFT 203
RETURN 28	NUMPAD5 76	NUMPAD6 77	RIGHT 205
LCONTROL 29	NUMPAD6 77	ADD 78	END 207
A 30	ADD 78	NUMPAD1 79	DOWN 208
S 31	NUMPAD1 79	NUMPAD2 80	NEXT 209
D 32	NUMPAD2 80	NUMPAD3 81	INSERT 210
F 33	NUMPAD3 81	NUMPAD0 82	DELETE 211
G 34	NUMPAD0 82	DECIMAL 83	
H 35	DECIMAL 83	OEM_102 86	
J 36	OEM_102 86	F11 87	
K 37	F11 87	F12 88	
L 38	F12 88	F13 100	
SEMICOLON 39	F13 100	F14 101	
APOSTROPHE 40	F14 101	F15 102	
GRAVE 41	F15 102	KANA 112	
LSHIFT 42	KANA 112	ABNT_C1 115	
BACKSLASH 43	ABNT_C1 115	CONVERT 121	
Z 44	CONVERT 121	NOCONVERT 123	
X 45	NOCONVERT 123	YEN 125	
C 46	YEN 125	ABNT_C2 126	
V 47	ABNT_C2 126	NUMPADEQUALS 141	
B 48	NUMPADEQUALS 141	PREVTRACK 144	

**Table 1 – Keycodes for the APCF.CFG / keyboard bindings file**

Source: [http://www.dirkfassbender.de/AFCP/key\\_commands.html](http://www.dirkfassbender.de/AFCP/key_commands.html)

## FSX Helicopter Auto Pilot (HAP) Gauge – Installation Tutorial

### Appendix C – A word of thanks for the following persons and products

This is an overview of all individuals i'd like to thank for their efforts. They have created wonderful free flightsimulator aircrafts and utilities and free downloadable (open-source) products, that – in my turn - enabled me to create this installation tutorial and the 5 training missions for you to enjoy.

#### 1. The creators of this wonderful Helicopter Auto Pilot for FS9/FSX.

Annti Pankonen	- HAP gauge programmer
Dirk Fassenbender	- HAP gauge designer
Plan-G	- VFR flight planning software
Firefox	- Internet browser
Gimp	- Open source graphic suite
Libre Office	- Free opensource office suite
Lightscreen	- Freeware Screen capture utility
US Army, Fort Rucker Alabama	- UH60 Trainings material
Airbus Eurocopter website	- Technical specs
Col..	

.. more to come ..