HELICOPTER: THE LOW COST TRAINING APPROACH

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Abstract

European Joint Aviation Authorities (JAA) have established the use of specific training devices for ab-initio training. The regulations have been prepared by JAR-STD and JAR-FCL working groups. Aeroplane regulations are already enforced and helicopter regulation is following the same process.

The French DGAC, the French Army Aviation, Proteus Hélicoptères[i] - a French ab-inito training school and Thales Training & Simulation in France have jointed their efforts to validate the basic principles and ensure the best adaptation of regulation to intended training.

The paper presents the device used and the experimentation conducted.

Basics

Historically helicopter simulation has always dragged behind the aeroplane simulation - specifically for ab-initio training and initial type rating - for many reasons including:

- the lack of appropriate regulations
- the lack of affordable devices of recognised quality i.e. good visual system with representative flight model
- the structure of operators: mainly small operators with less than 4 helicopters
- the cost of simulators compared to the operating cost of small helicopters that may be purchased for less than 300 K$.

Thinks are changing as these barriers are progressively shading off with:

- the emergence of new regulations defining specific designed for ab-initio training and for helicopters and granting training credits to low level devices
- the emergence of powerful PC-based computer configurations that allow for affordable realistic flight models and high-performance low cost visual systems
- The raising demand for efficient training to increase safety while decreasing training time. This makes the economical equation eventually viable.

As for aeroplanes, JAR-FCL 2 Flight Crew Licensing (Helicopter) defines the rules that apply to helicopter crew licensing. It allows for the use of helicopter FNPT - devices that are being described in the JAR-STD 3H document.

The technical requirements for helicopter FNPT are being defined by JAR-STD working group in close co-operation with JAR-FCL working group. They are now reaching the "final" approval step of NPA – Notice for Public Amendment – in the JAA legal process. It is intended to define three categories of FNPT instead of two for aeroplanes:

- FNPT I for IFR training
- FNPT II for VFR / IFR training
- FNPT III for special operations training

This is completed by MCC (Multi Crew Co-operation) option for multi-crew aircraft on FNPT II and III.

JAR-STD 3H main technical requirements for FNPT I - IFR are very similar to those of JAR-STD 3A

- A generic cockpit - sufficiently enclosed to avoid distraction - with instruments, equipment, panels, systems, primary and secondary flight controls sufficient for the training events
- Lighting environment for panels and instruments sufficient for the operation being conducted.
- Instructor station with view to flight crew members' stations, hard copy of map and approach plot, provision for position freeze and flight freeze, and Instructor controls necessary to perform the training task
- Representative generic flight / aerodynamics model with effect of change in aircraft attitude, sideslip, altitude, temperature, Gross Weight,

[i] HeliBourgogne at the time of experimental training

Centre of Gravity location and configuration, turbulence.
- Navigation / Communication equipment
- Representative control forces and control travels
- Complete navigational data regularly updated (5 airports/heliports)
- Engine & rotor sounds

Main technical requirements for FNPT II in addition to FNPT I

- The flight deck, including the instructors' and observer's stations, shall be enclosed.
- Circuit breakers when involved in procedures or malfunctions requiring or involving flight crew response.
- Crew members seats shall be provided with sufficient adjustment
- Generic ground handling and ground effects models to enable representative lift-off, hover and touch down effects to be produced by the sound and visual systems.
- Systems must be operative to the extent that it shall be possible to perform all normal, abnormal and emergency operations as required for the training.
- Instructors' station shall include dynamic flight path & approach plotting
- Aerodynamic modelling with effects of airframe/rotor icing, hover, auto-rotation, cross coupling effects
- Significant cockpit / flight deck / rotor sounds, responding to pilot actions
- A visual system (night / dusk and day) with **40 degrees Vertical by 150 degrees Horizontal Field-of-View** including adjustable cloud base and visibility, closely coupled to cockpit controls and instruments. A database with high resolution area to provide cues for take-off and landing.

Main technical requirements for FNPT III - special mission in addition to FNPT II are:

- Aerodynamic modelling to take into account visual database content (mountain, building)
- **60 degrees Vertical Field of View**
- Detailed high resolution generic visual databases with sufficient details to support:
- elevated heliports
- confined area

Depending on missions other features might be required such as Night Vision Goggles.

These devices are filling the gap between simple IFR trainers (Fig 1) and expensive Full Flight / Full Mission Simulators.

One might note that the definitions of these devices are very pragmatic keeping in mind the training context which is essential to fit the training requirements at the lowest cost. Some emphasis is given to the visual system that is considered as a "must" for efficient helicopter training and must include necessary details and sufficient Field-of-View. The old debate between collimated system and projected system has been closed off. It is almost recognised that for helicopter operations and near the ground training a projected system was totally adequate - especially in a single pilot configuration - and was rightly privileging Field-of-View at a lesser cost.

Being a member of the JAR-STD working group for helicopters, TT&S came to the conclusion that it would be beneficial to conduct some experimental training before a final decision is made on the definition of FNPT categories for helicopters and related training credits.

Figure 1 - 1980's EMY 150H IFR Trainer in use in French Army Aviation

The Helicopter Trainer used for the experimental training program

TT&S has developed an experimental device that is conforming to the main FNPT criteria.

The device is PC-based with three main components installed in a dark room:

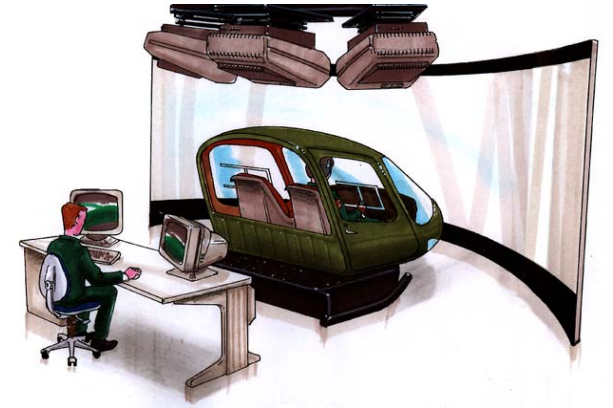

Figure 2 - FNPT artist's view

The cockpit is based on the Eurocopter Squirrel cockpit shell. The main Instrument panel is software simulated with an hardware overlay to allow for some button operations: like barometric setting e.g. This approach was intended to validate the principle of software simulated instrument display

For this experimentation, breakers and system operation had been omitted. Effort was concentrated on a realistic flight / rotor model capable of hovering and autorotations.

Figure 3 - Software instrument panel

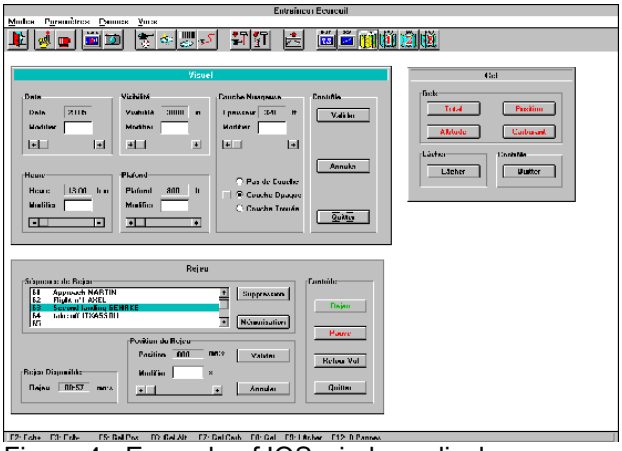

Figure 4 - Example of IOS windows display

The visual system image generator was representative of TT&S Space magic™ system in a 3 channels configuration offering 150 by 45 degrees Field-of-View.

Two databases were available to cover the whole training requirements ranging from "long range" navigation to specific helicopter flying skills.

One database was very similar to databases in use for airline training including cross-country navigation, specific airport area, etc.

A special emphasis has been placed on the second database content with sufficient details to allow easy and realistic low level VFR flight developed from a real south-west of France mountainous environment. The relief was derived from DMA altitude files enriched with realistic phototextures. As a consequence, this scene was offering additional capabilities such as takeoff and landing in unprepared area, landing in any position in the scene, take-off and landing in crowded area with trees, high voltage lines, cross roads, houses, etc.

Figure 5 - Typical visual system scene

The system was a direct projection system on a curved screen.

The Instructor Operating Station consists in two CRT controlled by one PC:

- One is displaying basic instructor controls on a windows based environment. It allows monitoring initialisations, weather and time conditions, visual scene content, replay operation, etc…
- The second is dedicated to instruments panel copy, map display, approach deviations display

The experimentation

The structure of the French CPL(H) course before the experimentation was subject to the following rules.

Modular course for PPL(H) holders: 150 flight hours reduced to 130 h for PPL(A) holders

Integrated Course: 100 hours for ab-initio reduced to 90 hours for PPL(A) holders and 70 hours for CPL(A) holders

The basis of the experimentation was a combination of trainer hours and flight hours on helicopter:

- 32 FNPT hours
- 70 flight hours of which 40 h with an instructor and 30 hours as single pilot in command.

The intended goal was to reach the level of training expected with the 100 flight hours that were required for obtaining of the helicopter Private Pilot License with a “blend” of synthetic training and actual flight.

An experimental ab-initio Integrated Course conducted by Proteus Hélicoptères - a French FTO has been designed. Students have been trained as follows under a very strict DGAC monitoring:

- Theoretical knowledge instruction for 4 months (1034 hours)
- Flight instruction during 7 months with a total of 132 hours including 100 hours on helicopter plus 32 hours on TT&S helicopter FNPT
- Skill test and issue of CPL(H)

Before the end of the training program, the trainees have been checked after 102 hours flight instruction by two DGAC Flight inspectors. The 102 hours were split as follows:

FNPT	Hughes 300 (Piston)	Alouette II (Turbine)	Total
32 h	62 h	8 h	102 h

This breakdown was selected to confirm trainee flying skills after a training sequence similar to the one intended in future courses. The 32 hours FNPT have been spent as follows:

Basic Flight	13:25 h
Navigation	5:00 h
Low altitude navigation	3:00 h
Unprepared site landing	4:00 h
Instrument flight	5:00 h
Night flight	2:00 h
Total	**32:25 h**

The content of the check was close to the content of the skill test for the issuance of CPL(H) including:

- Cross country flight
- Unprepared site landing
- Ground work
- Autorotations

During this check each student flew 1.5 hours on Alouette II turbine helicopter with 4 people on board: 2 flight inspectors, the instructor and the trainee.

At this intermediate check, it has been confirmed that all trainees had a level of experience that could be compared favourably with the level reached by trainees following the standard 100 hours training program on helicopter only.

The trainees have demonstrated the ability to maintain control of the helicopter at all time despite a trend to overcontrol due to the limited experience of Alouette II helicopter.

Autorotation exercise was very well taken in with smoothness, accuracy and very much less stress than in the helicopter.

Emergency procedures were also well taken in and the trainees demonstrated good judgement and airmanship.

The introduction of this trainer in the training program with:

- a preliminary theoretical preparation
- trainer hours interlaced with rotorcraft hours

- organised debrief / preparation and co-ordination between flight and trainer

clearly improved the quality of training. It also contributes to limit the usual cost overrun by limiting the number of actual flight hours to the minimum required by the regulation.

The collaboration between the French DGAC, Proteus Hélicoptères Training school and TT&S has been very productive to clarify the technical definition and the operation of an FNPT trainer. As a result of this experimentation conducted in full co-ordination with the French DGAC, all four trainees have passed the in-flight evaluation.

A similar program was conducted with the French Army Aviation school (EA-ALAT) in Dax and this led to similar conclusions. The objective was to assess the real benefits of trainer usage in basic training. The experimentation was limited to 4 trainees followed by 2 instructors and one officer. The training course was based on the existing EA-ALAT training program. This program was complemented by 19 hours on the trainer.

The traditional advantages of simulation i.e. initialisation, replay freeze that permit large time saving and place the Instructor in ideal conditions for teaching were recognised. On the other hand the advantages for the trainee - lack of stress and self-confidence - were also evidenced especially

- during the basic flying skills learning process (control co-ordination, hover, take-off & landing) and
- during the emergency situations management learning

Conclusion

The experimentation has undoubtedly demonstrated that **low cost simulation was possible for helicopters** too - provided that visual system quality is sufficient. The realism in simulation was sufficient to allow for correct transfer of training. Instructors and trainees are getting the full benefit of simulation in terms of quality and …cost.

Since June 8th 1999, a new Flight Training Program has been approved by the French DGAC based on the use of Synthetic Training Devices. This new training program is restricted to Integrated Courses conducted in FTO. It allows for **110 hours** reduced to 100 hours for CPL(A) holders **of which 15 hours may be conducted in an FNPT.**

This is a good step forward. We are convinced – with several members of the European Helicopter Association [i] - that the number of hours allowed on FNPTs could / should be further increased in accordance with the result of this experimentation. A total of **30 to 35 hours seems a realistic objective**.

FNPT are generic devices and it is an approach that must be kept in mind… and in the design of the corresponding devices. However, the numerous contacts we had – at Thales Training & Simulation - since this experiment have also demonstrated that **type specific training** was quite possible using the same low cost approach. This has been the choice of the French Air Force and the French Army Aviation with the recent procurement of 5 Fennec type specific devices. We are convinced that the same approach may be applied to a whole range of helicopter both civil and military.

About the author

JF Erismann joined TT&S in 1974 as a software engineer specialised in Flight, aerodynamics and automatic flight control systems. With an experience in commercial aeroplane simulators, he was a member of various international working groups (IATA, IQTG,…) and has been the secretary of the JAR-STD aeroplanes working group. After three years at TT&S in UK, and various position in Customer Support organisation, he is now a senior Sales & Marketing Manager in Helicopter Business Development in TT&S organisation.

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[i]European Helicopter Association - Member of JAR-STD and JAR-FCL Working Group and the Groupement Français de l'Hélicoptère (GFH).