

Task 16: Cues (Visual and Instrument) Needed for Helicopter Approaches to a Hover (Beringer)

Program Manager:

Tom McCloy, Ph.D., AJP-61, (202) 267-7167

Task Stakeholders/Sponsors

Mike Webb, Helicopter Instrument Criteria, US ICAO IFPP Member, AFS-420, (202) 385-4603,
Clark Davenport, Flight Test Analyst-Cockpit Integration/HF, Southwest Region - Aircraft Certification Service,
Rotorcraft Directorate, ASW-112, (817) 222-5151

Performing Organization:

Dennis B. Beringer, Ph.D., AAM-510, (405) 954-6828, dennis.beringer@faa.gov

University/Contract Performing Organization:

TBD

Project Start Date: 9/1/2009

Anticipated End Date: 12/31/2010

Requirements Statement	
Operational Shortfall or Knowledge Gap	Standard and procedures developed to date regarding helicopter approach to a hover have been for guidance to a missed approach point or decision height approximately one half mile from the helipad. In the future the helicopter industry, as represented by Sikorsky and Eurocopter, has expressed plans to request approval for instrument approaches to very low speeds and altitude minima. Current standards are limited to approximately a 200-foot AGL decision altitude at 70 knots ground speed.
Benefit in Closing the Shortfall or Gap	To be able to achieve lower minima (resulting in placing the aircraft closer to the helipad) and to make full use of new navigation capabilities, aircraft will need to slow from the current minimum speeds and actually transition from a forward phase of flight to a hover phase of flight. The FAA Flight Standards and Aircraft Certification lines of business need to know what cues will be required, both internal to the aircraft (instrumentation and displays) and external to the aircraft (direct vision, approach/landing-direction lights, other supplemental visual cues), to support the transition from translational flight to hover flight so that the requirements can be incorporated into the aircraft/avionics certification criteria and the operational approval criteria.
Description of the Desired Product	Guidance on the types of perceptual cues a helicopter pilot uses during transition from forward to hover flight.
Schedule	Provide a summary report that details the perceptual cues a helicopter pilot uses during transition from forward to hover flight.

Research Objective

Establish visual and instrument cues (both for momentary flight control and for navigation) required to support a helicopter approach from the helicopter minimum instrument approach speed (V_{min}) to a hover.

Establish how we should provide pilots with aircraft performance and position cues via cockpit displays and external visual cues (helipad approach lighting, for instance) that will assist them in safely decelerating the aircraft while remaining within the approach parameters.

Background

In the future the helicopter community would like to take advantage of high-integrity navigational signals to support vertically guided approaches to very low minima, possibly to a hover in low-visibility conditions. A key limiting factor for helicopter approaches is a known deceleration rate not to be exceeded during transition from translational flight to hover flight. Current standards set a decision altitude (DA) for continuing the approach at 200 feet AGL at a ground speed of 70 knots. To be able to achieve lower minima (resulting in placing the aircraft closer to the helipad) and make full use of new navigational capabilities, the aircraft will need to transition from the current minimum speed at DA to a hover over or very close to the desired landing zone.. It is important to understand what cues may be necessary to allow the pilot to perform this transition without full access to the normal direct visual cues present in the outside environment that would be present in VMC (visual meteorological conditions).

Previous Activity on this Task

A small body of knowledge, although not conclusive, exists which was conducted to gain a better understanding of what visual and other cues pilots use to maintain a hover. There is also a body of information relative to visual and proprioceptive cues used to maintain translational flight at the usual cruise airspeeds. However, what is needed is a clear understanding of what cues are used to achieve the transition from descending cruise flight to stabilized hover.

Proposed or Planned Research

Two phases of investigation will be conducted to assess the impact of various cues on the effective performance of approach/descent, transition, and hover flight in helicopters. The first phase will summarize the extant literature relating to the use of various cues during the performance of these flight tasks, and include interviews with subject-matter experts (helicopter pilots and helicopter flight instructors) to further refine the findings. This will be followed (as deemed appropriate as a result of the literature review and interviews) by empirical studies designed to examine the extent of the influence of major variables that can be successfully manipulated within the context of flight simulation. The studies will focus on visual and instrument cues (both for momentary flight control and for navigation) required to support a helicopter approach from the helicopter minimum instrument approach speed (V_{min}) to a hover. The study will compare the effects of different displayed-information content and formats on pilot awareness of aircraft performance and position and ability to maintain control/complete transition. Inasmuch as flight-control instrumentation is often placed lower in the visual field in helicopters than in fixed-wing aircraft due to the requirements for pilot visual surveillance outside the cockpit during descent/approach, hover-taxi, and landing, reorganization of the traditional arrangement of instruments or replacement with integrated displays may be necessary to minimize pilot eye movements while transitioning between instruments and the outside environment.

Research Question(s)

What are the visual and instrument cues (both for momentary flight control and for navigation) required to support transition from approach to hover/landing, beginning at DA and minimum approach speed and culminating in a hover over the intended landing zone, in both VMC and IMC?

How should we provide pilots with aircraft performance and position cues via cockpit displays and external visual cues (helipad approach lighting, for instance) that will assist them in safely decelerating the aircraft within the approach parameters?

Technical Approach

Current Year

The first phase will summarize the extant literature relating to the use of various cues during the performance of these flight tasks, and include interviews with subject-matter experts (helicopter pilots and helicopter flight instructors) to further refine the findings.

An empirical study focused on visual and instrument cues (both for momentary flight control and for navigation) required to support a helicopter approach from the helicopter minimum instrument approach speed (V_{min}) to a hover will be conducted. The study will compare the effects of different displayed-information content and formats on pilot awareness of aircraft performance and position and ability to maintain control/complete transition.

Out-Years

Empirical studies designed to examine the extent of the influence of major variables that can be successfully manipulated within the context of flight simulation.

Air Traffic Resources Required

None

Information Technology Resources Required

Coordinate Out the window scene generation equipment upgrade

Calibration

None

FY10 Milestone Schedule		
Description	Proposed Start Date	Proposed Completion Date
Initiate contract to assist with the literature review and interviews of SMEs	FY10 Q1	FY10 Q2
Summarize literature relating to the use of various cues during the performance of these flight tasks	FY10 Q2	FY10 Q3
Interviews with subject-matter experts (helicopter pilots and helicopter flight instructors) examining perceptual cues	FY10 Q2	FY10 Q3
Design a study that compares the effects of different displayed-information content and formats on pilot awareness of aircraft performance and position and ability to maintain control/complete transition	FY10 Q3	FY10 Q3
Collect data from empirical study	FY10 Q3	FY10 Q3
Analyze results and write a draft report	FY10 Q3	FY10 Q4

FY10 Deliverables		
Description	Proposed completion date	Actual completion date
Summary report of literature and details the perceptual cues a helicopter pilot uses during transition from forward to hover flight.	FY10 Q4	
Draft report of empirical study comparing the effects of different displayed-information content and formats on pilot awareness of aircraft performance and position and ability to maintain control/complete transition	FY11 Q1	