Notice of Urgent Warfighters Requirement – 15 August 2006

Technology Solutions to Resolve Helicopter Brownout Situations in Tactical Environments

Source: Air Force Research Lab

Overview

The U.S. Air Force Research Laboratory (AFRL) has requested assistance from the Defense Alliance of Minnesota in its urgent requirement to locate technology solutions to resolve helicopter brownout situations in tactical environments. AFRL has a 6-month requirement to achieve a 60% solution. Potential providers should therefore focus on rapid, potentially unconventional concepts that will be non-competitively bid in the near term.

Due to increased U.S. military helicopter operations in desert regions of the world, helicopter brownout has led to loss of life and mission degradation, and costs of approximately $100 million a year for the Department of Defense in terms of equipment damage and aircraft loss. Three out of every four allied coalition helicopter mishaps in the Afghanistan and Iraq theaters have been caused by brownout conditions.

This notice is meant to raise awareness among Defense Alliance membership about the critical nature of the problem, and to rapidly solicit ideas for potential solutions. AFRL desires to address this problem with the utmost speed, and is therefore focused on mature technology that can rapidly and seamlessly integrate with existing aircraft systems and current tactics.

Definition of the Problem

Brownout occurs when the rotor downwash of a helicopter disturbs the surface of the approach and landing area to a point that the sand, dirt and debris that becomes airborne causes loss of pilot visual reference with the ground prior to touchdown. This can also occur in snow conditions (known as whiteout). The loss of pilot visual reference to a fixed point inevitably causes some degree of unintended pilot or aircraft-induced drift away from the intended line of approach and landing.

Given the top heavy nature of most helicopters and the aerodynamics of their rotor discs while the aircraft is in close proximity to or is on the ground, landing with lateral drift of any kind can cause the aircraft to be damaged, or to roll over, particularly if combined with a pivot point (such as a rock, or rut) upon touchdown. Military helicopters operating in a tactical environment, especially during combat operations, are more likely to encounter risks associated with brownout due to: rapidity of maneuver (including approach, landing and departure) to mitigate enemy fire risk, or to preserve the element of surprise; nighttime operations, with or without night vision devices; unfamiliarity with landing zones; and heavy gross weights due to combat

payloads and high ambient temperatures, both of which can seriously degrade aircraft performance, and can even restrict hover capabilities.

It should be noted that brownout conditions occur to varying degrees for a given landing zone depending on the aircraft in use (single versus tandem rotor), its configuration (weight), tactics being employed (rapidity of approach and landing, accompanying aircraft, time on deck, etc.), and environmental conditions (humidity and/or rain, day versus night, and temperature and density altitude). In general, however, it should be assumed that helicopters will begin to experience brownout during an angled, no-hover approach to landing at approximately 1-2 rotor diameters above ground level (50 – 150 feet), with the most serious conditions being experienced at approximately 50 feet and below. As the aircraft slows, the thrust vector of the main rotor disc becomes more vertical (as the aircraft pitches its nose up to decelerate), and the thrust becomes greater as power is added to sustain a hover, or near-hover condition prior to landing. Also, the rotor thrust tends to circulate down, out, then back up and down again through the rotor disc just prior to touchdown. Therefore, all of these conditions combine just prior to landing, the most critical time for the pilot to eliminate lateral drift.

Finally, a helicopter *takeoff* may also cause brownout due to rotor wash. However, the aircraft is accelerating away from the dust and, and lateral drift is less of a safety factor except for obstructions in close proximity to the line of departure. The pilot is therefore able to set a power and nose attitude and fly the aircraft safely out of a zone, and not be overly concerned with induced drift due to restricted visibility. The majority of mishaps related to brownout conditions have occurred during landings.

Tactics in Use by U.S. Military Helicopters

Various situational rules of engagement, lack of access to classified information by contractors, specific tactical and environmental situations, mission requirements, aircraft specifics, and service differences all combine to make it difficult to generalize the tactics used for helicopters experiencing brownout in a tactical environment. However, for purposes of proposals, the following should be assumed as a general rule:

- Speed of approach is critical since the element of surprise is normally desired, or the need to evade or limit exposure to enemy fire is expected. This may preclude a flyover of the zone to reconnoiter its physical characteristics and best approach and departure path prior to landing in it

- The approach will most likely be an angled glide path (approximately 30-75 degrees from the horizontal). This is likely the case because it gives the pilot the best ability to see the zone prior to landing in it, and is the normal precursor for a “no hover” landing (see below). It also much preferred to a more vertical descent to avoid the rotary-wing aerodynamic phenomenon called “power settling,” in which a helicopter can begin an accelerated and uncommanded descent into its own downwash, for which recovery requires hundreds of feet of altitude

- The landing will most likely be to a “no-hover.” Because most at-risk tactical landings will be accomplished during hot or high density altitude conditions, and military helicopters laden with fuel and combat troops and/or supplies can assumed to be heavy, limiting their hover abilities, the angled glide path will most likely end in a “no hover” landing. Extended hovering also exacerbates brown out conditions prior to landing.

A “no-hover” landing may also be required if the tactical situation calls for a landing out of the prevailing wind line, further limiting the aircraft’s hover capabilities

Background and Existing Proposals

Those familiar with military helicopters may know that organic aircraft technology currently exists to provide pilots with drift cues during limited or zero visibility environments. Naval aircraft have operated for years, for instance, with Doppler radar emitters and radar altimeters that feed cockpit visual displays to counter drift during approaches and hovers for night, over water rescue and anti-submarine active dipping sonar operations.

Doppler and radar altitude systems, however, are ineffective in heavy brownout conditions due to the reflective nature of the sand and debris, particularly the fine, powder-like sand found in the desert environment of the Middle East. Similarly, night vision systems are hampered by lost visual cues that they require to be effective.

AFRL is just one agency that has examined and called for solutions to brownout over many years. As such, there are existing solicitations and proposals to solve the brownout problem. None to date, however, have addressed the ability to rapidly integrate an effective technology, or would require significant and unacceptable changes to the tactics of helicopters in a combat environment. Examples include:

- Matting that covers the landing area and its problematic dust: Examples include Envirotac II (better known as Rhino Snot ™), a substance that soaks into the ground and produces a ¾ inch prepared surface, which has been used extensively by U.S. forces in the Middle East; and ROLA-Trac ™, rolled matting used since Bosnia operations began. While these technologies are widely accepted and used in theater, both of these solutions require time and ground personnel to prepare the zone and are therefore problematic in a tactical situation

- Ultra Wide Band Radar Synthetic Aperture Rader (UWB SAR): An Army Small Business Innovation Research (SBIR) solicitation released in 2005 (A05-049) called for UWB to address brownout, wire strike avoidance and minefield detection. Aircraft capabilities to achieve all three of these issues requires a lengthy development and aircraft integration time, and would likely not meet the timeline of this solicitation. Note that the AFRL call only requires that the brownout issue be addressed

- Global Positioning System (GPS): Despite advances in GPS, and its commercial and military uses in the aircraft approach system worldwide, GPS does not allow adequate discrimination in positioning cues that can ameliorate drift during terminal helicopter landing in tactical environments

- Re-designed rotor blades: Traditional helicopter blades push dust toward the fuselage, creating brownout. The EH-101, a European helicopter, has blades designed to push dust away from the fuselage, improving visibility for the aircrew. This approach may have promise, but would be dependent on a re-design by the aircraft manufacturers of current U.S. military helicopters

- Better discrimination of landing zone suitability through remote sensing of soil and surface characteristics: The Naval Postgraduate School is working on this approach, but it would limit current tactics by extending the time required for landing zone selection,

and could limit the number of available zones when the tactical situation may not allow such careful discrimination based on brownout tendencies

Proposal Assumptions

Given the nature of AFRL's request, and the acute nature of the need for U.S. armed forces, the following are assumed of any suggested technology solutions to helicopter brownout:

- Speed of integration is essential: the technology must be rapidly adaptable as a solution, rather than show promise as a lengthy research project

- The technology solution should not significantly limit the existing tactical requirements and limitations of combat helicopter operations, to include speed, maneuverability, airworthiness, weight, space and relative stealth before and after landing

- Technology solutions need not be limited to organic aircraft technologies. Suggested solutions may include "prepping" the landing zone, for instance, in order to diminish the degree of blowing sand and debris that limits visibility

- Strong consideration should be given to the impact of a suggested technology on the logistic requirements to keep if functioning in a tactical environment overseas

Deadline and Method of Proposal Submission

Defense Alliance members that desire to submit an initial rough proposal for the AFRL's helicopter brownout problem are urged to submit white papers via the Defense Alliance of Minnesota by email (three emails listed, below) using Microsoft Word or PDF attachments, no later than ***06 September 2006***. The following elements should be included at a minimum:

- Introductory paragraph briefly describing the technology and its application

- Description of the maturity of the technology involved, current application (if any) and assessment regarding technical time requirements to adapt it to tactical military helicopter operations (excluding the normal government acquisition process)

- Rough estimated cost of the technology as adapted for use, including a brief assessment of the logistics required to keep the system operational in a tactical environment overseas

- Technology, academic and business teaming arrangements required to bring the application to usability for tactical helicopter operations (if applicable)

- Points of contact, including address, phone and email

- Nondisclosure agreement (see below)

- Proposals should not exceed 5 pages in length (plus attached references as required)

Remember that speed is of the essence. While thoughtful and realistic proposals are of course desired, it is recommended that proposals not be held up due to lack of specific information, or due to concerns regarding format. It is important at this stage to forward ideas that can then

lead to more specific requests for proposal (RFPs) from AFRL. The Defense Alliance will work closely with those submitting promising proposals in order to provide uniform requests directly to the AFRL program manager.

Nondisclosure and Intellectual Property

The Defense Alliance is acting only as a facilitator for AFRL in order to more rapidly bring ideas to the table for this urgent requirement. Because of the unorthodox nature of this solicitation, the Defense Alliance will not capture any intellectual property from submitted proposals unless a specific teaming arrangement is suggested and agreed to in writing. Therefore it is requested that submissions include a nondisclosure agreement to be signed by both parties.

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Summary

The Defense Alliance of Minnesota represents a broad and deep pool of knowledge and expertise across a variety of industries and academia that could well contribute to a rapid technology solution to the AFRL's urgent need for the helicopter brownout problem that faces our warfighters. It is hoped that our membership will take the time to understand this challenging issue, and contribute ideas that could help bring our warriors greater mission success and a safe return.