A HISTORY OF UNMANNED AVIATION IN CANADA

MDA™

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PREFACE

For those wishing to learn where unmanned systems have come from, and what activities are currently taking place in Canada as of January 2008, this e-Book is for you.

This book provides a brief history of the development and operation of Unmanned Aircraft Systems (UAS) in Canada. It is the first in a number of short electronic-books available from www.uavs.ca about unmanned aircraft in Canada, and aims to serve industry sector-members, the media, and the general public as a handy and objective reference guide.

It is not the intent of this book to describe how UAS operate, nor how today's regulatory or military planners classify these systems. These subjects are currently covered by a number of excellent publications which are listed in the recommended reading list at the end of this booklet.

Comments and feedback about the accuracy of the material presented herein is certainly welcome and can be directed to uav@mdacorporation.com.

ABOUT THE AUTHOR

Andrew Carryer holds a Bachelor of Science degree in Mechanical Engineering from Queen's University and a Master's of Applied Science in Aerospace Engineering from Carleton University. His first exposure to UAS came while working as a student at the Canadian Forces Experimentation Centre in 2002. After completing his MASc in 2005 he joined MDA where he is currently employed as a Systems Engineer.

Mr. Carryer previously served as a member of the Board of Directors for UVS Canada from 2003–2007. During this time he led the development of academic programs encouraging university students to participate in research related to unmanned vehicle systems. Mr. Carryer was also responsible for leading the development of Canada's first Unmanned Air Vehicle (UAV) design competition for students. The competition was held at 5 Wing Goose Bay in May 2007.

Mr. Carryer participated in Transport Canada's first UAV Working Group (2007) and is currently a member of the 2008 Transport Canada Working Group which is reviewing the Special Flight Operations Certificate (SFOC) process.

INTRODUCTION

Over the years many terms and definitions have been used to describe the technology discussed in this paper. Such terms include:

- Drones
- Remotely Piloted Vehicle (RPV)
- Uninhabited Aerial Vehicle (UAV)
- Unmanned Air Vehicle (UAV)

In recent years, two new terms have emerged and are now being adopted within the regulatory communities around the world. These are: Unmanned Aircraft (UA), and Unmanned Aircraft Systems (UAS). These terms recognize two very important distinctions over the previous nomenclature:

1. These machines are now officially recognized as being "aircraft." A term defined by the International Civil Aviation Organization (ICAO) as: "Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface."
2. The aircraft is recognized as only one component of an overall system, which also includes communications and control elements, which are not necessarily located onboard the aircraft, as is the case with manned aviation.

The Radio Technical Commission for Aeronautics (RTCA) established Sub Committee 203 (SC-203) released its Draft Guidance Document (20 July 2006) with the following definition of Unmanned Aircraft: "Aircraft operated without the possibility of direct human intervention from within or on the aircraft."[1] By contrast the Merriam-Webster dictionary for the word drone is as follows: "an aircraft without a pilot that is operated by remote control."

For the purposes of this document, the terms UAV and UAS are used interchangeably, as the latter has only started to see widespread use since 2006. The use of the word "drone" was widely used in technical papers until the early 1990s, and correct or otherwise is still widely used in the general media to describe today's current technology.

1 RTCA (2006). "Guidance Material and Considerations for Unmanned Aircraft Systems," Radio Technical Commission for Aeronautics, Paper No. RTCA 224-06/SC203-016, p 3.

THE EARLY DAYS (1960–1985)

Early developments of UAS and RPV in Canada followed the cancellation of the Avro Arrow program in 1959. These early programs were in support of both domestic and export-market military requirements.

Canadair

Beginning in 1963 and reaching full production in 1966, Canadair developed the CL-89. The system was manufactured in Montreal for the armies of Canada, the United Kingdom, and the Federal Republic of Germany[2], and was later designated the AN/USD-501. In 1974, design of the follow-on CL-289 began. The CL-289 UAS was able to carry more payload weight and had a larger operational radius than the CL-89.

Both the CL-89 and CL-289 resembled rockets, with their take-off achieved by a booster rocket. However once launched these systems flew like airplanes and maintained flight speeds with a turbojet engine. These were very rudimentary systems and external control of the aircraft was not possible once the system had been programmed. During a typical mission, a drone would launch and fly a pre-programmed route, its sensors and cameras would collect information, and then the system would return to a recovery site and land with the assistance of a parachute.

Defence Research Establishment Suffield

In 1979, under the auspices of the Technical Cooperation Program (TTCP), a joint US/Canadian feasibility study was undertaken to improve the US Army Ballistic Aerial Target System (BATS) using Canadian developed CRV-7 rocket motors. The TTCP program culminated in a vehicle known as ROBOT-5 standing for "Rocket Boosted Target." Defence Research Establishment Suffield (DRES) later initiated a program for both 7 and 9 motor configurations and later developed ROBOT-9.

By 1984 DRES had developed a number of aerial test platforms including:

- ROBOT-9
- ROBOT-5
- TATS-102
- Twin-HULK
- R^2P^2

ROBOT-5 and ROBOT-9 were proven to be very effective and extremely low-cost, high-speed target drones. Following their success, DRES began the proof-of-concept development of a winged, rocket-boosted, multi-staged target that was named Robot-X.

The Robot-X drone, designed for travel at high-subsonic speeds, was able to maintain a low altitude hold, manoeuvre along a pre-programmed path, and have a range greater than 37 kilometres. Wind tunnel tests were conducted in 1982 and the forward-wing, canard-configured, drone's design was frozen.[3]

2 McIntyre, P.A. (1970). "Development of a Recovery System for the AN/USD-501 Surveillance Drone", AIAA Journal of Aircraft, 7, (3), 240-245.

3 Markov, A.B., Ollevier, T.E., Penzes, S.G., Tuner A.E., Bergeron, D.M., Meidinger, T.V., & Jones, W.A. (1984). "DRES Remotely Piloted Vehicle and Drone Development Testing Facility". DRES: Suffield Memorandum No. 1106, [UNCLASSIFIED]

Boeing Canada

Flight tests of the Robot-X, developed by Boeing Canada Ltd. was completed in January 1985. This rocket-boosted aerial target was designed to simulate a variety of air threats for use in exercising air defence weapon systems. The drone was propelled by nineteen CRV-7 rocket motors which were fired in pre-programmed stages. Various flight profiles were achieved by a programmable microprocessor-based digital autopilot system.[4]

For 25 years (1960–1985) Canadian firms were recognized world leaders for their development of state-of-the-art systems. However, a lack of government support through procurements in this sector would see the technology largely disappear from the spotlight for approximately 15 years.

THE DARK YEARS (1985–1998)

Canadair's Story Continues

In 1987 Canadair sold CL-89 and CL-289 systems to the French and German governments. In 1990 the CL-289 entered service and was designated the AN/USD-502. Both France and Germany used these systems in Bosnia and Kosovo during the 1990s.[5]

Canadair (later acquired by Bombardier) developed a family of rotary wing drones including the CL-227 "Sentinel", CL-327 "Guardian" and the CL-427 "Puma."

According to the Federation of American Scientists:

> "Canadair's involvement with the US Navy started in 1988. Several demonstrations of the CL-227 were conducted to show the feasibility of launching and recovering a VTOL air vehicle from the deck of a small combatant ship. In a planned build up, land-based flight tests were conducted at the contractor's site in Montreal Canada on a tether due to air space restrictions. Flights at Ft. Huachuca, AZ, demonstrated the capability of a 20 km data link range. Flights were completed at Medicine Hat, Canada from a wooden deck to simulate the transition across the flight deck of a ship. A flight was accomplished aboard the Jan Tide, an oil rig replenishment ship, to a distance of 6 km from the ship. Although this was a manual flight and recovery, it continued the build up. The next at-sea demo was conducted aboard the USS DOYLE (FFG-39) during a STANAVFORLANT cruise. Extensive flight testing both at the Canadair facility in Montreal and also at Patuxent River, MD preceded the cruise to demonstrate the safety of the system."[6]

The CL-327 Guardian, was an improved version of the CL-227 Sentinel vertical take-off and landing system. Designed to operate from either land or ship, the aircraft included two counter-rotating rotor blades. Without a tail rotor to balance the torques, the counter rotating set of blades were needed to produce opposite torque moments. Payloads and fuel for the aircraft were stored in the upper and lower portions of the bulbous fuselage which protruded above and below the centrally mounted rotor arrangement. The craft's distinctive shape earned it the nickname "The Peanut".

The Guardian offered 6.25 hours of endurance, a 105 kg payload capacity, and a 200 km range. It entered limited production in October 1996, following the conclusion of a successful US Navy-sponsored heavy fuel

4 Penzes, S.G., Markov, A.B., Turner, A.E., & Boulter, B.G. (1987). "Environmental tests of the Robot-X Airframe" DRES, Suffield Memorandum No. 1192 [UNCLASSIFIED]

5 Pigott, P. (2007). "Canada in Afghanistan: The War So Far." Toronto: Dundum Press Ltd. p 192.

6 FAS (2008) "CL-227 / CL-327", retrieved 28-Feb-08, http://www.fas.org/man/dod-101/sys/ac/row/cl-327.htm

propulsion program. Since that time there have been a number of system demonstrations and unfortunate system failures. At the time of publication there are no known customers using the CL-327.

Boeing Canada

The Robot-X program continued into the 1990s with initial design work focused on developing a turbine propulsion system. However the program was cancelled before integration and testing could occur.

THE CURRENT BOOM (1998–2008)

In the late 1990s, Canada's Unmanned Aircraft sector re-emerged with firms starting to explore civil applications of the systems. Around the same time, the Canadian military also expressed an interest in employing UAS in both domestic and foreign theatres of operation.

Boeing Canada

The target drone business of Boeing Canada continued under the radar screen for many years and would later be sold to Schreiner Canada Ltd. This business was subsequently acquired by Meggitt Defence Systems Canada, and today Meggitt manufactures and operates a range of remotely piloted target drones, including:

- Banshee
- Ptarmigan I & II
- Vindicator I & II
- Vindicator (CU-162)

CANADIAN MILITARY ANNOUNCES INTENTIONS

Announcement of the Joint UAV Surveillance and Target Acquisition (JUSTAS) project by the Department of National Defence (DND) set the Canadian Forces (CF) on a path of experimentation, acquisition, and operation of many UAS. JUSTAS was endorsed by the military's Senior Review Board in October 2000, and the Canadian Forces Experimentation Centre (CFEC) was established in 2001 to conduct joint (Army, Navy, Air Force) concept development and experimentation activities.

CFEC would go on to plan five, and conduct four experiments between 2001–2004:

1. Global Hawk Overflight

An overflight of Alberta by the Global Hawk UAS, operated by the United States Air Force, was initially planned for May 2001; however this flight never took place. In the proposed mission, the aircraft would have departed from Edwards Air Force Base (AFB) in California and climbed to 45,000 feet before entering Canadian domestic airspace south of Medicine Hat. The aircraft would perform a series of circuits over Canadian Forces Base (CFB) Suffield, CFB Wainwright, and CFB Cold Lake before returning to Edwards AFB. In total the aircraft would have been in Canadian airspace for approximately eight hours.[7] While flight authorization had been received, the flight was canceled at the last minute for technical reasons.

7 Marsters, G. (2003) "Ummmm…. So Where Does the Pilot Sit?" Presented as the Turnbull Lecture at the 2003 Annual General Meeting of the Canadian Aeronautics and Space Institute (CASI).

Due to high demands for the Global Hawk's services elsewhere in the world, the experiment was delayed indefinitely.

2. OP Robust Ram

Operation Robust Ram was the first chance DND had to experiment with these systems. The exercise took place in April 2002 at CFB Suffield, and involved the charter of three systems:

- Pointer (AeroVironment), a mini-UAS

  During the exercise the Pointer conducted 39 missions totalling 15.9 flight hours. The aircraft operated below 500 ft above ground level, and had an operational radius <10 km.[8]

- CL-327 (Bombardier), the Guardian, aka "Peanut" a tactical UAS

  During the exercise the CL-327 completed seven missions totalling 15.3 flight hours, and flew at altitudes between 5,000–10,000 ft above sea level.[8]

- I-Gnat (General Atomics), a medium altitude long endurance UAS

  During the exercise the I-Gnat flew seven missions totalling 29.4 flight hours, up to a maximum altitude of 15,000 ft ASL.[8]

3. OP Grizzly

In June 2002, Operation Grizzly involved the I-Gnat UAS, which flew overwatch during the G-8 Summit Conference in Kananaskis. The aircraft was limited to a 30 x 35 nautical mile operating box around Kananaskis, and the Canadian Forces established a Joint Airspace Coordination Centre to integrate the I-Gnat with other airspace users.

4. Pacific Litoral ISR Exercise (PLIX)

The PLIX exercise took place off Vancouver Island in July 2003. Flying from the airport in Tofino, the medium altitude long endurance Heron (aka Eagle-1) UAS, manufactured by Israel Aerospace Industries (IAI) was operated with line of sight data links. The Heron is physically larger than the I-GNAT. This was the first time DND had operated a system over water. During the exercise, the operators noticed a vessel at sea purging bilge water. While not part of the exercise, the results of photographing this illegal activity were widely seen as validation for the utility of UAS for off-shore monitoring activities.

In a separate exercise, independent of the Canadian Forces, British Army Training Unit Suffield (BATUS) employed the same Heron system that flew during PLIX. Their exercise was conducted in October 2003, in concert with training activities in Suffield, Alberta.

5. Atlantic Litoral ISR Exercise (ALIX)

The ALIX trial took place in 2004 and was the culminating live experiment for CFEC. The trial used the Altair UAS from General Atomics which was flown via satellite communications (SATCOM). The Altair is also a medium altitude long endurance UAS, but is larger than the Heron. The Altair flew from CFB Goose Bay,

8 Laing, Capt(N). K.D.W., Newton, LCol. S. (2004) "DND looks to UAVs", Canadian Defence Review, (10), 4, 8-15.

Labrador, into northern Canada. The exercise was not without its challenges from both communications and airspace coordination perspectives.

In parallel to the Altair's operations along the East Coast of Canada, the Silver Fox UAS, manufactured by Advanced Ceramics, was flown over CFB Gagetown in support of Army training activities. Nine Silver Fox UA were purchased by DND and are used today by the researchers at Defence Research & Development Canada – Suffield.

The ALIX exercises demonstrated the use and limitations of SATCOM operations at northern latitudes. In short, the coverage provided by the communication satellites was insufficient at the northern latitudes to pass large amounts of payload information from the aircraft to the ground.

Following the completion of ALIX, CFEC began to focus on non-UAS related activities, and all things related to UAVs were placed in a Joint UAV Project Office. While the Joint Project Office continues to guide UAV development and sequencing within the Canadian Forces under the Chief of Force Development, procurement activity and fielding of systems is done within the Air Force and the Army.

UAV Campaign Plan

The first edition of the Canadian Forces UAV Campaign Plan was produced in March 2007, with the stated aim that "The UAV Campaign Plan builds on past CF UAV activities, establishes the framework for a coherent strategy towards the desired end-state, and builds a solid foundation for follow-on UAV capability development beyond 2010."[9] The action plan provided a timeline of currently initiated and planned activities.

Articles written by Maj. W. March and Capt. A McCorquodale, which appeared in a trade publication called Frontline Defence Magazine, provide an excellent summary of current UAV activities within the Canadian Forces.[10] [11]

Unlike the situation in the United States where all three branches of the military were procuring UAS simultaneously, the Canadian Department of National Defence has delineated operational and procurement responsibility between that of the Air Force and the Army. This delineation is largely based on system weight and operational altitudes where the threshold is set at 185 kg. Everything heavier belongs to the Air Force; everything lighter belongs to the Army.

CANADIAN ARMY PROJECTS

Under the Land Force Intelligence, Surveillance, Target Acquisition and Reconnaissance (LF ISTAR) project, the Army acquired two Unmanned Aircraft Systems under separate projects in 2003 and 2006, to support deployed operations in Afghanistan.

Sperwer from SAGEM

With discussions starting in February 2003, the Director General of Land Equipment Program Management (DGLEPM) office of Canadian Army purchased four Sperwer unmanned aircraft, one ground station, one ground data link, one launcher, and associated support equipment for $33.8M. The rail-launched aircraft was

9 Canadian Forces (2007). "UAV Campaign Plan Ed 1", produced by the UAV Joint Program Office.

10 March, Major W.A. (2007). "Learning to Walk". Frontline Defence, (6) Nov/Dec 2007, 12-17.

11 McCorquodale, Captain A. (2007). "Canadian Forces' Unmanned Projects." Frontline Defence, (6) Nov/Dec 2007, 18-22.

powered by a modified Bombardier Ski-Doo engine, and landed under parachute and airbags.[12]

The initial systems were delivered to Kabul, Afghanistan, in October 2003 to meet an urgent operational requirement. The prime contractor for the CU-161 is Canada-based Oerlikon-Contraves, known today as Rheinmetall Canada.

While the rapid acquisition and fielding of this system is notable, it has also resulted in learning many lessons at a steep price. With high attrition rates resulting from a plethora of causes, it was necessary to procure additional Sperwers from Oerilkon-Contraves in order to support operations in Kandahar in 2005. Canada also secured a number of older-Sperwers that the Danish Army were unable to use. Based on current usage trends, Canada's fleet of Sperwers are expected to last until approximately December 2008. Detailed information about CU-161 crashes are posted on the Canadian Air Force's Directorate of Flight Safety website.

Mini UAV Capability for CF Operation Archer

In February 2006, the Canadian Forces were deployed to Kandahar, Afghanistan as part of Operation Archer. In preparation for this operation, the Canadian government issued a letter of interest in September 2005, indicating to Canadian industry that the Canadian Forces were looking to acquire a mini-UAV capability.

Specifically, the letter of interest read: "The Op ARCHER Task Force requires mini-UAV systems to provide a beyond line of sight surveillance capability that is integral to Canadian Forces task force sub-units (companies and squadrons)."[13] The requirement specified that the system would operate for 90 minutes while carrying an electro-optic payload, and have a maximum speed of at least 35 kts. The general concept of operation was to operate the aircraft within a 7 km radius, without being seen or heard.

Thales Canada and Elbit Systems of Israel won the contract and provided the Skylark-1 System, which was still in use at time of publication.

CANADIAN AIR FORCE PROJECTS

Tactical UAV Charter

In September 2005, the Canadian Air Force embarked on a path to lease a tactical UAV system to support Canadian troops operating in the Kandahar province of Afghanistan as part of Operation Athena. The statement of operating intent for this capability stated:

> "Recent Op ATHENA experiences have proven the operational necessity of employing UAVs; however, there continues to be a shortfall in the capacity to collect, process and disseminate tactical intelligence in this arena. While the Air Force does possess some ISTAR Tactical Uninhabited Aerial Vehicle (TUAV) capability, an incremental level of greater coverage and flexibility is required to adequately support OP ARCHER.
>
> Due to the necessity of a mature ISTAR UAV capability at short notice in support of Op ARCHER, Canada must deal with the dilemma of providing this capability as soon as practicable while remaining cognisant of scarce CF training resources and personnel. Following an intensive options analysis, constrained within deployment deadlines for Op ARCHER, a complete alternate services

12 Connolly, D. (2007). "UAV a Great Success" Canadian Department of National Defence, Retrieved 27 February 2008 from www.forces.gc.ca/admmat/site/uav_e.asp

13 Government of Canada (2005). "Mini UAV to support Op Archer UOR", PWGSC Solicitation No. W8476-06BGRX/A, Issued: 26-Sept-05

> delivery (ASD) turn-key ISTAR capability, owned and operated by a civilian organization but controlled by the CF is the optimum solution."[14]

Two Canadian prime contractors submitted responses to this request for proposals. MDA was selected as the winner, however the project never went forward. Officials would later state that the budget for the project was insufficient and legal concerns had been raised surrounding the use of civilian contractor staff operating the aircraft in theatre.

Foreign Military Sale

In the Spring of 2007, the Canadian Air Force went to the federal cabinet with a request to purchase UAS directly from the United States. The Canadian government rejected this request after approving a number of other sole-source contracts for helicopters and heavy-lift aircraft. Few details are known about what capabilities were being sought or what the intended system would have cost the Canadian government.

Following the demise of this project, the Air Force began a new project entitled the Joint Airborne ISR Capability (JAIC).

Joint Airborne ISR Capability (JAIC)

In July 2007, the Canadian government released its letter of intent for the JAIC project. According to the wording in the LOI: "Ongoing CF operations have identified the need for a persistent, interoperable airborne Intelligence, Surveillance and Reconnaissance (ISR) capability to support a broad spectrum of activities from tactical-level engagements involving CF Land and Special Operations Forces to theatre-level intelligence assessments. The Joint Airborne ISR Capability (JAIC) project will provide an interim ISR capability to satisfy this operational shortfall."[15]

Rather than looking for equipment that was available off the shelf and which could go into theatre quickly, the requirements stated the need for a classified payload and an upgrade path to carry synthetic aperture radar (SAR) and weapons. The project asked industry to provide the option of either purchasing or leasing the equipment. There is anecdotal information that suggests that the timeframes and budgets required by industry to field the intended capabilities exceeded those available to the CF.

As a result, on January 9, 2008, the Canadian government announced that the JAIC project has been superseded and would not proceed. Instead, the government plans to proceed with Project Noctua whose mandate is to lease long endurance UAVs equipped with electro-optic/infra-red payloads that are suitable for over-land ISR operations. The systems will be contractor supported for international deployed operations and used for collective training in Canada.

Summary

At the time of publication, there are currently two systems being used by the Canadian Forces: Sperwer, and the Skylark. Future procurements and leases by both the Canadian Army and Air Force over the next five to ten years will have the country operating a family of UAS ranging in size from small hand-launched systems up to UAS which have similar wingspans to that of a Boeing 737.

14 Government of Canada (2005). "Tactical UAV, Charter", PWGSC Solicitation No. W8485-05AW10, issued: 23-September-2005.

15 Government of Canada (2007). "Joint Airborne ISR" PWGSC Solicitation No. W8485-07AW13/B, Issued 13-July-2007

COMMERCIAL DEVELOPMENTS AND APPLICATIONS

One event in 1998 would firmly place Canada in the history books of aviation once again.

A small American company called Insitu, which had partnered with the University of Washington, had chosen to demonstrate the capabilities of their UAS in Canada by attempting to fly from Newfoundland to Scotland. Crossing the North Atlantic has long been a rite of passage in aviation. This feat was accomplished by the Aerosonde aircraft on August 21, 1998. Four aircraft were launched; however, only one aircraft made the 3270 km flight successfully and arrived on the other side of the Atlantic. Operating on 1.5 gallons (5.7 L) of fuel, the Aerosonde achieved this historical flight in 26 hours and 45 minutes, and now hangs in the Smithsonian's Great Gallery within the Museum of Flight.[16]

Following on the heels of Insitu's accomplishment, a number of companies began to operate unmanned aircraft for commercial purposes. Canada has also played host to those wishing to perform research and development with UAS along with those who design and manufacture these systems.

National Research Council – Institute for Aerospace Research (NRC-IAR)

The NRC in Canada has been loosely involved in researching UAS for many years. In 2003, the institute commissioned a study to identify priority areas for research[17], it has also conducted flight tests of a surrogate UAS through conversion of the lab's Bell 205 helicopter, and studied various sense-and-avoid technologies.

IAR has also supported the Department of National Defence by developing maintenance techniques and patches for the composite structures of the UAS systems that are used in theatre today.

NASA

In 2003, the Intelligent Systems Division at NASA-Ames conducted a series of experiments with MLB's Bat UAS system in the Haughton Crater on Devon Island in the North West Territories. The focus of these operations was to explore the implicit challenges of acquiring mission-representative data from a small UAV acting as a surrogate planetary aerial explorer.[18] [19]

Fugro Airborne

Fugro Airborne initiated its UAS program in 2003, and by 2004 had formed a partnership with Insitu Corporation. By modifying the Insitu-designed ScanEagle, Fugro Airborne's GeoRanger was born. The aircraft was designed to carry a high-resolution cesium-vapour magnetometer, fluxgate magnetometer, and a data acquisition payload.[20] Fugro performed a series of test flights in early 2005 at their test site near Ottawa, Ontario, and continues to use the GeoRanger today. Typical flight mission profiles follow the elevation

16 Air & Space/Smithsonian, (1999). 14(4), 64-69.

17 Aerovations Associates, (2004). "Priorities for UAV Research and Technology Development in Canada" prepared under contract #: 514325 dated 5-Sept-2003.

18 Pisanich, G. et al., (2003). "Actions, Observations, and Decision-Making: Biologically Inspired Strategies for Autonomous Aerial Vehicles," retrieved 27 February 2008 from http://ic.arc.nasa.gov/publications/pdf/0635.pdf

19 Pisanich, G. et al (2003). "Initial Efforts towards Mission-Representative Imaging Surveys from Aerial Explorers," Retrieved 27 February 2008 from http://ic.arc.nasa.gov/publications/pdf/0653.pdf

20 Partner, R. (2006). "GeoRanger Aeromagnetic UAV: Development to Commercial Survey", Fugro Explore, 3, March 2006.

contours of the earth. The closer the aircraft flies to the ground, the higher the quality of the collected data products.

Universal Wing Geophysics

Universal Wing began its operations in 2005 with the use of a Dara-manufactured UAS. The system made a number of flights in the Canadian Arctic in 2005 and is intended for use as a collection asset for aiding oil exploration activities in frontier islands and offshore areas. Some of the operations performed to date include a 4,000 km line-kilometre survey on Vancouver Island for a mineral exploration company.[21]

Provincial Aerospace Limited (PAL)

In a joint program between PAL and Memorial University of Newfoundland, the two organizations have acquired a number of Aerosonde UAS and intend to operate them over the Canadian Arctic and North Atlantic. Proposed applications include ice and pollution monitoring, as well as illegal fishing surveillance. In November 2006 PAL's Aerosonde performed its maiden flight in Canada.[22]

MacDonald, Dettwiler and Associates Ltd. (MDA)

With a project initiated in early 2007, MDA partnered with Israel Aerospace Industries (IAI) to launch a service operation that used the Heron UAS. Operated initially within the range at Canadian Forces Base Suffield in Alberta; MDA's operation marked the first time a large UAS was flown by a commercial operator in North America and available on a fee-for-hire basis. Separately, the company is also working on the development and prototype of a combined satellite and UAS solution for homeland security and national defence applications.

MMIST

MMIST is an Ottawa-based manufacturer of UAS for the US Department of Defense. Low rate initial production of the SnowGoose began in June 2003, while the full-rate production contract was awarded to MMIST in August 2004. MMIST has since signed a $75M contract to provide its SnowGoose cargo UAS to the US Special Forces. The SnowGoose cargo UAS has been designated the CQ-10A and is used in psychological operations, such as leaflet delivery, by the US Special Operations Command.

Advanced Subsonics

Advanced Subsonics developed and tested a prototype system called Grasshopper which was intended for use by Army personnel; however they are not believed to have sold any such systems. The company has since returned to its roots and continued working on an insect-sized flapping-winged UAS. Successful hovering flight was achieved in 2006 with two demonstration aircraft.[23]

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21 Austin Development Corp. (2005). "Austin's subsidiary, Universal Wing Geophysics Corp. completes Arctic survey, accepts mineral exploration contract, plans offshore oil survey test." Corporate SEDAR Release, 9 June 2005

22 PAL (2006). "St. John's based company achieves Canadian Aviation Milestone", PAL news release, 1 December 2006.

23 Zdunich, P., Bilyk, D., MacMaster, M., Loewen D., et al (2007). "Development and Testing of the Mentor Flapping-Wing Micro Air Vehicle". AIAA Journal of Aircraft, 44, (5).

Aerial-51

Aerial-51 is a small Alberta-Based company that operate a small VTOL UAS that resembles a conventional helicopter. The system carries a large gimballed camera system and is used primarily to support the television and movie industry with their aerial photography needs. The company has been building and operating commercially since 2002.

CropCam

MicroPilot, an autopilot manufacturer located in Manitoba branched out into turn-key UAV systems and currently produces a system called CropCam. As the name suggests, CropCam was designed to give farmers an alternative to collecting imagery from satellite or manned aircraft. The system uses a model glider airframe with electric motor and Pentax digital frame-camera. CropCam UAS is intended to support the decision-making activities of farmers by providing them with additional information about crop health.[24]

CHALLENGES FACING CANADA

Great interest has been expressed within Canada's public and private sectors to exploit the advantages of UAS. The military, law enforcement and public security agencies and industry, all have firm plans or are giving serious consideration to incorporating UAS into their domestic operations within the next ten years. However there are a number of key challenges still facing widespread operations of these systems.

1. Access to Airspace
2. Access to Frequency Spectrum
3. Safe operation in the Canadian Climate

The first two challenges are issues being faced by every operator and regulator around the world. The third challenge however is of particular concern to Canada. Our cold winters and known icing conditions often test the limits of even the most reliable and mature technologies, and therefore pose an added challenge to UAS intended for year-round operations in Canada or in countries with similar climates.

24 Collins, S. (2007) "Aerial Scout: Remote-controlled plane helps diagnose crop problems so you can take action during the growing season." The Progressive Farmer, September, B-8.

FINAL THOUGHTS

For more than a century, Canadian pioneers and innovators have been responsible for establishing this country's history of aviation-excellence. With the recent boom in interest for unmanned aircraft systems, early adopters are starting to realize the benefits this new technology brings to their current ways of doing business.

With little congestion in the skies over Canada, especially when compared with the constraints facing Europe or the USA, Canadians are uniquely positioned to take an active leadership role towards the development, and the employment, of unmanned aircraft systems without posing a risk to other airspace users. These future advancements will mark the beginning of a new and exciting era in Canadian aviation history.

Assuming airspace access and spectrum allocation issues are addressed within the next ten years, we can expect to see significant growth in the use of UAS for civil applications. As demand for these systems increases, production volumes will also grow. Accordingly, unit sale prices are expected to decrease, thereby making UAS cost-effective alternatives to the approaches and methods widely used today.

Unmanned Aviation has been part of the Canadian aviation scene for approximately 45 years. Where things go in the next 50 years is anyone's guess, but it is likely to be an interesting and exciting journey.

RECOMMENDED READING

Fahlstrom, P.G. and Gleason, T.J. (1998). "Introduction to UAV Systems" Published by UAV Systems Inc.

Newcome, L.R. (2004). "Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles", Published by AIAA.

Shephard (2007). "Unmanned Vehicles Handbook 2007" Berkshire, UK: Williams Press.

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