Planes Without Pilots: Using Unmanned Aircraft for Research

A list of materials about this topic

Internet Resources

Drone planes research hurricanes
Available from: http://news.bbc.co.uk/2/hi/technology/7421297.stm
.Courtesy, NOAA/NASA. First published 23 January 2008. Retrieved 23 January 2009.
Meteorologist Eric Uhlhorn on what robotic planes will do.

NASA: National Aeronautics and Space Administration
Available at: http://www.hq.nasa.gov/pao/portal/
Accessed 23 January 2009
The NASA Public Portal was designed to provide one authoritative source of NASA content to the general public. To accomplish and facilitate this goal, NASA employees and contractors have worked diligently to create an environment that addresses the requirements of hundreds of disparate sites that NASA maintains.

NASA to fly unmanned drone for science research
Available from: http://www.physorg.com/news151262138.html
Space & Earth Science / Space Exploration (15 January 2009). Retrieved 23 January 2009.

NOAA: National Oceanic and Atmospheric Administration
Available at: http://www.noaa.gov/
Accessed 23 January 2009
"NOAA is an agency that enriches life through science. Our reach goes from the surface of the sun to the depths of the ocean floor as we work to keep citizens informed of the changing environment around them. From daily weather forecasts, severe storm warnings and climate monitoring to fisheries management, coastal restoration and supporting marine commerce, NOAA's products and services support economic vitality and affect more than one-third of America's gross domestic product. NOAA's dedicated scientists use cutting-edge research and high-tech instrumentation to provide citizens, planners, emergency managers and other decision makers with reliable information they need when they need it. NOAA's roots date back to 1807, when the Nation's first scientific agency, the Survey of the Coast, was established. Since then, NOAA has evolved to meet the needs of a changing country. NOAA maintains a presence in every state and has emerged as an international leader on scientific and environmental matters."

Poker Flat Research Range
Available at: http://www.pfrr.alaska.edu/
Accessed 23 January 2009.
Poker Flat Research Range is the world's only scientific rocket launching facility owned by a university. Poker Flat is located approximately 30 miles north of Fairbanks, Alaska and is operated by the University of Alaska's Geophysical Institute under contract to NASA's Wallops Flight Facility, which is part of the Goddard Space Flight Center. In addition to launching sounding rockets, Poker Flat is home to many scientific instruments designed to study the arctic atmosphere and ionosphere.
(3 March 2003) / February 18, 2003. Retrieved 23 January 2009.

Book Resources

Castillo, Pedro. ***Modelling and control of mini-flying machines***. Springer (2005) 251 p.

Chapters include introduction and historical background, the PVTOL aircraft, the quad-rotor rotorcraft, robust prediction-based control for unstable delay systems, modelling and control of mini-helicopters, helicopters in a vertical flying stand, modelling and control of a tandem-wing tail-sitter UAV, modelling and control of small autonomous airships, sensors, modems and micro controllers for UAVs, and model coefficients.

Williams, Kevin W. ***An assessment of pilot control interfaces for unmanned aircraft***. Washington, D.C.: Office of Aerospace Medicine, Federal Aviation Administration; [Ft. Belvoir, VA :

Available through the Defense Technical Information Center, April 2007; Springfield, VA: Available through the National Technical Information Service, April 2007] 12 p.; ill.

Williams, Kevin W. ***Human factors implications of unmanned aircraft accidents: flight-control problems***. Washington, D.C.: Federal Aviation Administration, Office of Aerospace Medicine (April 2006) ill. 6 pages. [Also available online via the Federal Aviation Administration OAM Technical Reports website (http://www.faa.gov/library/reports/medical/oamtechreports/index.cfm).]

Research that focuses on three types of flight control problems associated with unmanned aircraft systems: external pilot difficulties with inconsistent mapping of the controls to the movement of the aircraft; difficulties associated with the transfer of control from one control location to another during the flight; and problems associated the automation of flight control. Examples cited of specific accidents associated with each type of control problem. The accidents involve several different aircraft systems that are currently in use. Solutions are offered for each type of control problem.

Newspaper and Journal Resources

Aerodynamic Design of Micro Air Vehicles for Vertical Flight. *Journal of Aircraft*, 45-5, 1715. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"The research and development efforts outlined in this paper address the aerodynamic design of micro air vehicles with hovering and vertical takeoff and landing capabilities. The tilt-body configuration of the vertical takeoff and landing micro air vehicle is proposed based on a propulsion system consisting of two coaxial contrarotating motors and propellers. Values of thrust, torque, power, and efficiency of this propulsion system were measured in pusher and tractor arrangements of propellers and compared against single motor-propeller propulsion. With comparable efficiency, the developed propulsion system has very little propeller torque. Hot-wire measurements have been conducted to investigate the velocity profile in slipstream. The lower average velocity and significant decrease in velocity in the core of the slipstream found in the tractor arrangement are mostly due to the parasite drag caused by the motors. It causes the decrease of the thrust force observed for the tractor arrangement in comparison with the pusher arrangement. Wind-tunnel testing was conducted for a motor, a wing, and an arrangement of a wing with a motor. The drag force on the wing is produced by two mixing airflows: freestream and propeller-induced pulsating slipstream. The zero-lift drag coefficient increases by about 4 times with propeller-induced speed increased from 0 to 7.5 m/s. The results of this study were realized in the design of a vertical takeoff and landing micro air vehicle prototype that was successfully flight tested."

Dornheim, MA. (2005). **Civilians Try Drones**. *Aviation Week & Space Technology*, 162-26, 54-56. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"This article reports that scientists who are starting to use drones for civilian research remain enthusiastic about the prospects, but have been frustrated by practical problems that will delay their exercise by about five months. National Oceanographic and Atmospheric Administration scientists are getting a firsthand look at drone operations via their use of the General Atomics high-altitude Altair aircraft. Altair is the General Atomics prototype of its Predator B turboprop drone, with the wings extended from 66 feet span to 86 feet for better high-altitude capability."

Dornheim, MA. (2005). **Perpetual Motion**. *Aviation Week & Space Technology*, 162-26, 48-52. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"This article reports that people have long dreamed of perpetual flight, and the tipping point was reached earlier this month when a solar-powered drone stayed aloft for 48 hour. It showed that enough energy could be stored during the day to fly the aircraft at night, for at least several days. AC Propulsion Inc., a small research company in San Dimas, California made the flight after several years of dedicated effort by its founder, Alan G. Cocconi. It is informed that AC Propulsion used lithium-ion laptop computer batteries for storage instead of fuel cells, as well as an overall simpler approach, to become the first to fly through two full nights under solar power."

Dufresne, S, Johnson, C & Mavris, DN. (2008). **Variable Fidelity Conceptual Design Environment for Revolutionary Unmanned Aerial Vehicles**. *Journal of Aircraft*, 45-4, 1405. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"Describes the development of an unmanned aerial vehicle's conceptual design environment. A review of current unmanned aerial vehicle design challenges is conducted, which leads to the description of the desired capabilities for the environment. The key characteristics of the design environment include the capability of integrating variable fidelity, modular, and flexible disciplinary analysis tools. The environment is tested against available data from the AeroVironment Pathfinder Plus vehicle. In addition to the Pathfinder Plus mission analysis, aerodynamics, propulsion, and structures performance results are discussed and then applied to a hurricane-tracker mission. This case study demonstrates the environment's capability to perform and explore new types of missions. A further exploration of the Pathfinder Plus design space is conducted using response surface methodology. This investigation provides valuable information regarding design tradeoffs, which are essential for the selection of a final vehicle architecture."

Francis, M. (2008). **Unmanned systems**. *Aerospace America*, 46-12, 108. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"The article discusses several advances in the development of unmanned air systems (UAS) in the aerospace industry in the U.S. in 2008. These include the completion of the 1,000th flight of the RQ-4 Global Hawk system from Northrop Grumman and the maritime surveillance contract awarded by the Navy to Northrop Grumman. The Defense Advanced Research Projects Agency has also launched the Vulture program designed to create a vehicle for delivering and maintaining an airborne payload on station."

High times. (2003) *Economist*, 369-8354, 79-81. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"Discusses advances in aviation on the 100th anniversary of the airplane. Aviation has been transformed in the last 100 years. It will go a lot further in the next century as the pilot is eliminated. Today's vehicles bear little resemblance to the shaky craft flown at Kitty Hawk on December 17th 1903, by Wilbur and Orville Wright. Tomorrow's aircraft are likely to be still more marvelous, and perhaps even more different than today's are from the Wrights' pioneering effort. Predicting how different requires guesswork, an open mind and even a dollop of science fiction. As the leading frontier in aviation research, the military's ideas and development on Unmanned Aerial Vehicles (UAV) will be influential in the rest of aviation. Initially, pilots and a lot of equipment will be needed back at base to control these remote UAVs. But by 2015-2020, as onboard processing power begins to take off, UAVs are expected to start thinking for themselves. This could lead ultimately to completely autonomous UAVs and swarms of UAVs that talk to one another and operate as a single unit. By 2030, it is even possible that UAVs will be able to optimise their shape by "morphing" from one shape to another using stretchy skins and special "memory" materials. It will take commercial aviation far longer to eliminate the pilot than military aviation.

Hsiao, Fei-Bin; Hsieh, Sheng-Yen; Chan, Woei-Leong & Lai, Ying-Chih (2008). **Engine Speed and Velocity Controller Development for Small Unmanned Aerial Vehicles**. *Journal of Aircraft,* 45-2, 725-728. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"Discusses engine speed and velocity controllers for small unmanned aerial vehicles (UAV). The focus is on the SWAN UAV, a drone surveillance aircraft that was developed by the Remotely Piloted Vehicle and Micro-Satellite Research Laboratory. Tests on the SWAN UAV's O.S. Engines FS-120 Surpass III four-stroke nitro engine, which has an APC 17 x 6 propeller, were conducted in a wind tunnel. The resulting equations, based on the relation of throttle area and engine speed in steady state, are explained."

Keiser, BE & Peebles, PZ. (1969). **An Automatic System for the Control of Multiple Drone Aircraft**. *Aerospace and Electronic Systems, IEEE Transactions on Publication*, 5-3, 515-524. doi: 10.1109/TAES.1969.309853. Retrieved January 23, 2009, from Scitopedia.

"Manufacturers of civilian aircraft are treading warily on the issue of removing the pilot. The aircraft they are now designing for operation into the 2040s use computers to pick up, and correct, pilot error. Pilotless vehicles will also find early applications in a wide array of commercial and transnational uses--from fire fighting to geological and environmental surveys, border patrol, film production, research, rescue and even agriculture. The biggest breakthrough in civil aviation, though, would be the invention of the aerial equivalent of the motor-car."

Klyde, DH, Shweyk, KM, & Abate, GL (2008). **Atmospheric flight mechanics**. *Aerospace America*, 46-12, 7. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"The article reports on the ability of various research in atmospheric flight mechanics which continued to bring advances in unmanned air vehicles (UAVs) and micro air vehicles (MAVs) in the U.S. It cites the Boeing Phantom Works team at National Aeronautics and Space Administration (NASA) Dryden which continues the flight envelope expansion of the X-48B Blended Wing Body (BWB) prototype. It says the 500 pounds remotely piloted aircraft was designed to demonstrate the ability of the BWB concept."

Lin, Po-Hsiung. (2007). **The First Successful Typhoon Eyewall-Penetration Reconnaissance Flight Mission Conducted by the Unmanned Aerial Vehicle, Aerosonde**. *Bulletin of the American Meteorological Society*, 87-11, 1481-1483. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"The article presents meteorology research into a typhoon eyewall-penetration reconnaissance flight mission conducted by the Aerosonde remotely piloted vehicle. Real time transmission of meteorological data was made with Iridium satellite communication. Penetration of the typhoon Longwall's eye was accomplished when the eye was 100 kilometers offshore of the Taiwanese east coast. The success of the Aerosonde's first mission spotlights the potential of using unmanned aerial vehicles (UAV) for low-cost typhoon reconnaissance."

NOAA and NASA begin science experiment with UAVs. *Military & Aerospace Electronics*, June 2005 Supplement, p6. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"Focuses on the possible use of unmanned aircraft for Earth science experiments in the U.S. Atmospheric and oceanic research flights off the California coastline; Cooperation of the National Oceanic and Atmospheric Administration and U.S. National Aeronautics and Space Administration and General Atomics Aeronautical Systems Inc."

Reuder, J, Brisset, P, Jonassen M, M'ller, M, & Mayer, S. (2008) **SUMO: A small unmanned meteorological observer for atmospheric boundary layer research**. *IOP Conference Series: Earth and Environmental Science*, 1-1. doi: 10.1088/1755-1315/1/1/012014. Retrieved January 23, 2009, from Scitopedia.

"A new system for atmospheric measurements in the lower troposphere has been developed and successfully tested. The presented Small Unmanned Meteorological Observer (SUMO) is based on a light-weighted commercially available model airplane, equipped with an autopilot and meteorological sensors for temperature, humidity and pressure. During the 5 week field campaign FLOHOF (Flow over and around HofsjoUkull) in Central Iceland the system has been successfully tested in July/August 2007. Atmospheric profiles of temperature, humidity, wind speed and wind direction have been determined up to 3500 m above ground. In addition the applicability of SUMO for horizontal surveys up to 4 km away from the launch site has been approved. During a 3-week campaign on and around Spitsbergen in February/March 2008 the SUMO system also proved its functionality under harsh polar conditions, reaching altitudes above 1500 m at ground temperatures of -20 ∞C and wind speeds up to 15 m s-1. With its wingspan of 80 cm, its length of 75 cm and its weight of below 600 g, SUMO is easy to transport and operate even in remote areas. The direct material costs for one SUMO unit, including airplane, autopilot and sensors are below 1200 Euro. Assuming at least several tenths of flights for each airframe, SUMO provides a cost-efficient measurement system with a large potential to close the existing observational gap of reasonable atmospheric measurement systems in between meteorological masts/towers and radiosondes."

Rockwell, DL. (2008). **SAR for UAVs: The next big thing**. *Aerospace America*, 46-2, 22-25. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"Focuses on the application of synthetic aperture radars (SARs) in unmanned aerial vehicles (UAVs). The two primary modes used by SARs are the search or spot mode and the ground moving target indicator (GMTI) mode. The RDR-1700 is being developed by Telephonics for the U.S. Coast Guard's Bell Eagle Eye Deepwater UAV. The Forester ultra-high-frequency foliage penetrating SAR from Syracuse Research is created for the Army's FCS A160 Hummingbird UAV.

Warwick, G. (2008). **Sense of Shape**. *Aviation Week & Space Technology*, 169-4, 63-64. Retrieved January 23, 2009, from Academic Premier (Alaska Online databases).

"Reports that the U.S. National Aeronautics and Space Administration (NASA) is completing flight tests of the Fiber-Optic Wing Shape Sensor on its Ikhana unmanned aircraft. Indicates six optical fibers attached to the upper surface of the Ikhana's wing provide more than 2,000 strain gauge measurements in real time. According to Lance Richards, advanced structures and measurement group leader, the agency has demonstrated the ability to sense a wing's shape in flight, offering the possibility of improving aircraft efficiency."