Life Saver

By Robert W. Moorman

Flying in degraded visual environments (DVE) has always been a problem for pilots. But a small business in Virginia has developed remote sensing technology that could help pilots cope with this dangerous condition.

LandSafe allows OADs's UH-1H to land in brownout at the Army's Yuma Proving Grounds in Arizona. (Photo courtesy of OADS.)

The first thing you see on their website is a video of a UH-1H Huey slowly approaching the ground, then disappearing into a brown dust cloud. Only the wop-wop sounds of the rotor blades can be heard. Moments later the helicopter emerges from the cloud and lands safely. A succinct message is emblazoned on a black background: "LandSafe Aircraft Survivability System – The Brownout Solution."

Unlike a lot of websites that waste readers' time with hype and ancient testimonials, Optical Air Data Systems' (OADS) gateway to its business (**www.oads.com**) greets the visitor with an impressive video that shows what the company is selling and why the product is important to pilots.

OADS, headquartered at Manassas Regional Airport near Washington D.C., develops an assortment of lightweight and robust Light Detection and Ranging (LIDAR) and remote sensing solutions, including its LandSafe Precision Flight Instrumentation System.

LandSafe has its backers.

"The potential for what LandSafe can do to prevent hard landings or crashes in DVE conditions is there certainly," said General Gregory Martin (USAF, Ret.), former Commander of the Air Force Materiel Command, who has worked with OADS for the last four years. The fact that LandSafe and other OADS sensor technology has yet to make it on test military aircraft "indicates the tremendous difficulty a bureaucracy has in accepting new and potentially [so called] disruptive technologies," he said.

Despite efforts of former Secretary of Defense William Gates to streamline procurement rules, companies like OADS must wait years sometimes before their products become part of a broad-spectrum test program, said Martin.

The U.S. Department of Defense (DoD) is particularly anxious to acquire avionics systems that will assist military pilots in navigating through DVEs. Brownouts, whiteouts and other DVE events can cause spatial disorientation and loss of situational awareness, which could bring the aircraft down.

Lately, OADS has been very busy meeting with potential civil and military customers about LandSafe and other sensor technology. Initially developed as part of a 5-year Office of Naval Research (ONR) Program, LandSafe is an all-fiber optic laser integrated system that operates on the principle of Laser Doppler Velocimetry (LDV). Laser pulses from independent optical heads simultaneously interrogate the air outside the rotor wash to accurately measure aircraft altitude, airspeed, ground drift and relative wind in real time, even at low speeds or hover conditions, according to the company.

Customized signal processing algorithms are used to differentiate between returns from scatters, such as dust, sand, snow, rain or fog. This information is collected and processed in real-time and displayed to the pilot on a customized hover display.

In simple terms, LandSafe is a sense-through technology that shines light

from the cockpit toward the air in front of the aircraft or at the ground. Lasers bounce off the dust particles in the air. Data retrieved from that encounter is analyzed, then passed along to the pilot.

LandSafe can augment or even replace the ancient pneumatic pitot tube pressure measure instrument located outside of the aircraft. The pitot tube is prone to freezing up or providing inaccurate readings.

"Our system provides a direct measure of the true airspeed of the aircraft," said OADS President and co-founder Philip Rogers. "There is no issue of icing, drag or physical condition with our onboard calibration system."

Pilot tubes on helicopters are not reliable below 40 knots; yet, rotorcraft operate frequently at that speed or slower. Past attempts to make pitot tubes more sensitive to respond to pressure changes at or below 40 knots have failed.

"All you see is rotor wash," said Rogers, whereas LandSafe operates in "clean undisturbed air" down to zero knots.

The technology's ability to measure the relative wind is particularly important during takeoffs and landings. Sudden, unexpected wind gusts can on occasion lead to rollover accidents of helicopters.

OADS recently provided *Vertiflite* a demonstration of its multi-dimensional LandSafe system installed in its Bell Helicopter UH-1H Huey. The Vietnam era Huey is outfitted with sensors in the nose and belly of the rotorcraft to provide the pilot with essential flight information. Data boxes onboard analyze the information from the sensors.

A standalone Rockwell Collins test display is installed in front of the left seat to give the data readouts from LandSafe. Once in full production, LandSafe system would most likely be overlaid on to cockpit flat panel display.

The demonstration flight over Manassas Regional Airport outside of Washington D.C. aptly showed the ineffectiveness of the pitot tube as an airspeed instrument at 40 knots and lower. On several occasions during the flight, the pilot tube-linked display registered zero during slow speed flight while the LandSafe system accurately displayed the true air speed. At times, there was a difference of 20 knots or higher.

Aircraft-specific landing profiles can be entered into the LandSafe system with an orange dot signifying that it isn't safe to land and a white dot when it is, based on aircraft limitations on landing gear. So explained OADS Test Pilot Donald Vang, a former helicopter crew chief, who served tours in Afghanistan and Iraq. In 2008, he became a civilian pilot and was part of OADS' LandSafe DVE testing in Nevada and Arizona.

Wind Endeavor

At one time, 80% of OADS business involved the wind power industry. While aviation provides the majority of the business these days, remote-sensing devices for wind power remains a major part of the company's efforts.

The Vindicator Laser Wind Sensor (LWS) is a forward-looking LIDAR system capable of measuring real-time three-dimensional wind speed and direction data out to 300 meters.

OADS developed Vindicator in partnership with its commercial spin-off Catch the Wind, Inc. The company has produced several generations of LIDAR wind sensors for wind turbine control as well as wind resource assessment.

The compact, eye-safe Vindicator is used mainly as a tool to provide wind turbine control for giant wind power units. The Vindicator senses the wind as it approaches the turbine, allowing the control systems to optimize blade orientation to achieve maximum power yields.

The Vindicator is currently undergoing beta testing for validation and use by the wind power industry, mainly. But others have shown interest. Vindicator was used to demonstrate to broadcasters in the booth the ability to measure wind for football games and other sporting events.

In aviation, the WindSceptor air data sensor system, aimed at fixed-wing commercial and business aircraft, provides real-time information about relative turbulence levels at flight levels above and below the aircraft to ensure passenger comfort at cruising altitudes. The device also provides winds aloft information at flight levels above and below the aircraft to optimize flight time and fuel usage. The system also provides accurate airspeed, angle of attack and angle of sideslip below 20,000 to minimize runway length requirements during takeoff and landing operations.

The Vindicator Laser Wind Sensor is being tested to provide wind turbine control based on wind ahead of the turbine blade. (Photo courtesy of OADS.)

The OADS Huey testbed at their hangar at Manassas Regional Airport in Virginia. (Photo by the author.)

Debate and Testing

A major debate among pilots, engineers and scientists regarding remote sensing technology is the choice between the "see through" versus "sense through" tools. Which is better?

See through advocates want the pilot to be able to see obstacles and landing site in DVE conditions. The see through option of today is helpful, but insufficient for flying in DVE conditions, Rogers maintained.

Providing the pilot with an instrument that can be coupled to an autopilot, Global Positioning System (GPS), and obstacle avoidance technology would be the "ultimate solution," said Rogers.

OADS provided details of LandSafe at the AHS 68th Annual Forum in Fort Worth Texas last May. In its Forum paper, OADS mapped out the capability of its life saving technology in hostile environments, such as flying in DVE conditions. [For additional details on LandSafe, download the paper from the AHS Online Store at **www.vtol.org/store**.]

Getting customers to consider sense through technology as a viable pressure-monitoring tool is only half the battle. Also needed, said Rogers, is a change in mindset of the helicopter training community. Helicopter pilots are trained typically to fly under visual flight rules with the aid of objects for reference, particularly for takeoffs and landings. Consequently, much of the industry prefers see through technology.

A see through solution penetrates the dust cloud or snow, and gives the pilot an unobstructed view of the landing site. Typically, these solutions are radar or laser detection and ranging-based three-dimensional images. A sense through system provides quantitative information about the aircraft ground speed, drift and height above ground digitally at a high update rate. These are typically LIDAR solutions.

Sense-through and see-through technologies are getting a lot of attention these days because flying in DVEs is the leading cause of non-combat related accidents, according to the U.S. Army Program Executive Office (PEO) Aviation.

One misconception about LandSafe worth noting: The technology wasn't designed to help pilots see obstacles, such as telephone wires, radio towers and ground structures. Nor was it supposed to be linked with a terrain warning, autopilot or GPS system. Landsafe is a standalone system that was designed initially to help military helicopter pilots land or takeoff in DVE conditions.

"Accidents occurring in Iraq and Afghanistan were not due aircraft running into objects," Rogers said. "They were due mainly to brownout conditions," Rogers said.

LandSafe has a critical advantage over see-through competitors, according to OADS Chief Scientist Dr. Pri Mamidipudi, who has many years of experience in the design of high power lasers and laser remote sensing systems. The standalone technology continues to provide data in GPS-degraded environments and doesn't need to be linked with other avionics systems to operate.

LandSafe has accumulated over 1,000 flight hours of testing – including 200 hours in DVE conditions – measuring the airspeed and ground speed of the helicopter from 0-60 knots and the height above ground level up to 5,000 feet.

A close-up of OADS LIDAR sensors. (Photo by the author.)

The DVE tests, which the Office of Naval Research (ONR) said concluded in 2008, took place at Creech Air Force Base in Nevada, the Army's Yuma Proving Grounds in Arizona and at the Patuxent Naval Air Station near the Chesapeake Bay in Maryland.

A "major helicopter manufacturer" is currently evaluating the airspeed portion of the LandSafe, Rogers said. And the technology is slated for testing on other platforms. Vertiflite was unable to obtain specific tests results of LandSafe from ONR, the Army or the U.S. Navy's Naval Air Systems Command. A NAVAIR spokesman said only that LandSafe had successfully completed initial testing.

The U.S. Army, Marine Corps and Special Operations community are evaluating LandSafe for retrofit on their fleets of rotorcraft and as standard equipment for new military rotorcraft, said Rogers. Each military branch has its own testing to certify military aircraft and systems.

The Army, which operates approximately 3,800 rotorcraft, appears ready to move from the research and development and testing phases to putting together an acquisition strategy to acquire sensor systems to help pilots fly in DVE conditions, according to the Army's PEO. Whether the technology will be see through or sense through is anyone's guess at this point.

On the civil side, Emergency Medical Services (EMS) and search and rescue organizations have expressed interest in Landsafe. These outfits like the technology because it helps keep the helicopter in a stationary hover during rescue operations. This feature is particularly useful when trying to pull someone who is stranded or injured from the side of a mountain. The Los Angeles County Fire Department and the Fairfax County Fire and Rescue Department in Virginia are looking at the technology. Rogers expects FAA certification of LandSafe sometime in 2013.

Hobby Business

OADS President Phil Rogers, an experienced fixed-wing pilot, has amassed an impressive historic aircraft collection. It includes: a 1940 Navy Boeing Stearman N2S-1 (Boeing designation A75N-1) a 1942 North American T-6 Texan, a 1952 Chance Vought F4U-7 Corsair and a Lockheed T-33 trainer in restoration. The Corsair saw combat service with the French Navy and then was one of the aircraft used in the TV series "Baa Baa Black Sheep."

In addition, there is their 1964 UH-1H "Huey," which saw extensive action in the Vietnam War. The Huey is restored and painted in its original colors and used as the test aircraft for OADS sensor based technologies, including LandSafe.

The company also operates a Hawker Beech Premier 1A.

OADS's Vietnam-scarred Huey is surrounded by other icons of the history of flight, including this 1940 Boeing Stearman. (Photo by the author.)

Early Years

After obtaining a four-year and advanced degree from Cornell University, and taking advanced study at California Institute of Technology, Rogers went to work in 1977 for Lockheed's Advanced Development Projects, better known as the Skunk Works.

While there, he worked on problems affecting high performance military aircraft. In a round about way, this major assignment for the young aerospace engineer would plant the seed for the eventual formation of OADS.

"Back then we found that modern military jet aircraft were exceeding the capabilities of the air data measurement technology," Rogers recalled.

To resolve the problem, Rogers and his colleagues considered the development of a laser-based optical air data system that was unaffected by speed, temperature or weather anomalies. Unfortunately, laser technology in the 1970s and 1980s was not advanced enough to form the basis of a robust, lightweight remote sensor system that could provide reliable data not always provided by a pitot tube.

Rogers left the Skunk Works in 1987 to become an aerospace consultant. His goal to develop next generation remote sensing devices took shape in 1990 when the telecommunications industry gave birth to fiber optic laser technology. Shortly thereafter, Rogers and his wife Alisa, also an aerospace engineer, formed OADS.

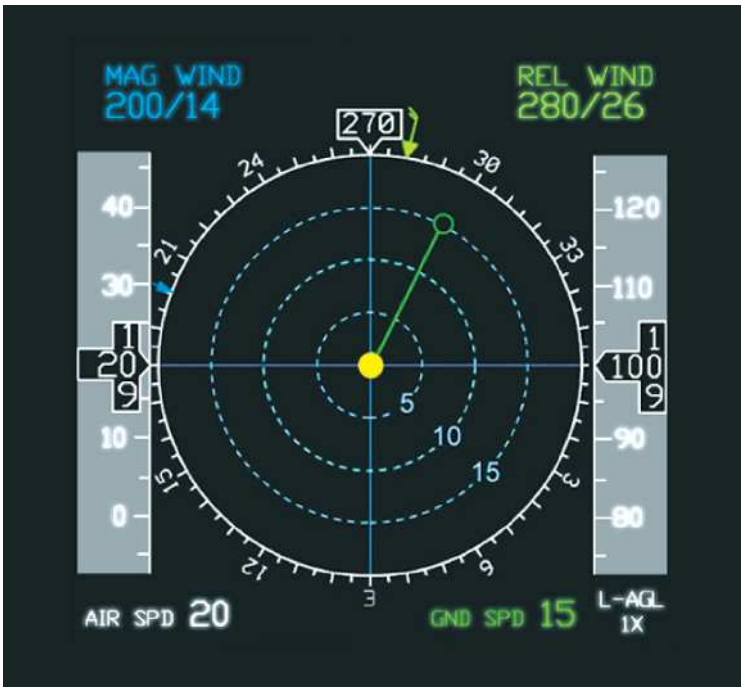
In 2000, OADS began work on its air data system. About that time, officials from the Bell Boeing V-22 Osprey tilt rotor program approached their company about developing a low-speed, airspeed system to help pilots who encounter "brownout" or other DVE conditions. OADS air data system was not ready for primetime, but the overture from the V-22 program officials proved to Rogers that his instincts were correct.

OADS is now expanding into the fixed

wing world after concentrating on sensor systems for rotorcraft for nearly ten years. One fixed-wing airframe manufacturer that should consider the technology is Airbus. On June 1, 2009, Air France Flight 447 crashed into the ocean 351 miles off of Brazil's northeastern coast. All 216 passengers and 12 crew perished. Frozen pitot tubes, which produced irregular speed-readings in the cockpit, were deemed a factor in the crash. Rogers maintains that this accident might have been prevented with LandSafe.

"Airbus is aware of and contributing to various international research activities in the field of speed measurement with optical features. OADS's LandSafe is one of them," said Airbus for this story. "Airbus is following closely research activities and will ensure that its aircraft make use of such enhancements as they become available."

LandSafe, which provides essential flight information in real time, might have help prevent the June 14, 2012 crash of an Air Force V-22 in Florida during a gunnery-training mission. Five crew sustained non-life threatening injuries. The official report of the accident investigation board notes that "No formal guidance exists to prescribe corrective procedures for a CV-22 that enters the wake of another CV-22. Pilots are thus left to adapt recovery procedures for entry into Vortex Ring State (which occurs when a CV-22 descends with power into its own wake) to recover from CV-22 wake entry…."



Cockpit display of the OADS system. The symbology could be integrated into existing displays. (Graphic courtesy of OADS.)

"What this system does is tell you when you're approaching [conditions like] a Vortex Ring State and helps you avoid it," said Major General Randy West, (USMC Retired), former commanding officer of Marine Air in Kosovo. West spent much of his Marine Corps career flying helicopters. "If you wanted, you could couple the technology to an auto pilot that would prohibit an aircraft from entering into it."

OADS is looking for launch customers from the rotorcraft and fixed-wing market, as well as a strategic partner who can help bring LandSafe and other OADS technology to market. The company prefers to partner with a leading avionics manufacturer, which is better equipped to bring LandSafe to market and integrate the technology with its onboard avionics.

Honeywell, Rockwell Collins, Garmin, Innovative Solutions & Support and Thales could be possible partners for OADS sensor based technologies for aircraft. Rogers declined to provide specifics about potential partners or current customers.

LandSafe could be put on the fast track soon because the DoD is particularly anxious to acquire avionics systems that will assist military pilots in navigating through DVEs.

Both the civil and military markets also are looking for technology that provides accurate, consistent, essential flight information. LandSafe is one technology that OEMs should consider as a safety tool and technological alternative to the pitot tube.

Brownout solutions like LandSafe could make DVE accidents a thing of the past. (Photo courtesy of OADS.)

About the Author

Robert Moorman is a freelance writer specializing in various facets of the fixed and rotor wing air transportation business. With over 27 years of experience, he runs a freelance writing business, RWM Associates. His writing clients include several of the leading aviation magazines targeting the civil and military markets. Robert can be reached at **rwmassoc@verizon.net**.

Competitors' Offerings

OADS isn't the only manufacturer of sensor systems to help pilots fly in DVE conditions.

Honeywell is developing an advanced lightweight compact sensor, which is part of a Cable Warning, Obstacle Avoidance System. A product for military applications could be available within a few years, said Honeywell.

BAE System's Brownout Landing Aid System Technology (BLAST) uses off-the-shelf technology to help helicopter pilots see through DVE obscurant conditions.

Rockwell Collins is fielding a brownout approach and hover symbology in its Common Avionics Architecture System (CAAS)-equipped cockpits and other cockpits, which feature its displays. The technology grew out of the Brownout Situational Awareness Upgrade Program in the early 2000s that Rockwell Collins performed for the U.S. Army. The technology was never fielded, but Rockwell Collins developed CAAS shortly thereafter. Among the features in CAAS is an approach and hover symbology that came out of the brownout upgrade program.

Thales' TopOwl Helmet Mounted Sight & Display system (HMSD) is not a brownout system specifically, but can also provide pilots with capabilities to help them in DVE conditions.

Rockwell Collins is fielding a brownout approach and hover symbology in its CAAS-equipped cockpits, such as this SOCOM MH-60. (Photo courtesy of Rockwell Collins.)