ACRP Problem No.  12-04-13

Wind Profiling System to Address General Aviation Airport Wind Hazards

ACRP Staff Comments: No comments offered.

TRB Aviation Group Committees Comments: AIRCRAFT/AIRPORT COMPATIBILITY CMTE - This is research to validate a commercial product. It appears to be outside the scope of ACRP.

Review Panel Comments: Not recommended — This research is to validate a commercial product.

AOC Disposition: No funds allocated. No discussion.
I. Problem Title

Wind Profiling System to Address General Aviation Airport Wind Hazards

II. Research and Problem Statement

General Aviation airports in the United States often do not have sufficient atmospheric measurements that are proximate to the airport and, most importantly to their runways. As air traffic at these General Aviation airports in the United States continue to grow, this inability to measure local winds may contribute to increased number of aircraft accidents and incidents. A low-cost, wind profiling system positioned at the glide-slope of the runways, as well as on the perimeter of the airport property shows promise for providing additional wind information to the air traffic control supervisor. This information may be used to alert the air traffic controllers, and ultimately the pilots about to land or take-off at these airports.

General Aviation airports generally do not have access to adequate Federal or State funds to purchase advanced weather monitoring equipment currently on the market due to the cost of those systems. However, the incorporation of this low-cost wind profiler may increase the airport safety substantially. This project aims to demonstrate and validate the usefulness of this wind profiler for alerting the traffic control supervisor to potential wind hazards, at a purchase cost that may be affordable for the less instrumented airports.

III. Objective

The objective of this project is to validate and demonstrate the utility of a low-cost, laser radar wind profiling system for runway glide-slope use for General Aviation Airports.

IV. Research Proposed

Ophir proposes to develop a low cost, small and robust, wind profiling system for use General Aviation airports. This system provides accurate, atmospheric wind profiles through the atmospheric boundary layer with a per-unit cost estimated to be less than $100,000!

The primary goals of this effort are to complete the prototype design; assembly, test and integration of a prototype laser radar (lidar) capable of measurement of wind profiles; complete Proof-of-Capability laboratory testing, and then to complete out-of-doors testing in a representative environment. The planned outdoor demonstrations will occur in Erie, CO at the NOAA Boulder Atmospheric Observatory (BAO) tower site, upon approval from NOAA, and at the Centennial Airport in Englewood, CO, upon approval of the Airport Authority and the FAA.

The following list of tasks are envisioned to achieve the objective stated in Section III.

- Design, assemble and laboratory test a prototype 455 nm wind profiling laser radar to demonstrate wind profiling in a controlled environment.

- Package the 455 nm wind laser radar for use out-of-doors in fair weather conditions.
Perform out-of-doors demonstration testing near a meteorological tower, such as the NOAA, 300 m AGL, Boulder Atmospheric Observatory tower located in Erie, CO.

Perform on-site demonstration testing, measuring the wind profile proximate to the glide slope at Centennial Airport.

Perform data analyses from the out-of-doors demonstration tests to compare the 455 nm wind lidar data to that of the meteorological tower and the airport observations and anemometer measurement results. In addition, compare the 455 nm lidar’s performance to that predicted by Ophir’s laser radar models to assist the design of the Production 455 nm Wind Lidar for future deployment.

Summarize all research in a Final Technical Report for submission to the ACRP.

V. Estimate of the Problem Funding and Research Period

**Recommended Funding:** $600,000; **Ophir’s Proposed Cost Share:** $300,000

**Research Period:** 18 months

VI. Urgency and Payoff Potential

Although the worldwide commercial aviation major accident rate has been nearly constant and quite low for many years, the increase in traffic over the years has meant an increase in the actual number of accidents. The worldwide demand for air travel is expected to more than double by 2017. This traffic volume could lead to 50 major accidents per year.\(^1\) It is estimated that weather hazards, including icing, turbulence, lightning and wind shear continue to be identified as a contributing factor in nearly a third of all accidents. Addressing weather hazards at airports with little to no weather forecasting capabilities, such as General Aviation airports, is a way to address part of this weather challenge. The urgency of putting in place a low-cost, wind profiling system to increase the safety of General Aviation Airports is a problem that needs to be addressed now.

If we consider Centennial Airport (Englewood, CO) which was the third busiest General Aviation Airport in the country in 2006, about 18% of the aircraft accidents from 1970 to 2011 report that wind was a contributing factor. Specifically, of the 200 accidents or incidents recorded at this airport over the past 40 years, about 34 of these, including three fatalities, reported wind as a contributing factor.\(^\text{II}\) This accident rate may be reduced significantly if a system were able to report the winds on the glide-slope of the runway for take-off and landing. At this time, at this particular airport there are two wind anemometers placed on opposing ends of the busiest runways. The airport also has wind socks at opposing ends of the runway area. And there are many occasions when these wind socks are pointing in opposite directions. The potential payoff is a decrease of at least 20% in accidents and incidents at airports such as Centennial Airport.
VII. Relationship to FTA Strategic Research Goals and TCRP Strategic Priorities

This problem statement of detection of wind hazards at General Aviation airports falls into the research field of safety for airport operations where emerging technologies and applications are made available to airports. This proposed project addresses the Federal Transit Administration’s (FTA’s) Strategic Priorities. Specifically, this project falls under the Strategic Research Goal #4: Improve Safety and Emergency Preparedness; Section 4.1 of this goal states “Identify Solutions to Improve Transit Safety.” This weather hazard identification tool seeks to improve transit safety – specifically providing warning of wind hazards at General Aviation airports. In addition, the low-cost, wind profiler falls under the Transit Cooperative Research Program’s (TCRP’s) Strategic Priority III – Continuously Improve Public Transportation.

VIII. Related Research

Several current and past projects are directly relevant to this problem statement and their results complement the research proposed here. They include the following:

- **Wind Field and Wind Shear Lidar Combining the RMCW and Edge Techniques for General Aviation Airports**
  NASA SBIR Phase II, Contract No. NAS5-32818
  Ophir constructed a low-cost, ground-based lidar for measuring dangerous wind shear conditions. The lidar was operated in the field where it demonstrated that it could make measurements of wind for ranges even beyond 10 km. However, this system was not eye-safe, nor compact, portable or low cost.

- **Ground-based Wind Profiler for Vertical, Wind Profile Measurements**
  Customer Confidential
  Ophir successfully completed a contract with a large, meteorological sensing, commercial company for trade studies to develop a cost-effective, upward-looking, wind profiling lidar system for use in airports, wind turbine farms and for atmospheric research.

- **Low-Cost, Compact Wind and Temperature Lidar for Measurements in the Boundary Layer**
  NOAA SBIR Phase I, Contract No. WC133R10CN0207
  Ophir successfully completed this project that entailed preliminary design and a proof-of-feasibility performance assessment for a wind and temperature lidar that was sufficiently low cost to enable wide-spread deployment within the NOAA National Profiler Network for forecasting data for the National Weather Service.

- **Additional related research efforts** include laser radar projects for both ground-based and airborne air data measurements for the Naval Research Laboratory, Naval Air Warfare Center, the US Air Force, two commercial aircraft manufacturers and three major aerospace companies.

Ophir proposes to leverage these past research efforts, along with ~$300,000 in cost sharing for the procurement of critical laser radar hardware, to design, develop and validate an inexpensive, small, light-weight, and power-efficient wind profiler for use at General Aviation airports.
IX. Person Developing the Problem

This problem statement is being developed by Ophir Corporation with the principal contributors including: Ms. Lisa G. Spaeth, Director of Business Development; Dr. Loren Caldwell, Director of Research and Development and Mr. Martin J. O’Brien, President. In addition, Ophir has worked cooperatively with FAA representatives at the Centennial Airport, as well as with the Airport Authority at Centennial Airport, including the Executive Director.

X. Process Used to Develop Problem Statement

The process used to develop this problem statement includes study of the aviation industry needs, discussions with and past contracts for various customers including the Department of Defense, NOAA, NASA, the National Science Foundation, several commercial aircraft manufacturers, and wind turbine manufacturers, the FAA and Airport Authorities. Ophir has been working in the aviation area, specifically developing avionics, such as the B-2 Bomber Pilot Alert System for identifying condensation trail conditions since the 1990’s.

XI. Date and Submitted by

Date of submission: 3 March 2011
Submitted by: Ms. Lisa G. Spaeth; lisas@ophir.com; 303.933.2200
Wind Profiling System to Address General Aviation Airport Wind Hazards:

A Proposal to Demonstrate a Laser Radar Wind Profiling System at Centennial Airport, Englewood, CO

March 3, 2011

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ii http://www.ntsb.gov/ntsb/Response2.asp
iii Federal Transit Administration, Strategic Research Plan, September 30, 2005.
iv http://www.trb.org/TCRP/TCRPOverview.aspx