P1.23 TOTAL WIND—A NEW APPROACH FOR AIRPORT WIND FIELD ANALYSIS

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1. INTRODUCTION

Airport efficiency has become more and more important as both aircraft traffic has increased and financial environment for both airlines and airports has become more competitive. Maintaining high level of safety while increasing efficiency will be essential for future airport operations.

- For airports, it is increasingly important to be able to demonstrate high level of weather-readiness for airline hub operations. Airport operation business will be more competitive in future.
- In Europe, weather is the reason for 42% of the delays. This translates roughly 2.5 million minutes and 400 Euro.
- Changing runway configuration can have an effect on traffic up to 2.5 hours after configuration change.
- For airlines, airport efficiency is one of the most important factors in both customer satisfaction and profitability.
- Among major U.S. airlines the number of flights arriving on time fell to 72.6 percent in 2000 compared with 76.1 percent in 1999. Similar trends are true also for European and Asian airports.

2 . TOTAL WIND APPROACH

One approach for helping the aviation industry to manage weather related delays is to create an application that helps ATC personnel to visualize and nowcast wind field and its evolution.

In USA, such products already exist, ITWS is one good example, NCAR WSSDM is an other. Internationally situation is different. Problem are different data formats and data types that make data fusion more complicated. Also, number of available measurement types vary from airport to airport. This means that wind application should be modular and its data interfaces well defined and easily adaptable.

Work processes are different. This means that if application that works perfectly for one user, is can be unsuitable to an other. For example, responsibilities for observers, meteorologists and ATC personnel can be very different and have to be taken into account when designing a weather information system.

3. POSSIBLE FEATURES

If a wind field application is developed, the major features could be:

- Data fusion from multiple inputs
- Data quality control
- Wind field analysis from measurements and numerical models
- Wind field visualization
- Incorporation of LLWAS algorithms
- Wake vortex advection estimates
- Advection estimates
- Analysis and nowcasting of 3-dimensional wind field
- Area of operation: radius 5 km – 20 km
- Height of wind field up to 500 m – 1000 m
- Modular design, allowing utilization of a small subset of all available features as appropriate to individual airport requirements.

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3. USER BENEFITS

Main benefits from this new approach are:

- Better wind measurement quality control and detection of faulty sensors and/or sensor siting
- More predictable wind conditions leading to early estimate of hazardous wind related phenomena mainly wind shear and microburst occurrences
- More predictable wind patterns and hence ability to better adjust holding patterns and runways in use
- Knowledge of possibility for wake vortex advection to other runways. This helps flight controllers to optimize spacing of landing aircraft.

The Wind Field application should be as modular as possible, ideally to be adaptable from small, local airports with limited financial resources needing only to know general wind situation at airport to large international airports with needs with needs for wind field visualization and prediction as well as wind shear, turbulence and wake vortex warnings

One important goal is to make Wind Field product suite information compatible with general AWOS systems, giving user tools to integrate visualization and other tools in one display or other output.

One of the main difficulties designing new aviation weather tools is how to convey the right information to the right user in the right way. Every piece of information is useless if is not either understood or it is so difficult to use that it is ignored. Since no commonly agreed way to visualize wind field at airports exists, it is left for system providers to find an acceptable visualization method. The challenge is not technical, but ergonomic.

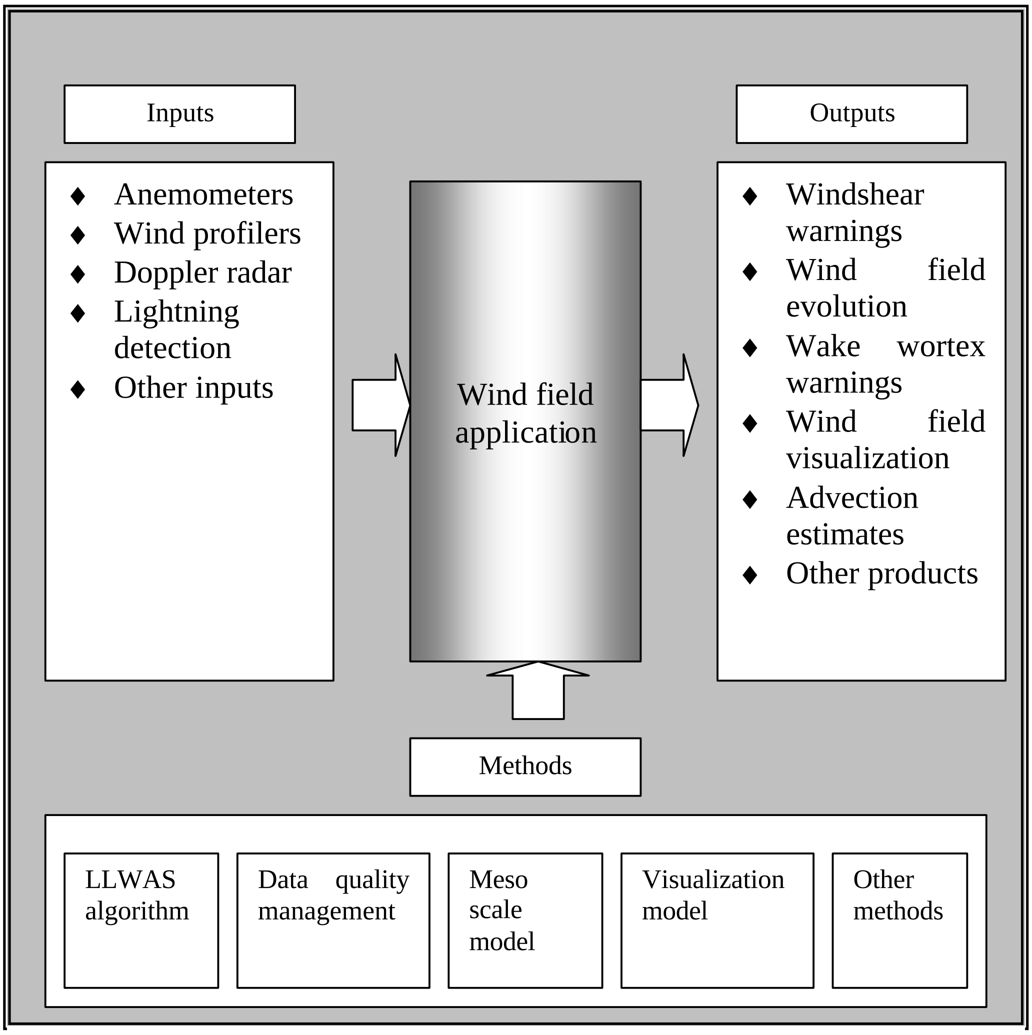

Fig1. Wind application principles

4. LLWAS WIND QUALITY ANALYSIS

Vaisala has introduced a new approach for LLWAS systems – fully integration with airport's automatic weather observation (AWOS) application. In order to achieve that, we have developed a modular, truly distributed computing architecture called ROA (Remote Object Architecture). In addition to full LAN transparency, ROA offers full hot-stand-by capability that is essential for airport operations.

To fully understand the reliability of LLWAS system, effects of various error sources were studied. To ensure the high quality output of phase III LLWAS system, wind measurements have to be equally reliable and error free. Main error sources for airport wind measurements are:

– Terrain inducted wind patterns.

– Wind anomalies caused by man-made structures or trees.

– Aircraft jet wash and wake vortex.

– Wind sensor malfunctions.

– Communication errors between wind measurement sites and main computer.

Simulations show that Most dangerous malfunction for one station was speed underestimate. Speed underestimate can be caused by faulty bearing in anemometer type wind sensor or shielding caused by vegetation or buildings. Simulations showed that 50% underestimate can delay the beginning of wind shear alert for several minutes and some cases totally suppress alarm condition.

Typically wind direction errors were not so dangerous for LLWAS operation. In some cases, LLWAS alert was delayed, but usually for lesser extent.

These simulations show that

- Use of solid state anemometers is recommended, reducing the risk for wind speed underestimate because of faulty bearings.
- LLWAS wind sites should be kept clear of shielding vegetation
- Quality analysis is very important; it is recommended that data quality is analyzed periodically so that wind data quality could be kept on constant level.

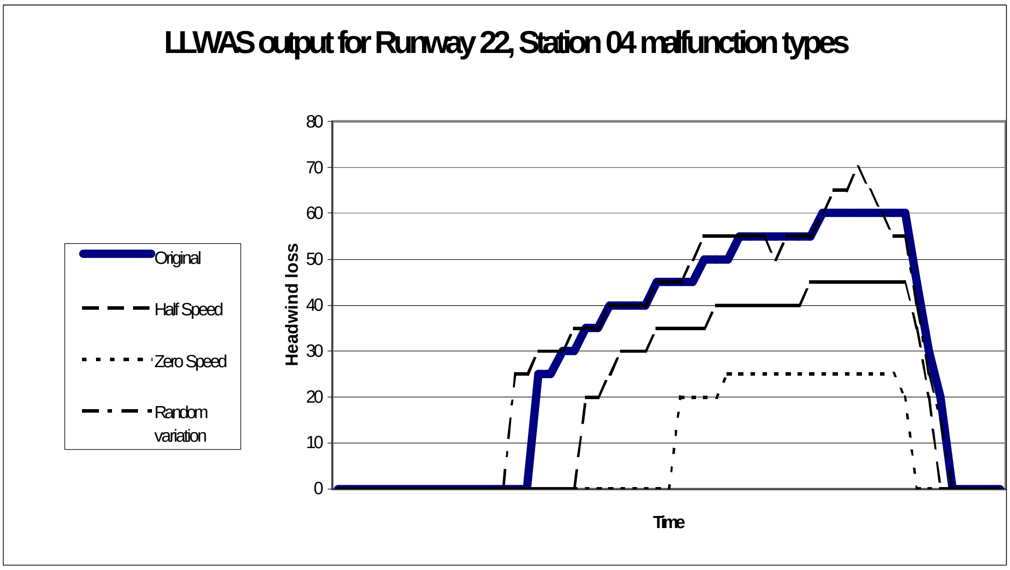

Fig2. LLWAS one station malfunction types