Improvement of Low-Level Wind Shear Information of JMA

Japan Meteorological Agency (JMA)

ICAOMET/ATM Seminar (Tokyo, 29 June-1 July 2015)
Wind Shear (WS) affects airplane safety operation

DRAW (TDWR) detects low-level wind shear in Rainy condition

Doppler Radar for Airport Weather (DRAW, Japanese version of TDWR) (from 1996)

Doppler LIDAR detects low-level wind shear in Sunny or Cloudy condition

Light Detection and Ranging (LIDAR) (from 2008)

Detection Area

Arrival  RWY  Departure

WS Observation in all weather conditions

DSM, MB alerts are simple text message, and contents are not enough.

Current Low-level Windshear Information of JMA
Wind Shear Alert
Over 20 kt Increase or Decrease of Head Wind Component

Microburst Alert
Over 30 kt Decrease of Head Wind Component

(Example)
0837 34LA MBA 39kt- 3nm FNL

- 34LA 34L (RWY)
  A: ARRIVAL
  D: DEPARTURE

- MBA MBA (Microburst Alert)
  WSA (Wind Shear Alert)

- 39kt- 39kt (wind speed change)
  + :GAIN
  - :LOSS

- 03nm FNL: 03nm (Position)
  FNL (Arrival side)
  DEP (Departure side)
  RWY (Over Runway)
To provide new WS information, JMA started a collaborative research with JAXA (Japan Aerospace Exploration Agency). JAXA developed information providing system, called LOTAS.

**LOTAS**
*(Low-level Turbulence Advisory System)*

- **LIDAR**
  - Observation by compact RADAR/LIDAR near airport

- **RADAR**
  - Short-term forecast of radar echo

- **Wind information on flight path**

- **Users (Airlines)**
  - Cockpit
Doppler Lidar (Narita, Tokyo) 

JMA JAXA Weather information compiler

WEB Server Wind information for ACARS datalink

Graphical wind information for operation staff

Terminal of operation control center ACARS System

Airplane Flight crew can check wind condition on flight path in cockpit

Based on LOTAS, JMA and JAXA developed a test system with cooperation of JAL and ANA

ALWIN (Airport Low-level Wind Information)
Head Wind
Cross Wind

Detection of Wind Change
(in past 10 minutes)

For Operation Staff

For Airplane

Cross Wind

Graph

Detection info

Head

Wind

Graph

Display of Flight Path Wind Information
Detection of Temporal Wind Change

(Wind Speed and Direction)

SL/MB information (position and moving direction)

Vertical Wind Profile

[*] indicating existence of large wind change

Wind variable/wind change is indicated by [VRB] or [V], like METAR

AVERAGE WIND WITHIN 5NM FROM RJAA

Wind Vertical Profile Detection

For Operation Staff

For Airplane

Display of Airport Information
Head Wind Graph

Text information (Wind speed/direction)

ALWIN

ALWINは、承認航空会社（JAL、ANA）により、調査研究用に評価を受け、評価期間は2014年3月から4月までの間、評価対象は羽田空港のRWY16R、16Lの着陸を目的とした。調査対象者は、全体として973件のフィードバックを得た。

### 調査結果

<table>
<thead>
<tr>
<th>項目</th>
<th>内容</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>目標</strong></td>
<td>各航空会社の要求により、調査期間を設定</td>
</tr>
<tr>
<td><strong>対象</strong></td>
<td>全体として着陸フライト、各操作スタッフ</td>
</tr>
<tr>
<td><strong>質問文書</strong></td>
<td>フライトクルー用（2ページ）、オペレーションスタッフ用（3ページ）</td>
</tr>
<tr>
<td><strong>評価内容</strong></td>
<td>4つのカテゴリーに分類</td>
</tr>
<tr>
<td><strong>フィードバック数</strong></td>
<td>973件</td>
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### アクセス環境

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日本気象協会

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2015年度航空便着陸LOTASアンケート（JAA用）

2回目のアンケート

はちみつ

1. LOTASは、着陸障害状況の早期発見を目的として、通常の着陸状況に対してアンケートを実施します。
2. 各航空会社の要約は、各操作スタッフの着陸状況及び使用状況について。
3. 評価：

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Over 80% of users hopes for operational use

- JAL, ANA All Crews: 75.23% Hope for practical application
- ANA Operation staff: 77.78% Hope for practical application

70% of crew thinks the system useful

- JAL Crews: 30.9% Useful, 40.14% Slightly useful
- ANA Crews: 25.0% useful, 40.79% Slightly useful, 14.47% Not useful
- No answer: 13.38%

Not hope: 11.93%, 2.29%
### Comments

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<th>Reason</th>
<th>Improvement Plan</th>
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<td>Actual wind did not consist with estimated wind.</td>
<td>- Add WS info in the past 10 min to notify details of current weather condition tendency.</td>
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<tr>
<td>Wind changes by time (time between data acquisition and landing).</td>
<td>- Add gust information.</td>
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<tr>
<td>Gust wind.</td>
<td>- Indicate wind variable width in ACARS graph.</td>
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<tr>
<td>UP/DOWN DRAFT (First prototype ALWIN provided mean wind only).</td>
<td>- (Calculated width is horizontal component only. But there is good relationship between horizontal and vertical wind by isotropy of turbulence).</td>
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<td>Can not use in rainy condition.</td>
<td>- Laser is attenuated by rain.</td>
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<td>LIDAR: Infrared radiation.</td>
<td>- Utilize TDWR data.</td>
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### Users' Comments for ALWIN
Comparison with anemometer

- **RMSE:** 1 kt
- **Mean Direction (deg.):** 6.48 deg
- **Mean Wind Speed:** 2.05 kt
- **Max Wind Speed:** 2.63 kt
- **Min Wind Speed:** 1.85 kt
- **GUST (MAX - MEAN):** 1.61 kt

Comparison with FDR (NRT16R)

- **RMSE:** 2-3 kt
LIDAR can not observe in rainy weather. In such conditions, RADAR will become important to provide wind products. (The new data is not yet adopted in the current test system, but will be tested soon)
Wind information for ACARS datalink

Graphical wind information for operation staff

Terminal of operation control center

ACARS System

Airline

Anemometer

Real time data of 6 sec intervals

(Current test system uses 10 min intervals)

Airport Doppler Radar Administration System (ADRAS)

Data transmission System in JMA (ADESS)

Website of Aviation weather information in JMA (MetAir)

ALWIN is scheduled to start operation in April 2016

HND, NRT, KIX
• To make more effective windshear information, JMA developed new information with JAXA and Airlines (JAL, ANA)

• New information named ALWIN was provided by test system and the evaluation shows users request its operational use

• ALWIN is to be improved so as to meet requirements of users

• ALWIN is scheduled to start operation in April 2016