Wake Vortex in Flight Simulation

WakeNet2-Europe

Simulator Engineering and Projects
Hamburg May 10 – 11, 2004

How it started
Available on the following simulators

/ B737-300/400/500 (CAE)
/ A319 (CAE)
/ B767-300ER (THALES)

Validation

/ Subjectively tuned by Pilot during simulator acceptance
This model simulates the effects of an aircraft passing through a single wake vortex or a pair of wake vortices. The orientation, magnitude, and duration of the vortex may be modified through the instructor facility of the simulator.

The wake vortex model is designed for operation in a real-time simulation environment. It uses the aerodynamics model provided by Boeing and a qualified environment model to provide the required wind fields. Reasonable simulation of aircraft flight dynamics is the intention of this model.

The software implementation of this model is designed for use in a CAE manufactured flight training device.

Refer to:

- Journal of Aircraft, Vol. 33, No. 2, March-April 1996:
- Vortex Wakes of Two Transports Measured in 80 x 120 Foot Wind Tunnel (V.J. Rossow, et.al., NASA Ames Research Center, Moffet Field, CA 94035-1000)
- FAA - 727-200 Level C Full Flight Simulator
**AIRCRAFT-DEPENDENT DATA**

**A319 data:**

**Wing data:**

DATA MAC\_319 / 13.76 /

DATA B\_319 / 111.83 /

The A319-100 wing span is 111.83 ft. The fuselage diameter is 12.92 ft. Therefore, if each wing is split into ten sections, each segment is 4.95 ft wide.

**A319-100 wing chord data are estimated for lateral distances of:**


8.94 13.89 18.84 23.79 28.74 33.69 38.64 43.59 48.54 53.49 feet from the aircraft centerline.

**DATA CHRD\_319**

A 1, 1.6, 2, 2.6, 3.2, 3.8, 4.4, 5

A 8, 8.6, 9.2, 9.8, 10.4, 11, 11.6, 12.2, 12.8, 13.4

**DATA WSWP\_319 / 27.0 /

**DATA FDIAM319 / 12.92 /

**DATA A0\_319 / 5.67 /

**DATA M\_319 / 0.3 /

**DATA AOAST319 / 15.0 /

**Horizontal stabilizer data:**

**DATA HMASC\_319 / 8.86 /

DATA HB\_319 / 40.83 /

The A319-100 horizontal stabilizer span is 40.10 ft. Therefore, if each side is split into 4 sections, each segment is 5.10 ft wide.

**A319-100 stabilizer chord data are estimated for lateral distances of:**

-17.85 -12.75 -7.65 -2.55 2.55 7.65 12.75 17.85 feet from the aircraft centerline.

**DATA HCHD\_319**

A 4.9, 7.3, 9.8, 12.2, 12.2, 9.8, 7.3, 4.9

Time. Since the vortex is fixed with respect to the runway and the aircraft position with respect to the runway is known, the position of the aircraft with respect to the vortex may be accurately determined. Thus, the vortex encounter is simulated solely as a function of geometry.

**A summary of instructor inputs for the simulation is shown in Table I.**

<table>
<thead>
<tr>
<th>Control</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude</td>
<td>&gt; 2000 ft AGL</td>
<td>Direct or at-altitude encounter; Approach Encounter</td>
</tr>
<tr>
<td>be</td>
<td>&lt; 2000 ft AGL</td>
<td></td>
</tr>
<tr>
<td>Snow Angle</td>
<td>0 deg</td>
<td>Effect of approach encounter, pure trailing CCW vortex</td>
</tr>
<tr>
<td>be</td>
<td>&gt;-90 deg and &lt; 90 deg</td>
<td>Approach encounter, pure trailing CW vortex</td>
</tr>
<tr>
<td>Lateral offset</td>
<td>0</td>
<td>Effect of encounter; lateral distance from vortex axis to aircraft flight path</td>
</tr>
<tr>
<td>Vertical offset</td>
<td>0</td>
<td>Effect of encounter; vertical distance from vortex axis to aircraft flight path</td>
</tr>
<tr>
<td>Turn</td>
<td>0</td>
<td>Effect of encounter; vertical distance from vortex axis to aircraft flight path</td>
</tr>
</tbody>
</table>

**NOTE**: This number is 600 ft. It is the current version. It will be changed to 2000 ft AGL to allow simulation of an approach from the normal altitude at the outer marker.

Wake Vortex, Hamburg, May 10-11, 2004 © by Lufthansa Flight Training
Figure 1. Direct Entry for a Vortex Encounter

Figure 2. Entry at Altitude for a Vortex Encounter
Vielen Dank!

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