NATIONAL INSTITUTE OF AEROSPACE

Final Report For:
NASA # NNL06AC78T

Task Title:
Guide to APA-Based Models

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Reporting Period:
January 2008

National Institute of Aerospace

NWRA-SEA-08-R367   **9 January 2008**

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In Robins and Delisi (2008), a linear decay model, a new IGE model by Sarpkaya (2006), and a series of APA-Based models were scored using data from three airports. This report is a guide to the APA-based models.

A list of models used in Robins and Delisi (2008), as presented in Section 3, is as follows:

APA 3.1.1	- the original APA model with a minimum circulation decay in ground effect of $\Gamma/\Gamma_o = 1 - T/K$, K=8, and a modified version of APA 3.1.1 with K = 5.
APA 3.2.1	- APA 3.1.1 with Proctor's model for the circulation decay during the initial stages of IGE; with the same minimum decay rates as in APA 3.1.1. Proctor's model is linearly phased in between the times of 0.25T and 0.4T, where T is the time scale b_o/V_o, b_o and V_o being the initial separation and descent speed of the vortices.
APA 3.2.1E	- APA 3.2.1 with a minimum decay rate equal to the environmental decay rate at the beginning of IGE or $\Gamma/\Gamma_o = 1 - T/K$, K=8, if the environmental rate is less than this; also scored was a version of APA 3.2.1E with K=5.
APA 3.2.2	- An alternate version of APA 3.2.1 (K=5 only) where the onset of Proctor's model occurs exactly at a time of 0.25T.
APA 3.2.2E	- An alternate version of APA 3.2.1E (K=5 and 6) where the onset of Proctor's model occurs exactly at a time of 0.25T.
Sarpkaya's IGE Model	- described by T. Sarpkaya in a report entitled "A Physics-based Real-time IGE Model of Aircraft Wake Vortices Subjected to Crosswind and Stratification."
$1 - T/5$ Linear Decay	- APA 3.1.1 with the IGE non-dimensional decay rate equal to $1 - T/5$.

The source codes for models APA 3.1.1, APA 3.2.1, APA 3.2.1E, APA 3.2.2, APA 3.2.2E, and Sarpkaya's IGE Model are provided on an accompanying CD-ROM disk. The one-line code change that determines the value of K for the APA 3.X.X models is clearly indicated in the code for the respective models. To find this code,

simply search for "C*********" in files `ge1pth.f` and `ge2pth.f` to find the code that sets K.

The code change required to transform APA 3.1.1 to the 1 – T/5 Linear Decay model is as follows:

Original Code from APA 3.1.1 files ge1pth.f and ge2pth.f:

```
C
C****************  FOLLOWING CODE FOR K=8 ********************
          DGMIN = 0.125*TWOPI*VZIN*VZIN
C****************  FOLLOWING CODE FOR K=5 ********************
CCC          DGMIN = 0.2*TWOPI*VZIN*VZIN
C**********************************************************
C
          IF(DELGAM.LT.DGMIN) DELGAM=DGMIN
C
          DGFAC = DELGAM/GAM(1)
          DO I=1,NPTS
             DGAM(I) = GAM(I) * DGFAC
          ENDDO
C
```

Modified Code for the 1 – T/5 Linear Decay Model:

```
C
          DELGAM = 0.2*TWOPI*VZIN*VZIN
C
          DGFAC = DELGAM/GAM(1)
          DO I=1,NPTS
             DGAM(I) = GAM(I) * DGFAC
          ENDDO
C
```

The input parameters required for all code versions are the same as described for LINES 3-10 in Robins and Delisi, 2005.

References

R.E. Robins and D.P. Delisi, 2008. Evaluation of Real-Time Wake Vortex Prediction
    Models and Recommendations for IGE. NorthWest Research Associates Report
    R366, Seattle, WA, January.

R.E. Robins and D.P. Delisi, 2005. Software Package for Simulation of Trailing Vortex
    Evolution using the Algorithms APA (version 3.2), TDAWP, and D2P. NorthWest
    Research Associates Report R291, Bellevue, WA, February.

T. Sarpkaya, 2006. A Physics-Based Real-Time IGE Model of Aircraft Wake Vortices
    Subjected to Crosswind and Stratification. Hydrodynamics Applications, Inc. report
    to NASA, October.