

AFDD Motion Data Sharing Agreement

The motion file that the HART team agreed to release was obtained by AFDD using the OVERFLOW-2/CAMRAD-II loose coupling methodology. This motion file contains blade motion data for the HART II baseline case (BL5.3) obtained after the 8th coupling iteration using the standard grid (19.4 M grid points). Please refer to the reference, AHSSF06_AFDD.pdf (Lim) available in the HART II DLR ftp site.

The description of the motion file is given as follows:

===== description of the HART II BL AFDD motion file =====

The blade coordinate system is +X spanwise, +Y towards the leading edge, and +Z up along the shaft axis. The quantities, (xqc, yqc, zqc) are the locations of the quarter chord of the undeformed blade, and include the offsets of the quarter chord line from the rotating hub coordinate system (origin in the hub center) such as the torque offset or sweep. The quantities, (dx, dy, dz, dxang, dyang, dzang) are translational and angular deformations of (xqc, yqc, zqc), and so include the elastic deflections, trimmed control motions and the precone effect but no built-in twist angle. The precone angle is 2.5 degrees and the built-in twist is defined as 0 degree at the 75% blade span with a twist rate of 8 degrees. The angular deformations are Euler angles that are computed with a sequence of Z, Y and then X (Z-Y-X) rotations. The translational quantities (xqc, yqc, zqc, dx, dy, dz) are non-dimensionalized with the blade radius, and the rotational quantities (dxang, dyang, dzang) are in degrees.

The data structure begins with the blade quarter chord information, and then describes three translational and three rotational deformations for each azimuthal angle in separate blocks. The 'nspan' is the number of spanwise locations for the deformations, and the 'npsi' is the number of azimuthal positions given. Any intermediate azimuthal position needed for the CFD computation should be computed by the spline interpolation or Fourier analysis.

nspan npsi

100 24

| xqc | yqc | zqc |
|-----------------------|-----------|-----------|
| .01000000 | .00000000 | .00000000 |
| (..... abbreviated) | | |

psi

.00

| dx | dy | dz | dxang | dyang | dzang |
|-----------------------|-----------|-----------|------------|-----------|------------|
| .00000190 | .00000004 | .00043604 | -.01571050 | .00734076 | -.00028581 |
| (..... abbreviated) | | | | | |

The following are the description of the requested results computed using the HART II BL motion file. Airloads, hub loads and wake position are mainly suggested while velocity maps are suggested as optional.

Airloads

1. M^2C_n time history at $r/R = 0.87$

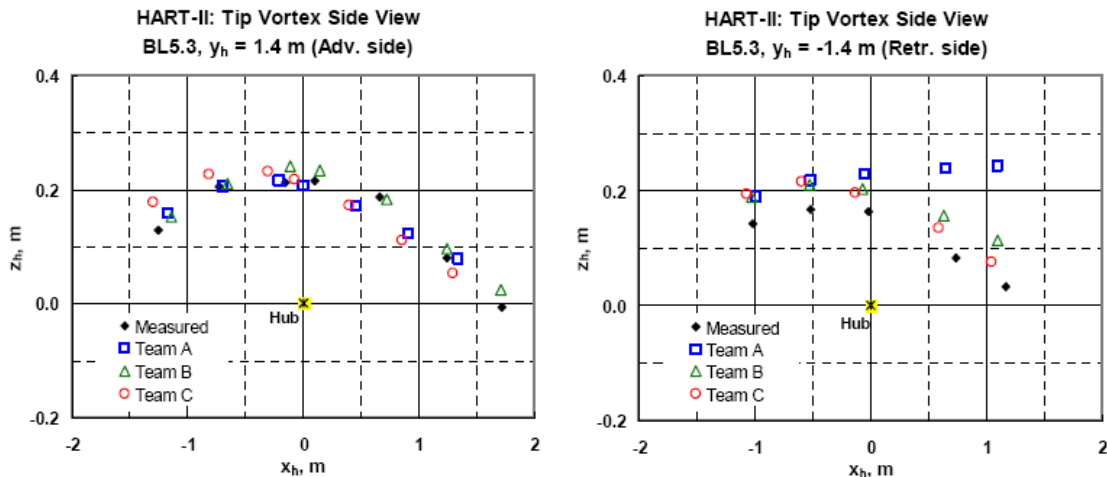
Nonrotating Steady Hub Loads

1. thrust, T [N], +ve up along the shaft
2. hub roll moment, M_x [Nm], +ve advancing side down
3. hub pitching moment, M_y [Nm], +ve nose up

Wake Positions

1. vortex position [m], $(x_h, +1.4m, z_h)$ in the longitudinal cutting plane at $y_h = 1.4m$
 - a. Pos. 17-19 in the 2nd quadrant for the blade azimuth of 70 degrees
 - b. Pos. 20-23 in the 1st quadrant for the blade azimuth of 20 degrees
2. vortex position [m], $(x_h, -1.4m, z_h)$ in the longitudinal cutting plane at $y_h = -1.4m$
 - a. Pos. 43-45 in the 1st quadrant for the blade azimuth of 20 degrees
 - b. Pos. 46-47 in the 2nd quadrant for the blade azimuth of 70 degrees

The vortex positions, $(x_h, \pm 1.4m, z_h)$ are in the hub coordinate system after a shaft tilt. The positive x_h is downstream, the positive y_h is to the right, and the positive z_h is up along the shaft. The sample figures shown below are from ERF03_AFDD.pdf (Lim).



Velocity Maps (OPTIONAL)

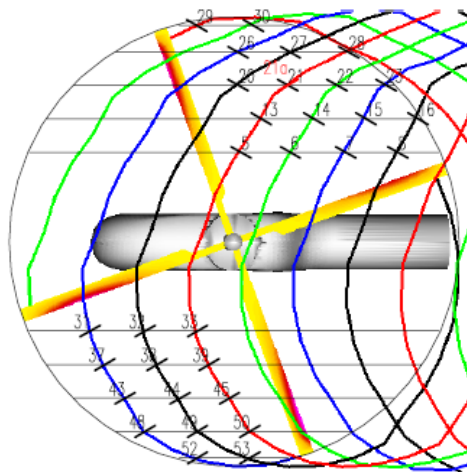
1. velocity vector maps of the positions given with the tip vortex position centered with a 30° upstream view. The data should contain three components of the positions [m] $(x_v, y_v, 0)$ and three components of the velocities [m/sec] (U_v, V_v, W_v) for the velocity field, $-0.12m \leq x_v, y_v \leq +0.12m$, $z_v = 0m$
 - a. Pos. 17 for blade azimuth of 70 degrees
 - b. Pos. 22 for blade azimuth of 20 degrees

The vortex coordinate system is defined as the PIV measurement coordinate but centered with the vortex core, such that the x_v , y_v are positive right in the horizontal axis and positive up in the vertical axis. The PIV vortex position numbering scheme is shown in the figures below, and the detailed information could be referred to the HART II Test documentation.

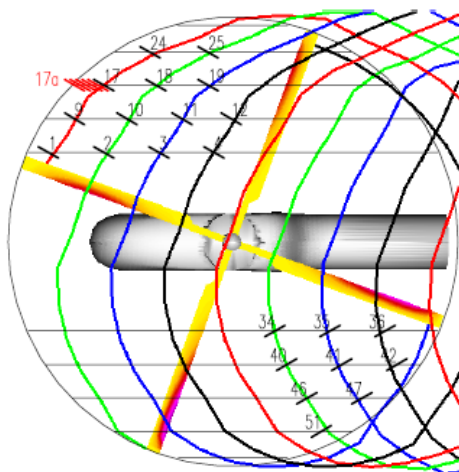
===== format of vortex position (free write format) =====

```
TITLE= "Your Organization"
VARIABLES=
"X (m) ", "Y (m) ", "Z (m) ", "U (m/s) ", "V (m/s) ", "W (m/s) "
-0.120 -0.120 0.000 4.12345 1.12345 1.12345
( ..... abbreviated )
```

Baseline, $\psi = 20^\circ$



Baseline, $\psi = 70^\circ$



The HART II BL motion file requesters are assumed obligated for sharing their computed results in return for the upcoming HART II workshops prior to any conference presentation, and also strongly recommended to present their computed results in the HART II workshops.

In order to request the HART II BL AFDD motion file, please send an e-mail to Joon Lim, AFDD (jwlim@mail.arc.nasa.gov, +1-650-604-5891). The computed results should be sent to Joon Lim early enough if you wish that your results are included for the workshop result comparison, so as to combine all the CFD results from the workshop participants.