

APA Program Vortex Run Outputs

The names of the output Cases are constructed using the prefix specified in the "Wake Vortex Analysis" dialog box, and the time of the corresponding snapshot contained in the case, to the nearest 0.01 seconds. For example, if the prefix is "RTA" and 5 snapshots will be taken of the 300 second flightpath described above, then the names of the output cases will be RTA60.00, RTA120.00, RTA180.00, RTA240.00, and RTA300.00.

The Parameters output in each of the Cases are as follows:

<u>Physical Quantity</u>	<u>Units</u>	<u>Parameter Name</u>
"Snapshot" Time (scalar, i.e., 1 value)	seconds	same as Time parameter selected in input dialog box
Altitude of left vortex	feet	ALT_L
Lateral displacement of left vortex from a/c centerline (+ = right)	feet	Y_L_FT
North position of left vortex	nautical miles	N_L_NM
East position of left vortex	nautical miles	E_L_NM
Circulation strength of left vortex	ft ² /s	GAM_L
Circulation strength of left vortex, normalized by initial strength	-	GAMR_L
Altitude of right vortex	feet	ALT_R
Lateral displacement of right vortex from a/c centerline (+ = right)	feet	Y_R_FT
North position of right vortex	nautical miles	N_R_NM
East position of right vortex	nautical miles	E_R_NM
Circulation strength of right vortex	ft ² /s	GAM_R
Circulation strength of right vortex, normalized by initial strength	-	GAMR_R
Time at which vortex element was created	seconds	BORN_ON
Age of vortex element (difference between "Snapshot Time" and "BORN_ON" time)	seconds	AGE

The routine will create autoplots of these parameters for up to 5 Cases (snapshot times). For each Case, the autoplots will present:

N_L_NM vs. E_L_NM & N_R_NM vs. E_R_NM

ALT_L vs. E_L_NM & ALT_R vs. E_R_NM

ALT_L vs. N_L_NM & ALT_R vs. N_R_NM

ALT_L vs. GAM_L

ALT_L vs. GAMR_L

ALT_L vs. E_L_NM and N_L_NM, & ALT_R vs. E_R_NM and N_R_NM (3D plot)

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Definition [\[edit \]](#)

If $\mathbf{V}$ is the fluid [velocity](#) on a small element of a defined curve, and $d\mathbf{l}$ is a vector representing the [differential](#) length of that small element, the contribution of that differential length to circulation is $d\Gamma$:

$$d\Gamma = \mathbf{V} \cdot d\mathbf{l} = |\mathbf{V}| |d\mathbf{l}| \cos \theta$$

where θ is the angle between the vectors $\mathbf{V}$ and $d\mathbf{l}$.

The circulation around a [closed curve](#) C is the [line integral](#):^[1]

$$\Gamma = \oint_C \mathbf{V} \cdot d\mathbf{l}$$

The [dimensions](#) of circulation are length [squared](#), divided by time; $L^2 \cdot T^{-1}$, which is equivalent to velocity times length.

In PRACTICAL terms., Gamma (Γ) is the vortex strength, and the local velocity can be solved for any radius by the following equation

$V = \Gamma / 2\pi r$ where V is in fps, and r is in feet (APA outputs Gamma in ft squared/sec)