Wind is the "garbage collector" in the system.

By Frank Gutierrez

The FMS computes track angle and ground speed from the successive position computations. The FMS receives Heading and TAS from the system. The FMS then solves for the final side of the vector triangle and computes wind (side 1- HDG/TAS; side 2- TRK/GS; side 3- Wind direction/magnitude).

In a perfect world, the difference between TRK/GS and HDG/TAS is actual wind (direction, magnitude). Of course, the world is far from perfect...

Any errors in position can affect the TRK/GS side of the triangle. Any sensor errors can affect the HDG/TAS side of the vector triangle. Consequently, the wind computation is the collective result of all (position and sensor) errors. A portion of the computed wind vector represents the "actual wind", and the remainder is a summation of all other (position and sensor) errors.

Previously, when a customer called in and reported errors in wind, I would ask them if the two FMCs (assuming dual equipage) had numbers for track angle and ground speed that were 'pretty close' (meaning within a degree for track angle and with a knot or two for groundspeed). If the answer was yes, then the FMCs is navigating per design. The differences in wind are a result of collective errors from the heading and true airspeed data, the position computations, or some of both.

In those cases where the track angle and ground speed agreed within a degree and a knot, there is nothing wrong with the system, so no amount of changing boxes will affect the result (unless the issue was sensor error, and by changing a box the sensor error is reduced). In some cases, changing a box did not affect the position computation performance, but actually made the wind issue worse.

I would expect that stronger winds will indicate closer to each other in direction, where lighter winds will be more likely to differ by greater angular values.

Probably not the answer you were hoping for, but this has been my experience with our systems. Due to the nature of the computation (and I'm guessing this issue is more pronounced with the AHRS based system), wind is a garbage collector. I've never correlated the differences seen between AHRS and IRS equipped aircraft, but I can believe that the heading sensor could make a huge difference in the goodness of the wind values provided.

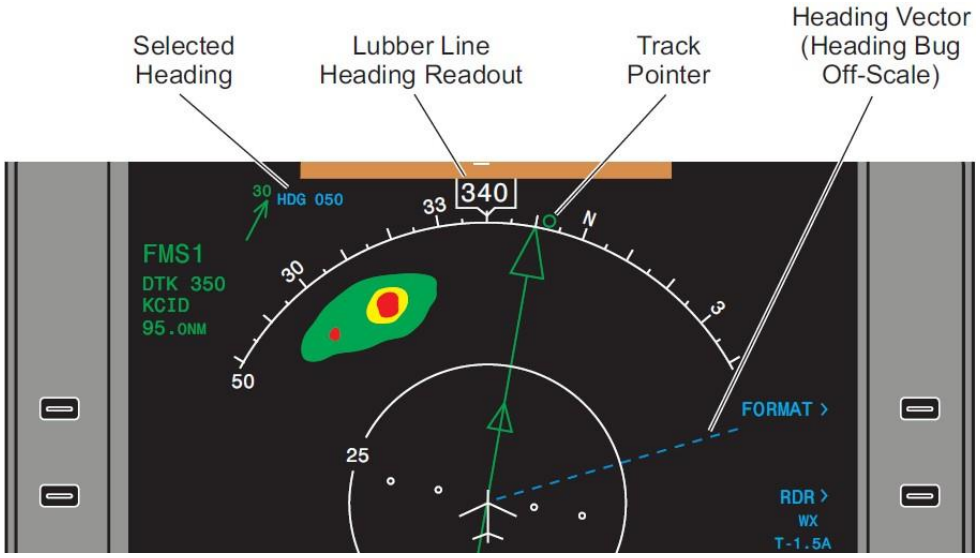
I am aware that there is one OEM that chose to strap the system to provide IRS wind (instead of FMS wind) as the value displayed on the EFIS

Wind Magnitude and Direction Display
A wind vector and speed readout show if the FMS detects a significant amount of wind. The wind vector is an arrow that turns to show the wind direction. Wind speed numerically shows (in knot next to the arrow).

Wind magnitude and direction is shown full-time to the left of the heading readout on the PFD. Wind magnitude and direction is shown to the left of the heading readout on the MFD Rose, Arc, and PPOS Map display formats.

The wind direction arrow represents the wind direction relative to the aircraft (the arrow points in the direction the wind is blowing to. The above example shows left quartering tail wind from 210°. The color of the wind magnitude and direction is green if from the on-side FMS and yellow if from the cross-side FMS. Wind magnitude and direction are sourced from the on-side FMS unless the cross-side FMS is the active Nav source; then the cross-side FMS is the source.

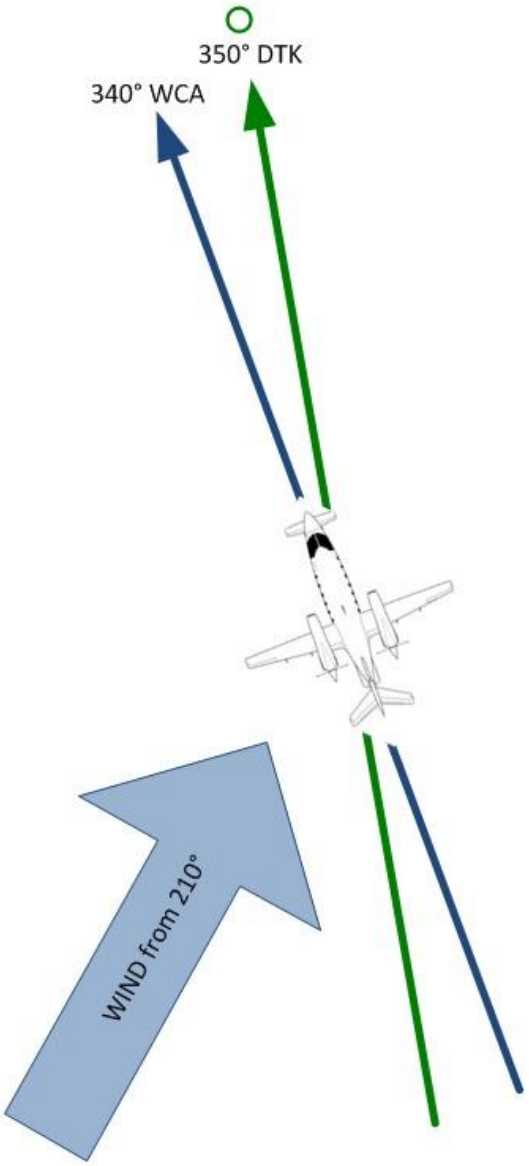
Track / Drift Angle Pointer
The open-circle-shaped track/drift angle pointer is positioned on the Compass Rose or Heading Arc at the current aircraft track over the earth. The difference between the position of the track/drift angle pointer and airplane heading (read under the lubber line) is the drift angle. When the pointer is under the lubber line, the drift angle is zero. The track/drift angle pointer is green if it is being driven by the on-side FMS source and yellow if it is being driven by the cross-side FMS source.



The track or drift angle is the (wind correction angle) or the angle the aircraft needs to fly into the wind to maintain a straight course over the ground.
In the above example you can use the following numbers:

Wind Direction 210° left quartering tail wind (reciprocal of 030°)
Wind Speed 68 knots (not shown in the above figure)
Course/Direct Track (DTK) 350°
TAS (I put the aircraft at 235 KTS for this example)

Results:
Heading 340°
Wind Correction Angle -10° correction into the wind to maintain the DTK of 350°



MFD NAV STATUS Page (CL-300)
The drift angle shall be displayed suffixed with an ’L’ or ’R’ to indicate the relative direction of the track angle with respect to the heading angle.

If the wind is causing the aircraft track to be to the left of heading the drift angle is considered to be ’left’.

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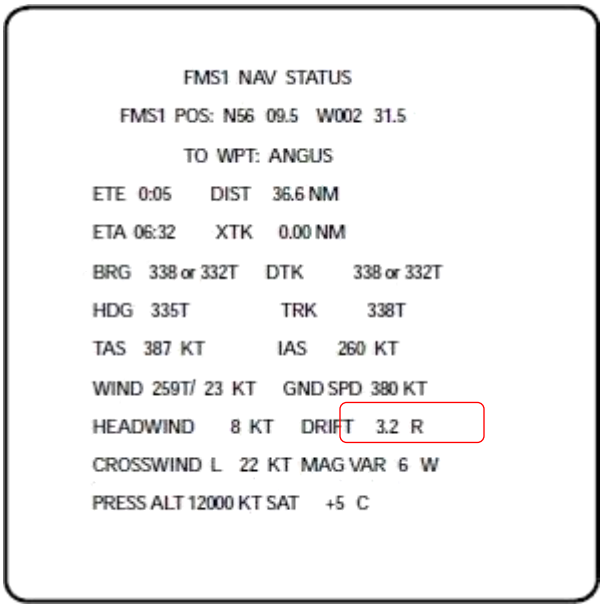

MFD NAV STATUS Page (7”X7” Display, True North Referenced) Selected course shall be displayed as Desired Track (DTK) for selected course.

Selected course shall be displayed as Course (CRS) for RJ, RJ--700 and RJ--900 aircraft types.

Drift Angle is output from the FMC, which indicates the current aircraft track over the earth. This value is output in value between 0 and 90 with an indication of left or right. While on ground, the FMC shall output a value of 0 for drift angle. If insufficient data is available to compute drift angle, the FMC shall output NCD.

Drift is calculated using radial position error, time in air, and NM/hr. It's computed every five minutes, and is displayed as dashes until aircraft time in air > 30 minutes.