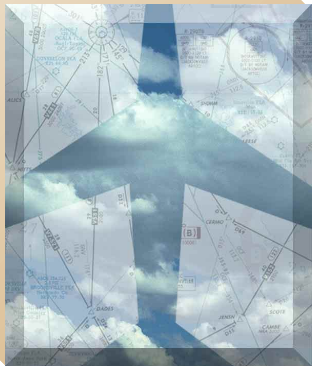

The Chart Clinic – Ninth in a Series

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It's pretty obvious that the shortest distance between two points is a straight line. When flying, one can argue whether that is a geodesic line, a great circle line, and whether or not either one of those is accomplished by drawing a straight line on a piece of paper. And when that flat piece of paper represents a portion of our round world, it becomes even more interesting – and maybe a bit confusing. But the real challenge is to make the shortest distance a reality – in a world of airways that zig zag across the country.

Do you have to fly the airways? What about altitudes on your own direct routes? What about radar coverage? What about communications coverage? What about GPS?

Off-Airway Navigation

There are a number of ways to create shorter routes and fly off the airways. Two series of Jeppesen charts can be used to draw direct routes. The easiest is the RNAV enroute series which uses 11 charts to cover the entire U.S. In the next article, we will discuss the RNAV enroute charts and concentrate this month on the conventional IFR charts.

The Jeppesen low and high altitude enroute charts can also be used to create direct routes. However, many of the charts do not share the same scale as the adjacent chart, so a straight line is virtually impossible to use as a direct route for long distances. On the high altitude charts, the west half of the U.S. is charted at the same scale of 40 nautical miles to the inch. In the east half, the scale is 25 miles to the inch so it is possible to plot longer distances on the high charts.

Precision Plotting

Are Jeppesen charts plotted accurately enough to draw a direct route that can be flown? Generally speaking, yes. If the charts were not plotted accurately, a straight line drawn adjacent to a restricted area may in fact penetrate the restricted area. Jeppesen uses a computer graphic system which generates and maintains the charts. The computer graphic system uses the same navigation database that is the basis for most airborne FMS and GPS databases. Because of this compatibility, *all* information which has a latitude and longitude is plotted at precisely the exact location where it exists on the earth.

So-called "attribute" information about a facility, such as frequencies, identifiers and names, are *moved away* from the VOR so that the attributes can easily be read. Other exceptions? When the missed approach point is on the end of the runway, the small triangle used to depict the MAP in the plan view will be moved slightly toward the FAF so it can be read. Otherwise, the runway symbol would cut up the triangle so badly that it wouldn't be easily discernible.

What all this accuracy really means is that a straight line drawn on a Jeppesen chart *can* be used to determine if a direct route will avoid airspace such as Class B airspace, restricted areas, prohibited areas, etc. Because Jeppesen uses the Lambert Conformal Conic projection for the enroute charts, a straight line is as close as possible to a geodesic line (better than a great circle route.) The closer that your route is to the two standard parallels of 33° and 45° on the chart, the better your straight line. *There are cautions, however.* Placing our round earth on a flat piece of paper will cause distortions, particularly on long east-west routes. If your route is 180° or 360°, there is virtually no distortion in the course line.

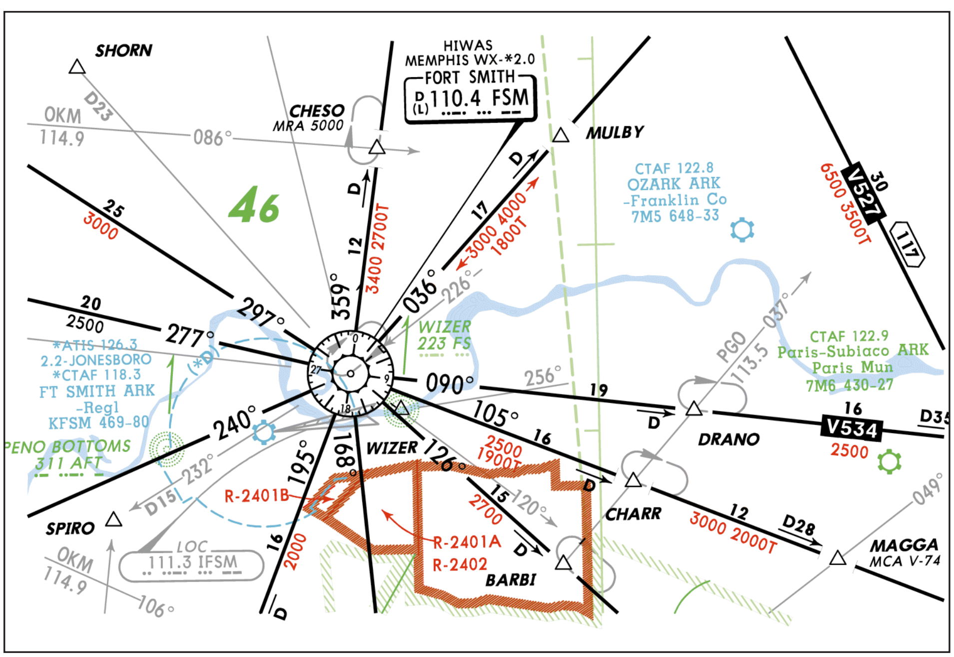
About the only way to precisely determine if you have accurately flown adjacent to the restricted airspace is by the use of some of the airborne Jeppesen GPS databases which include a graphic display of the airspace on the GPS receiver display. But, from a practical standpoint when not using an airborne database, leaving a few miles as a buffer will ensure that you stay away from protected airspace.

In the illustration below, a straight line from the Paris Municipal (Arkansas) Airport to the Fort Smith Regional Airport will pass just north of restricted area R-2401A and B and R-2402. Since both airports and the restricted areas are precisely plotted, there is an assurance that you will stay north of the restricted areas. From a practical standpoint, it might be smart to go direct from Paris to the Wizer NDB. This route will go even further north of the restricted areas and place you over the final approach fix to runway 25 at Fort Smith.

VORs for Direct Route Navigation

One of the most common means for flying direct routes is to use conventional navigation such as VORs. When flying direct off-airway routes, remember to apply the FAA distance limitations. The FAA has established an operational service volume for each class of VHF navaid to ensure adequate signal coverage and frequency protection from other navaids on the same frequency. The maximum distances vary with the altitudes to be flown. When using VORs for direct route navigation, the maximum distances between navaids specified with the appropriate altitudes are as follows:

Below 18,000'	80 NM
14,500' to 17,999' using H class navaids	200NM
18,000' to FL450	260NM
Above FL450	200NM



There are times when ATC will initiate a direct route that exceeds the stated distances. When that happens, ATC will provide radar monitoring and navigational assistance as necessary.

GPS for Direct Route Navigation

The use of GPS for direct route navigation has made the job of flying direct *much* easier. Most handheld GPSs, as well as all panel mount GPS receivers, have a navigation database, so the entry of destinations as well as waypoints is simply a matter of knowing the identifier of the place you want to go.

The FAA acknowledges there is an "increasing use of self-contained airborne navigational systems which do not rely on the VOR/VORTAC/TACAN system." When filing for long direct routes using GPS and not the VOR navaids, the routes will be *approved only* in a radar environment. In this case, you are responsible for navigating on your direct route. ATC is there for ATC purposes, not for providing navigation.

GPS as a Substitute

The FAA recently issued a notice announcing that GPS can be used as a substitute for all DMEs and NDBs in the United States. This has many interesting implications. Let's assume ATC asked you to report passing the CHARR Intersection southeast of Fort Smith VOR on the airway. Using the VOR to navigate on the 105° radial, when the GPS reads 16 miles from FSM, you would be at the CHARR intersection. The GPS distance from FSM would be legal as the formation. From a more practical standpoint, it would be easier to enter CHARR in the GPS receiver and have the intersection called from the database. In this case, the GPS would continuously read the distance to go to CHARR, and the GPS would also continuously provide the time to get there.

The GPS is now authorized to navigate to and from an NDB and to determine when you are over the NDB position. For the direct route from Paris, Arkansas, to the Wizer NDB, the GPS can be used for both navigating and determining position, but the coordinates for the Wizer NDB must be retrieved from the GPS airborne database. Additionally, the database must be current. One of the nice features of this authorization is that the Wizer NDB could be out of service and the GPS could still be used to fly to the NDB's location.

Very important – in order to be authorized to substitute the GPS for NDBs and DMEs, the GPS avionics must be approved for terminal IFR operations. This new authorization essentially *deletes the requirement for an ADF receiver to be in the airplane*. There is one use that still remains for the ADF. It is still required to shoot an NDB approach which has not been approved as an overlay approach. Also, this authorization is good only for the U.S.

In the next issue, we will look at some of the RNAV charts, the high altitude enroute charts, and some charts outside the United States.

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