How Did We Get from There to Here?

By Chris Hope, Master CFI

A couple of months ago, I wrote of some of the overlooked details of GPS navigation, and after I did so I got to thinking of all of the different methods we have used over the past 100 years to help us navigate from point “here” to point “there”. And then I realized that I have used all but one of those methods in my own flying. Talk about making me feel old! However, it is not that I have flown since the days of Orville and Wilbur. It is that some of the methods they and the early pilots used are still viable today.

Many of our navigation practices date back to the days of nautical navigation. Indeed, the use of nautical miles instead of statute miles, and our practice of referring to the pilot in command as ”Captain” are two of the most obvious examples.

And as an aside regarding knots and mph. Anyone who has flown a variety of aircraft that were manufactured in different eras has noticed that some aircraft have the airspeed indicator denoted in miles per hour and some have it denoted in knots. What gives? If you look at the manufacturing dates of these aircraft, you will notice that in the aircraft that were created prior to early 70’s or so, the airspeed indicator is generally shown in knots. And the, for the next 15 years or so, the indicator is shown in mph. And then, more recently it is back to knots.

Traditionally, we pilots have used knots. Engineers and pilots generally prefer that system. However, for any given speed, the true airspeed defined in statute miles per hour results in a larger number than the same speed in knots. And my personal assumption is that this is the period in which the marketing people held sway in the aircraft business. It makes the airplane look faster. But back to navigating.

In the very early days of flying, navigation was not such a big deal. After all, the pilots prior to World War I did not travel very far. Airplanes during that period were crated and transported to the locations were they flew. World War I changed that.

The Great War gave aviation the first real opportunity to actually display the capabilities that early pioneers promised. As the young pilots flew across the front lines during the war, mapmaking began in earnest. And when those planes returned to civilian life in the US and Europe, people started to realize that we really could travel from one point to another.

So the first thing we needed to navigate from one point to another was a map. More to the point, an accurate map that showed the landmarks that those pilots could see from the air. Roadmaps were not much use in that period through the 20’s. The US did not have many roads outside of the cities. So, many of the early airmail pilots took to

using railroad maps for their navigation. (The first use of “I F R” perhaps?) This was fine to a point, but it left two large problems unresolved. First although railroads went to many towns during that time period, they did not go to all. (And they weren’t all that accurate. After all, train engineers did not need an accurate map. And neither did the general public.) And secondly, there was no detail when one flew near Chicago or Pittsburgh or Denver or any other city. Where was the airport relative to the railroad? Where was the high terrain? Where were the tall buildings?

Two projects developed to address these issues, one government-sponsored and one privately developed. The US Postal service subsidized the early airlines by contracting the young airlines to deliver the mail between the larger metropolitan areas. During those early days, income from the mail far exceeded the income from passengers. (And because the Postal Service paid on the basis of weight, it was not unusual at all for airline employees to mail bricks to distant locations.)

Because the Postal Service had a vested interest in getting the mail delivered, and because the Great Depression was, by now, in full swing, the US Government addressed the navigation concerns of the young airlines by marking the routes. For daytime navigation, markings were painted on the roofs of buildings, marking the route to the various towns and to the airports. And for night navigation, a series of light beacons were constructed to show the way. Every ten miles or so, along several particular routes, lights would flash out various Morse code identifiers, letting the pilot know which route he was on, and how far along that route he had traveled.

This was an okay system, but did not add much more accuracy to navigation than before. So pilots generally made up their own maps. Pilots would make up maps for the routes they flew, adding the details that were concerned themselves. One such pilot, in the late 20s and early 30s, was Elrey Jeppesen. A pilot for United Airlines in those days, his maps became so accurate that they were used by his airline, as well as by other pilots. In time, he would leave the cockpit to form a company dedicated to aviation map-making.

So how do we navigate when we can see, but there are no landmarks? Again, the same way the ancient mariners did it. If possible, by use of stars and sun. Otherwise, by computing time and speed and direction.

Computing a course by time, speed and direction, called deduced or ded reckoning, is as old as travel. As simple as it seems however, the three required elements are anything but simple. First of all, an accurate compass is necessary. Secondly, an accurate means of measuring time is required. And finally, it can be tough to measure speed when the water or air that your craft travels through is moving as well.

Ancient mariners discovered that certain stars, most notably Polaris, could be found consistently in space. And by calculating the angle between the horizon and certain stars, and knowing what time of day that particular angle should occur, they could discern their true position.

Actually, the trickiest part of this was the timing part. Checking the angle between the horizon and three different stars would let the navigator know his latitude. But in order to ascertain his longitude, he needed to know the difference in time between his current location and some base latitude location (Greenwich England) And for that he needed an accurate clock, one that would keep time over long periods of time and would not be affected by heat, cold, or salty water. But that is a story for another day.

So here we are today, 110 years after Wilbur and Orville proved that we could control our flight through the air, and as long as we can see outside we still use the same three systems for navigation. Oh, we have updated them a bit, but nothing fundamentally has changed.

First of all, our maps are more accurate. At some distant point in the past, the US government decided that we could be safer pilots if someone could map the US accurately, and make those maps available to all pilots. And out of this, the VFR navigation maps were created. In time, three sets have come into common usage. The largest scale is the World Aeronautical Chart (WAC) and the Operational Navigation Chart (ONC). Both of these are laid out at a scale of one inch equals approximately 13.9 nautical miles. For pilots who want more detail, the Sectional Chart fills the bill, with one inch equaling about half that distance, or approximately 6.9 miles. And finally, when we need more accurate in the large cities, we can use the Terminal Area Chart (TAC) where one inch equals about 3.5 miles.

So all is well, as long as we can see the world below us or the sky above. But how did we get to the point where we could navigate around the world without ever looking outside? Come back next month.

Don't just practice until you get right. Practice until you don't get it wrong

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