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Flight-Sim Navigation

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Chapter 1

Navigation Fundamentals

Navigating accurately in your flight simulator requires keeping a few fundamentals in mind. Dismissal of these fundamentals as “too basic” or taking any of them for granted can result in navigation errors of many miles or kilometers. The longer your flights, the greater difference these errors will make. The fundamental navigation features that underlie everything else you will do are *position*, *direction*, *time*, *speed* and *altitude*.

Position

Position is a specific location on the Earth or in its atmosphere, usually expressed in relation to other known positions. The world-wide system for determining position is meridians/parallels, which comprise a global grid of north/south and east/west lines. Positions are expressed in relation to lines on that grid. The same system is used for all aircraft — both on the surface and at any altitude.

Meridians, parallels, latitude and longitude are commonly used in aviation navigation, so a clear understanding of their definitions and relations to one another is always crucial.

Meridians.

Meridians are north/south great circles dissecting the globe and intersecting at the north and south poles. They appear vertical on north-oriented maps. There are 360 of these circles. The distance between each meridian is one

Chapter 2

Aviation Charts

☞ Official aviation charts are fully explained for realistic simulation.

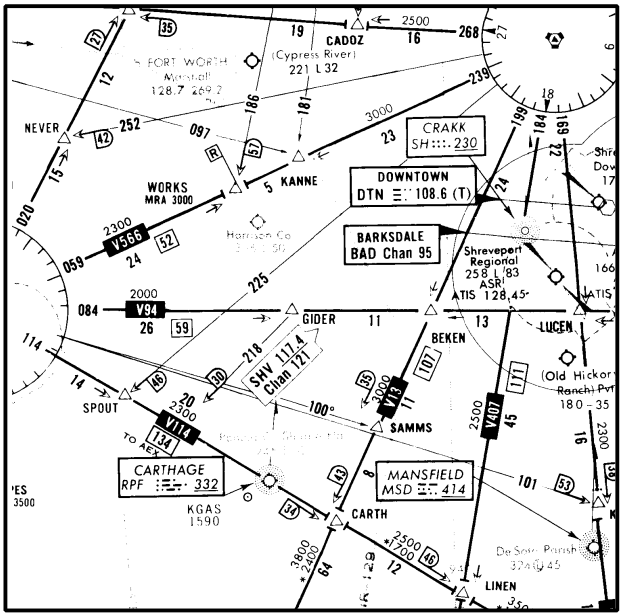

Figure 2-E: Example of an Enroute Chart

Chapter 3

Planning and Preparation

Estimate Fuel Needs. Professional pilots calculate the flight time and fuel consumption as accurately as possible. Having enough fuel is both a legal requirement and a smart practice. Pilots are required to carry enough fuel to reach their destination, plus 30 minutes worth of additional fuel when flying visually and 45 minutes when flying on instruments. Pilots who appreciate life, health and their aircraft make sure they have enough fuel before they embark on any flight, legal requirements notwithstanding. Carrying too much fuel, however, slows the aircraft, puts undue strain on the engine and wastes fuel, time and money. None of these risks is real in flight simulators, so only your sense of realism requires calculating time and fuel. Computing fuel needs is explained in chapter 4, “Pilotage and Dead Reckoning.”

Check Enroute Elevations. Elevations along your route can affect your courses and altitudes. You will have to maintain minimum safe altitudes throughout your flight. You might have to fly over or around busy airports and high mountains.

Chapter 4

Pilotage and Dead Reckoning

Pilotage and dead reckoning are two basic visual navigation methods. Pilotage is simpler; dead reckoning is a little more complicated. This chapter presumes clear weather, because visual flight rules are not permitted in poor visibility. Furthermore, this chapter assumes calm air for the simplest explanations of these navigational methods. Considering and compensating for winds in navigation is explained in chapter 6, “Wind Compensation.”

PILOTAGE

Pilotage is flying from one visible fix to another using only a visual chart for reference. You depend on your own eyesight and the atmosphere's clarity. You can use an aviation chart to help you locate the points, or you can use familiar landmarks if you know the terrain along the route. Any visible landmarks will do — mountains, rivers, lakes, highways, buildings, farms, islands, coastlines and airports.

Because pilotage doesn't require advanced instruments or complicated computations, it is the simplest and most elementary form of navigation in aviation. It

Chapter 5

Radio Navigation

Omnibearing Indicator

The omnibearing indicator (OBI) is the instrument on which you read your VOR signals. When the needle is centered, you are aligned with the VOR radials shown in the top and bottom of the instrument. The words "to" and "from" mean that you are heading to or from the heading shown on top. They prevent pilot misunderstandings, confusion and disorientation, all of which can and do happen during instrument flights. Figure 5-C shows the omnibearing indicator.

You can use the OBI to track to or from any VOR in range. When you are flying toward the VOR, set your OBI to the “to” reading and hold that heading. When you are flying away from the VOR, set your OBI to the “from” reading and hold that heading. Use the distance measuring equipment (DME) to determine whether you are flying closer toward or farther from a VOR station. Correct your OBI “to/from” settings accordingly.

Chapter 6

Wind Compensation

All winds affect your flight course and duration. Whenever you have winds and turbulence engaged in your flight simulator, you will be constantly challenged to correct for them and stay on course. To compensate for these differences, pilots use the wind triangle, which is explained in this chapter. Apply these techniques to the navigation principles and methods explained in the previous chapters. Figure 6-A shows wind effects on aircraft.

WIND DYNAMICS

Winds are dynamic, meaning their actions affect and are affected by one another. Pilots are concerned with *direction*, *speed*, *altitude* and *variances*.

Wind Directions

Pilots are concerned with head, tail, cross and vertical winds and combinations of them because of their effects on flights. Figure 6-B shows relative wind directions.

Chapter 7

Air Route Navigation

For long-range instrument flight, air traffic routes are the safest, most efficient courses to follow. United States routes are explained in this book, and routes in other countries are similar. Your maximum simulation experience calls for your using these air routes as closely as you can on all your long-range cross-country flights.

Airways and Route Systems

Airways and route systems are courses established by authorities and followed by pilots as highways in the skies. The two systems of concern to flight simulator pilots are VOR airways and jet routes.

VOR Airways. *VOR airways* extend from 1,200 AGL up to but not including 18,000 MSL. They are based on VOR navigational aids. They are depicted on en route low-altitude charts. VOR airways are shown in blue on aeronautical charts and identified by a "V" followed by the route number.

Jet Routes. *Jet routes* extend from 18,000 MSL up to and including flight level 45. They too are based on VOR navigational aids. They are depicted on en

Chapter 8

Global Positioning System

The *global positioning system* (GPS) is a space-based radio positioning, navigating and time-transfer system. It provides a highly accurate positioning, velocity and time information on a continuous global basis to any pilots with approved equipment. It has been available to general aviation since 1994, it is becoming more and more widely used by general-aviation pilots, and it will be the electronic navigation system of the future.

This book explains GPS generally. It does not explain any specific GPS device from any manufacturer.

Because of GPS's global availability, nearly total accuracy, ease of use and relatively low cost, it is quickly becoming the primary electronic navigation system. It is commonly used in VFR navigation, and it is becoming more common for IFR navigation. It will eventually replace VOR, NDB and DME for electronic navigation, but this will be several years from now. Currently, it supplements these navigation systems overall and replaces some of them in a few areas. Waypoints are taking the place of navaids as en route and instrument approach fixes. Some aviation writers opine that GPS will ultimately eliminate the need for the current airway system. ILS will still be used because of its greater precision for landing approaches.

Chapter 9

Long-Range Navigation

San Francisco to Honolulu

This oceanic flight requires an aircraft that can remain airborne for this trip of 2,085 nautical miles (3,861 kilometers). Typical single-engine aircraft are inadequate for this flight, because their range is about one third the distance between San Francisco and Honolulu. Consequently, this trip is limited to business jets and commercial airliners and similar aircraft. It will take about six or seven hours in a business jet and about five hours in a commercial airliner.

From San Francisco, head approximately 250 toward Hawaii. Use dead reckoning to check your position en route about every hour, and compare it to your needed course. At a given airspeed and heading, you should be at certain locations every 30 minutes. About five hours after departure, you should be close enough to the Hawaiian islands to receive their VORs. Adjust your course accordingly. Then join the Hawaiian airspace and proceed to Honolulu along their air routes.

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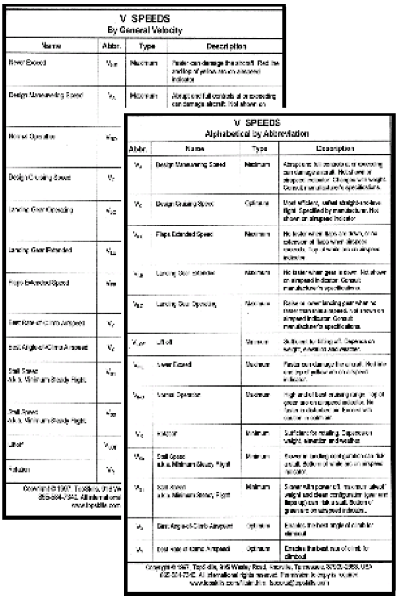

For example, "Vne" means the designated velocity should never be exceeded (it differs for each aircraft).

Your V-speed card lists the most common general-aviation V-speeds in two easy-to-find ways – alphabetically on one side and by velocity on the other side. Each V-speed is identified by name and abbreviation and explained in clear language. These cards are a handy size for using at your flight simulator.

You will get a V-speed card free with every order of flight-sim books from TopSkills! This is author Bill Stack's way of saying "Thank You."