GPS FOR MARINERS

Second Edition

INSTRUCTOR'S GUIDE

February 22, 2013

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This seminar course is designed for students desiring to learn fundamental GPS skills. Basic navigation skills are covered to the extent required to understand GPS operations. The course includes basic functions of the GPS chartplotter. Navigation computer software is not included in this course.

Required reading is GPS for Mariners (Second Edition), Chapters 1-4.

. The textbook is used as reference material. The course doesn't require pre- reading the book. The course outline introduces subjects sequentially, whereas the book introduces some subjects in groupings. The book chooses a more holistic presentation style, so it probably serves the less experienced student better to read it after the course lecture. The instructor uses the book at their discretion.

This course is designed for a minimum of two-2 hour sessions for a total of four hours. The four hour schedule requires a crisp fast presentation. Some instructors may choose longer class periods to cover the subjects in more detail. Longer class time may increase student tiring. Increasing the number of class days typically discourages enrollment. It is a local decision to choose the optimal class schedule.

A suggested breaking point for session 1 is slide #53

This is a seminar course with no final examination and no Certificate of Completion.

Note for those acquainted with GPS for Mariners - First Edition: The Second edition updates electronic navigation technology, it has more attractive color figures, and it devoted much more attention to navigation basics.

General Notes:

This course outline doesn't follow the exact sequence of the book**.** The book accommodates readers who have varying levels of navigation skills; whereas, this class outline assumes that the student has very little prior knowledge of navigation.

The course includes chart plotting exercises using a very simple chart to avoid student intimidation. Using a local chart would be preferred; however, the flotilla would be required to re-create the exercises for their local charts.

It is preferred to use navigation tools for plotting, but the class exercises are designed to allow the use of plain paper as a ruler and for scaling functions.

This course outline assumes that the instructor has a good knowledge of GPS. This guide includes some of the main points to cover on each slide. The notes on the slide itself are often short cryptic statements for quick reminders.

Caution: The students will be plotting a simple course. The class schedule assumes that the student will perform this plotting quickly. It's common for one or more students to require much assistance with plotting which consumes a lot of class time. The instructor must choose whether to add more class time to accommodate these students, or to offer counseling for the slower students after the class.

SLIDE NOTATIONS

Session 1. Introduction to GPS and Navigation Fundamentals

Slide 1

This slide is shown until all students are seated and the course is to begin.

Show "It's Everywhere" as a fly-in.

"It's everywhere" is a great attention getter to launch the seminar! Immediately go to the next slide.

Slide 2

Disclaimer5

Slide 3

Ask how many students have a GPS in their car. Tell students that all recent cell phones have a GPS built in. Ask how many students have a tablet computer. Anyone with an aircraft GPS?

Students may be surprised to learn that they already have a GPS in something that they own.

Slide 4

Now that the students are turned on to the course, tell them what will be covered in class. Keep the enthusiasm going.

Slide 5

Introduce instructors at this point. Provide background as appropriate.

Slide 6

Housekeeping .Inform the students that this presentation doesn't follow the textbook's presentation exactly.

Slide 7

GPS justifications: . Emphasize that a GPS assists the boater in getting from one point to another. It does not assure that the boat will not encounter hazards. The operator has overall responsibility and requires many considerations to assure a successful trip. Some knowledge of basic navigation is needed to successfully use a GPS, and that is covered in the course.

A GPS is justified even if used only to provide position information to authorities when in need for help.

Slide 8

This is a setup for the next slide

Slide 9

GPS is a satellite-based system. A constellation of satellites orbit the Earth. Each satellite completes an orbit every 12 hours. As a result they move across the sky slowly as viewed by an observer on the Earth. The constellation, of in-orbit satellites, provides a number of satellites in view at virtually every place on Earth. Three satellites must be in view at the same time to provide a position. There are typically 30 satellites in orbit of which 24 are active. The others are spares.

Slide 10 The entire mission of the satellites is to provide you with a position.

The satellite sends out a signal that includes its location along with the time the signal is sent.

The receiver has a clock that compares the time sent with the time received.

The receiver can figure out its distance from the satellite, and very quickly as the radio waves travel at 186,000 miles per second!

Since the receiver was also given the satellites location, it can compute where the receiver is located in relation to the satellite.

This gives a circle on the earth where that same distance occurs; a circle of position.

Three or more satellites can provide a FIX.

There are two levels of fix that will provide you with a navigation solution, i.e., a position. A 2-D solution can be derived from at least three satellites. Three satellites provide three circles. Where all three coincide is the receiver's actual location on earth. The forth satellite provides verification that one of the other three are not in error. This assumes that you are located on the surface of the Earth, and you had better be! The more accurate position is the 3-D solution that requires at least four satellites in view and providing signals to your GPS receiver. The forth satellite also provides the elevation. The 3-D fix is generally accurate to about 30 feet along the surface of the Earth.

Slide 11

GPS receiver automatically selects the strongest satellites that are in view.

The GPS receiver calculates and displays the accuracy of the fix based upon the specific satellite geometry of the satellites in-view.

Slide 12

Explain how it works. The WAAS satellites are geo-stationary (always at the same place in the sky). A GPS receiver at each ground station gives a position which the ground station compares to its known position (Geodetic marker). The ground station responds with the error in distance and direction. The WAAS system sends the correction to be applied to the user's GPS. Thus, providing a more accurate position.

Slide 13

Emphasize that GPS is a worldwide system.

Incredible – a simple, inexpensive device that will give one's location within 30 feet anywhere in the world. Also point out that much of this is American invention, engineering and investment!

Point out that if the GPS does not seem to be working correctly, it may not be receiving strong enough signals due to being inside a building, in dense foliage or perhaps inside of a boat with lots of obstructions overhead. Fortunately, newer GPS receivers are more sensitive than older devices so this is not usually a problem in a marine application. GPS can be jammed by hackers, but it's rarely done.

Slide 14

THIS IS A CLASS STIMULATOR OR MOTIVATOR. "This can happen to you if you lose track of where you are"

Slide 15

Many people are intimidated with charts and avoid them. This slide must convince students it's in their best interest to learn basic navigation/charting skills

Slide 16

Emphasize that this isn't a basic navigation course. It covers only navigation elements necessary to understand the operation of a GPS

Slide 17

Basic elements of a chart . Describe in general terms only

Slide 18

The Title Block is the focus for the discussion of charts, since most of the chart elements are listed here

Some of this information is needed to initially setup a GPS

Refer the students to page 17. This image was copied from the "Booklet Charts" provided in PDF at: http://ocsdata.ncd.noaa.gov/BookletChart/

Address Chart Number and Edition. Current chart editions can be viewed at: http://www.nauticalcharts.noaa.gov/mcd/OnLineViewer.html

All U.S., Canadian, Russian, and European LORAN-C signals were terminated in 2010. LORAN started during WW 11 and replaced with GPS

Slide 19

Describe mecator . Just mention other projections types. River charts are covered in more detail where appropriate

Slide 20

Scale is the second Title Block entry, which is given for a specific Latitude.

Discuss scale in general.

Large scale = small area showing great detail

Small scale = large area for long distance planning

Slide 21-25

Go through these scales rather quickly.

1:10,000 means 1 inch, foot, mile and so forth on the chart is representing 10,000 as much distance on the earth.

Slide 26

Discuss the overall concepts of latitude and longitude

Slide 27

General discussion. Class exercise is the next slide where the specifics of identifying Lat./Long. on a chart is demonstrated and practiced.

Meridians: 0° at Prime to 180°, E and W

Equator: 0° at Equator to 90°, N and S

1 Deg = 60 min, 1 min = 60 sec

Formats: Degrees° Minutes' 10^{th} of minutes or Degrees° Minutes' Seconds"

Discuss using dividers and, when they are not available, use a sheet of paper.

One minute of latitude is one nautical mile = 6080 feet. One tenth of a minute of latitude is approximately 600 feet. One hundredth of a minute of latitude is 60 feet, and so forth.

Explain how the nautical mile was derived

> The difference between 41 degrees 27.700 minutes of latitude and 41 degrees 27.701 is six feet.

Slide 28

HAND OUT THE PRACTICE CHART

Slide 29

Chart exercises

What's the Latitude (Lat.) of the lower right corner? **33° 00.0' N**

What's the Longitude (Long.) of the upper right corner? **078° 54.0' W**

What's the Lat. and Long.? of the left top corner? **33° 09.0' N 079° 00.0'W**

Use this exercise to discuss the specifics of reading Lat./Long. In degrees, minutes and 10ths of minutes.

For courses taught east of 100° longitude, get the students used to entering Longitude using a zero as the first digit. This is a good habit pattern for entering GPS waypoint coordinates.

TO REDUCE APPREHENSION ON CHARTS- Point out that this chart has most info removed to show that it isn't that complicated if they learn one element of a chart at a time.

Slide 30

1

Lat/Long Exercise:

What is the Lat./Long.? of the green buoy, G C'3' **33° 05.9' N 078° 57.4' W**

What is the number located at: 33° 06.8' N 078° 56.1' W **"16"**

Traditional navigation measures to the nearest 0.1', which is the practical limit of our charts, tools, and eyeballs.

Introduce the precision of GPS, which usually measures to the thousandth of a minute.

Slide 31

Explain distance scales on chart

Slide 32

No comment

Slide 33

Distance exercise

The traditional navigation standard of precision is to the nearest 0.1 nm. GPS receivers usually calculate distance to the hundredths of a nm.

How far is it in nautical miles (nm) from bottom to top along the right side? **9.0 nm**

How far is it from marker G ‘3’ to marker G ‘11’? **1.95 nm**

Slide 34

WGS84 is the datum of choice or most charts within the USA.

Why do you need to know this? Your GPS must be set to use the same datum as the charts you are using

Note the contour lines.

Slide 35

Discuss:

Datum at MLLW. There will probably be a difference between the charted soundings and what the depth actually is, because the chart is based on hydrographic surveys going a long way back, sometimes to pre-1900.

Source Diagrams

Effect of weather (winds, atmospheric pressure, rain, etc.)

fathom contour lines are Increments of 6’

.Slide 36

What are the minimum and maximum depths within the white area of the chart? **18’ and 31’**

What are the incremental depths shown by the contour lines? **18’, 11’, 6’**

If you cruise into a shaded area on this chart, the charted depth will be. **18 feet or less**

Slide 37

his slide is used to introduce the concept of time zones and UTC in particular.

This slide is used to introduce the concept of time zones and UTC in particular. Note that time zones are often not straight when they pass through land; for example, an island may choose to have one time zone and not two when a time meridian passes through the island.

Slide 38

The magnetic pole is where a compass points. Latitude and Longitude on a chart are oriented to True north.

Slide 39

A compass rose is found on the chart, often in multiple places. It gives a reference to get a true course or a magnetic course. Lay a ruler between two points on the chart and then move the ruler to the compass rose without changing the ruler's direction. Read off true or magnet course directly. A special type of instrument, called "Parallel Ruler" makes the job error-free. Other devices used also.

Go immediately to the next slide to show a parallel ruler.

Note that the magnetic variation changes slowly over time

Slide 40

You will be using this parallel rule or something similar in the next task. There are various devices that perform the same function. A plain piece of paper may be used for an approximate measurement.

Slide 41

Student knows that taking a trip over land requires constant changing on streets to get to destination. This compares to using waypoints and routes on the water.

Waypoints are like landmarks defining a street intersection or destination. A mariner may change direction and/or speed at a waypoint. Routes are collections of Waypoints going from departure to destination. For a trip of several days, the mariner will likely use multiple routes joined together

Slide 42

Space between waypoints called a “leg” Each leg is analyzed to assure there are no intervening hazards. Note that this journey was diverted to avoid a hazard.

Slide 43

Create Route layout. If no tools are available, fold a piece of paper and plot each course as best you can. Determine distances using Latitude scale.

We shall soon see that a GPS can do much of this for the navigator! It is a great assistant.

Slide 44

Resulting route

Slide 45

This is the result of the prior exercise put on a “Navigator’s Log” for the convenience of the helmsman. Helmsman may use the log and a compass to conduct the journey. The forerunner of a GPS route

Slide 46

Explain the formulas. GPS does this calculation for you.

Explain formula for TIME – SPEED –DISTANCE, and confirm the practice trip data on the Navigator’s Log. A GPS simplifies this greatly as it will determine much of this information. Navigators often use this formula in a quick mental “sanity check” to confirm that the GPS is working correctly. It should be memorized.

But we are not yet done planning. He Navigation Log must be modified so that we can use our compass to follow the intended course.

Slide 47

All calculations shown on Navigators Log.

Slide 48

Discuss all compasses (front and back reading) and hand bearing compass as tools.

Slide 49

A radio speaker 20 Ft. from compass can cause deviation problems.

Orientation of magnetic device changes the effects of deviation.

EVERY BOAT SHOULD HAVE A COMPASS DEVIATION TABLE! It often explains the difference between compass and GPS readings.

Sailboats with a pedestal helm will often have little or no deviation

Sometimes a professional “Compass Adjuster “is required to fix deviation problems:

Slide 50

GPS handles all this automatically, but understanding of this is important .

Slide 51

Navigators Log – before and after deviation.

Slide 52.

Explain how to obtain a fix. We will see that a GPS constantly derives a fix.

A SUGGESTED BREAK POINT for SESSION 1

Slide 53

Now that you have a knowledge of basic marine navigation, it is time to learn about how a marine GPS will make your navigation job much easier. It’s like having a dedicated navigator on your vessel. It can give you the situational awareness that greatly improves the safety of your vessel and crew as you go from your origination point to destination.

Slide 54

Many mariners use a handheld as their primary GPS, especially inland boaters. Some purchase a mount so it can be held in front of the helm station and can be plugged into ships power. Those with more expensive GPS installations often carry a handheld as a backup.

Slide 55

Here is an example of hand-held marine GPS units made by several different manufacturers. Some have push buttons to control operation. Newer devices have touch screens. Most hand-held GPS units now have color displays with charting capability. Manufacturers still offer low-end black and white units with limited or no charting capability although these are becoming uncommon. Having a color charting capability adds greatly to situational awareness and thus contributes to safe operation of a vessel.

Most hand-held units are water resistant or waterproof. Many will float.

Prices range from just over $100 for a low-end B&W unit up to about $1000. Higher price is associated with a better display and an extensive built-in custom chart database. GPS w/ special chart info. are $15,000 +

Some hand-held devices come with a basic color chart data base yet allow the buyer to add detailed charts for his or her area by the purchase of memory chips that plug into the side of the unit. Some manufacturers provide a USB connector whereby a cable can be connected to a computer to allow the downloading of additional charts into the unit's memory.

Slide 56

Newer devices have touch screens and no physical buttons.

Slide 57

Most fixed-mount marine GPS units sold today include impressive color charting capability. Higher-end units have charts that are identical in detail to paper charts. Prices range from $300 or so for a basic black and white chart plotter to many

thousands of dollars for higher-end systems. The larger the display normally equates to higher-end.

Slide 58

This slide shows a typical fixed-mount GPS mounted at the helm station of a smaller size boat.

Slide 59

The Ray Marine system shown is integrated with a number of sensors contained within the boat. In addition to electronic charts, it is possible to show graphical display of water depth, undersea temperature profiles, view cameras mounted throughout the vessel, determine location and identification of nearby vessels and so forth.

Investment can go beyond $10,000 for a fully integrated system.

Slide 60

Some mariners purchase a low-end B&W GPS or a GPS brick (shown) that serves only to send longitude and latitude data to a desktop or laptop computer. Computer Assisted Navigation software and charts are purchased for the computer. The result is a powerful charting system. Such systems are usually restricted to vessels with an enclosed bridge where equipment can be protected from the elements and where the computer display can be kept out of direct sunlight.

Mariners have been using this combination of hardware for over 15 years with excellent results.

Slide 61

Tablet computers such as Apple's I-pad and Android-based E-pads as well as smart phones are changing the landscape of marine navigation. In many cases, especially for inland river use, these devices may suffice to provide the needed situation awareness necessary for safe vessel operation. Navionic is one supplier of "Apps" for these devices. The Apps are very inexpensive. At the time this course was prepared, Navionics was selling their App, to include access to all USA and Canada charts for about $10! The Apps have limited navigational capability although it is very easy for a user to touch the screen to set-up waypoint and routes and accumulate a plotted track log. Look for more advancement in months and years to come.

At the time this course was developed, tablet computers and smart phones were not ruggedized for the marine environment (waterproof, sunlight visible displays), look for that to change in the months and years ahead.

Slide 62

With basic navigation now in-hand, let’s see how a GPS can simplify the navigators job.

Slide 63

Point out the major elements with special emphasis on the buttons, cursor and display screen. Point out that some newer GPS units are be sold with touch screens, thus eliminating buttons. This lowers cost and may increase reliability. Touch screens also tend to be more user friendly and a limited set of buttons. If touch screen is wet, wiping it off could execute some commands.

Slide 64

Now, let’s Power-Up a typical GPS and see what screens initially come up.

Upon power-up some devices have a disclaimer screen. It warns not to use the GPS as the principle navigational device. More about this later..

Emphasize that one should never rely only on a GPS for navigation. Always check position by multiple means.

Slide 65

After the disclaimer screen, the next screen will be the satellite acquisition screen.

The screen usually is the first one to appear upon power-up as the user needs to confirm that the GPS has acquired a fix before proceeding to use it for navigation.

This screen in this slide shows the GPS locked-on the to satellite network and ready to navigate with a high degree of accuracy.

IN an emergency, this is the screen to go to in order to provide authorities with your location (longitude and latitude).

Briefly discuss why accuracy may vary. If WAAS is not turned on accuracy will suffer. If satellites are blocked from view such that only a small part of the sky is visible it may be difficult for the device to get an accurate fix. Anytime the user plans to rely on the GPS to provide very accurate positioning, he or she should check this screen to determine how accurate the GPS location is.

Slide 66

A GPS just out of the box may take as much as 20 minutes to get the first fix, especially for devices manufactured a number of years ago. Newly manufactured devices are often able to do a cold-start fix in a matter of minutes.

Since the device was likely manufactured in Asia, if it is brand new, its last fix was likely half way around the globe!

Remind student they must use the satellite acquisition slide to ensure the GPS is ready for accurate navigation.

Slide 67

Discuss each of these buttons in detail. Explain what they do. See Sweet's book for an excellent description of each function.

Point out that although each manufacturer may have a different layout or slightly different names for the button function, most units are very similar.

Slide 68

This display is for the Garmin handheld GPSmap 76CSx. Note that the buttons are almost identical to those discussed on the previous slide.

This is a good slide to use to explain what the cursor is used for. It allows one to scroll around the map display. it is used to enter names and values for waypoints, and it is used to move up, down and around menus. It is an important button.

Slide 69

This is a lead –in. There's many more types of screens that can be selected to view.

Slide 70

These chart screens must have an active waypoint entered in order for the GPS to calculate some of the data shown.

Slide 71

Note that if the vessel is not moving then the GPS is not able to provide an accurate compass heading unless the device has a built-in magnetic sensor

Explain that the GPS computer calculates course, speed, time-in-route, estimate time of arrival and so forth from examining changes in longitude and latitude.

Slide 72

This Highway screen also requires an active waypoint. As long as the vessel is kept in the middle of the road it will reach to selected waypoint while staying on the desired straight-line course. If additional waypoints have been entered and identified as a route, then that waypoint will show further down the road and the direction of the road will change as each waypoint is reached.

This is a very useful screen for staying on course. Deviating from the desired course is immediately apparent as well as the required corrective action to get back on course.

Three different GPS devices are represented in the slide. Note the screen in the upper-left; it shows cross-track error. Usually, the data shown on the Highway screen can be selected by the user during Setup.

Slide 73

Explain each situation. The highway picture makes it obvious when the vessel is on-course, off-course or about to head off-course. A quick glance at the highway screen is all it takes to assess the situation. That is one advantage of this screen.

Slide 74

During setup, a user can define the desired parameters to be displayed. For example, the user may prefer the data field that is showing altitude to show something else that is more valuable to the mariner.

Slide 75

Some GPS units also have tide and current tables in their internal database. This subject can be expanded as appropriate to the tide characteristics in the area..

Slide 76

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The Menu screen is an important one. Some GPS units have a dedicated push button to get to the Menu screen.

Shown are menu screens for several different types of GPS devices. The top screen is associated with a touch-screen GPS. For the other two screens, the cursor control is used for menu selection.

Slide 77

The Menu screen is an important one. Typical choices include Setup, Navigation, Locate and Screens.

Upon first use, it is critical to go to the Setup menu and establish the required parameters of use.

Describe what each of the Setup choices do.

Discuss Simulation mode (not shown)and the advantages of using it. One can practice in the comfort of one's home without the need to have GPS satellite-locked.

If one uses the simulator mode it is imperative that they switch back to navigation mode before using the GPS for actual navigation.

Slide 78

The Navigation menu is a very important one. This is where waypoints and routes are entered and managed.

All these navigation functions on this slide and the next few slides exist on all GPSs, however, they may be grouped or accessed differently. If you understand what each function does you will recognize it when manipulating your own unit

Slide 79

Explain in general terms the different modes of entering a waypoint (remind them about waypoints (students created them during their exercise and used them to define a trip)

Explain what the “go-to” function is

Slide 80

Explain the detail attributes of a waypoint.

Slide 81

Explain what a “mark “ is and the different modes of creating them

Slide 82

Executing a mark

To MARK the Waypoint on the water, press the MARK button (on some models, this is the same as the ENTER button as shown).

This brings up the New Waypoint Screen as shown with a number assigned and the coordinates already entered.

To accept this, simply press ENTER.

This is a very easy way to enter waypoints for future use when out on the water is good weather.

If someone falls overboard, hitting the Mark key immediately records the position of the MOB which can then be used to navigate back to the person. Some GPS devices have a separate MOB key that is used specifically for man overboard; it immediately brings the device into the navigation mode to the MOB waypoint.

Slide 83

Describe the process of selecting waypoints from an internal list. If your unit has built-in charts, all the standard buoys on the chat are pre-loaded on your waypoint list

Slide 84

Units with touch-screen capability are very easy to use to define waypoints. Just touch where you want a waypoint. It is easy to see from the chart where navigable waters are and thus where to locate a waypoint.

In the photo above you can see that a route is being defined. The same as done in your exercise earlier

Note that this navigator has chosen waypoints near the green buoys but not directly at the buoys. In bad weather you would like to have waypoints near navigation aids but not directly at the aid. In very poor visibility one could likely collide with the aid. That is how accurate GPS is!

Slide 85

Selecting a

Selecting a waypoint using the cursor on the Map Screen.

On most GPS models, the coordinates of the Cursor position are displayed on the screen.

Scroll until the desired coordinates or desired Navigation aid is highlighted.

Mark this location as a waypoint.

Slide 86

Some mariners use computer assisted mapping systems to define waypoints which they can download to a portable GPS. They take their portable GPS to the boat with needed waypoints already entered.

Slide 87

Waypoint Coordinates might be entered manuallyas follows:

Take student through the process. Point out each GPS operates slightly differently. Read your GPS manual for the correct method for your set and practice, practice, practice before depending upon your GPS on-the-water.

Slide 88

Entering a number with one digit in error can result in a serious navigational mistake. It is not the big errors that will get you. They tend to be obvious (1000 miles to go to the next waypoint)! The smaller errors of a few hundred feet can put you outside the channel and up on the rocks! That is why the higher-end GPS units have real value. With a color chart plotter it is often obvious when waypoint entries are incorrect because it is easy to see that the waypoint is out of the channel. One avoided grounding will easily pay for a more expensive GPS that has color chart plotting capability.

Using the exact location of an Aid to Navigation may result in a collision. Select a waypoint nearby the aid.

Slide 89

Different GPS devices provide different ways to annotate waypoint information. For some devices, only the name can be changed. For others, it is possible to select unique symbols for the specific waypoint when it is displayed on the map screen as well as to enter descriptive text. Even a keyboard might be provided to make it easier to enter the text and numerical values.

Higher-end units tend to be more user-friendly!

Slide 90

Now let’s discuss how to navigate to a waypoint.

Use the navigation screen that works best for you. Many people like the highway screen as it is obvious when you get off course. Others much prefer to show a chart so that they can see what is around them. The chart screen will show the desired course and where the vessel is at all times. Numerical data is also placed on the chart screen that tells what course to follow to stay on course, or show how to correct the course..

Slide 91

Describe the process getting to and arriving at a waypoint with the highway screen as an example.

Slide 92

Check the path of the go-to waypoint for hazards to navigation. Do it on a paper chart, or if you have a chart-plotter, it can be done directly. However, a paper chart is the safest way to do it.

In this case, going directly to the “go-to” waypoint will likely result in a grounding.

Slide 93

The solution is to add another waypoint. You can then “go-to” the first waypoint and then when you get there, “go-to” the next destination waypoint.

Slide 94

GPS can be directed to go to one waypoint to another, or it can be directed to go to a sequence of waypoints –called a Route.

Slide 95

The GPS can record a sequence of stored waypoints at a Route.

Routes are given names; they can be altered, and can be activated in either direction.

Slide 96

Discuss the methods.

Let’s look at manual entry in more detail.

Slide 97

The Route Definition Page is accessed via the Main Menu on most GPS models.

This screen has a name (generally, the name will be created automatically using the names of the first and last waypoints in the list although the user can change the name.

The first waypoint is entered by scrolling the highlight down to the top blank WPT field and pressing ENTER. Now you can scroll the characters. As you enter the first character, the first waypoint on the waypoint list starting with that character will appear in the field. As you enter the second character, the top waypoint with those first two characters appears. Continue the process until the exact waypoint name that you want is displayed. Then press ENTER to accept.

Scroll to the next WPT field below the top one. Do the same thing. Repeat until all the points are entered.

The GPS will compute the Course and Distance between each of the waypoints in the Route, corresponding to each leg of the route. It also will compute the total trip distance.

Once entered, you can activate the Route for navigation, or Invert it to navigate the opposite sequence to return.

Slide 98

An introductory slide to navigational tips

Slide 99

Explain what each means. All these terms will be used in discussing or explaining navigation.

Slide 100

Using the Chart screen for navigation. Explain the meaning of each screen and associated data fields. Emphasize the value of a screen with a choice of true chart display or magnetic display.

Slide 101

Explain the meaning of each display. The chart screen is better when waypoints are far apart.. Waypoints crowded together can be confusing. Go-to screen is very precise

Slide 102

This is one danger of using the compass screen. It is not as obvious as other screen presentations that the vessel is off-course. It’s not obvious when going of course

Slide 103

Explain that when in cursor-mode, the location of the cursor is shown in the map screen with distance and bearing to the cursor from the boat indicated. One can use a hand-bearing compass to confirm the bearing if the cursor is placed over an aid to navigation or a prominent landmark.

Slide 104

Another advantage of a GPS that has chart-plotter capability; additional information stored within the GPS that is useful for navigation. In the example shown, one can quickly determine a buoy’s light and sound characteristics. Of course, one must have this feature in their GPS.

Slide 105

Emphasize this. It is a serious problem.

Slide 106

Various types of alarms that a GPS might provide. Depth alarm requires and integrated GPS-depthfinder or a data connection between the GPS and a separate depth-finder.

The next slide graphically shows the various types of alarms.

Slide 107

No comment

Slide 108

Transition slide. Now let’s talk about the color map screens that so many GPS devices now include.

Slide 109

Attributes of Raster charts

Slide 110

Attributes of Vector charts. The quality and features vary greatly depending on the cost. .

Slide 111

Important subject.

Explain to the student what a Notice to Mariner is and why it is important; example, it might mark the location of a recently submerged vessel that might be directly in line with the course you choose to follow! Notices of Mariners come out every week.

It is easy to add the information to a paper chart. Even if the user is willing to electronically update their electronic chart every time they goes boating, the manufacturer may not provide such a service or even if he does, the latest Notices to Mariners may not be included.

The recreational boater who relies exclusively on the charts that came with the GPS may put his vessel at risk since he will lack current marine information.

Slide 112

No comment

Slide 113

Explain special features available

Slide 114

Aerial photographs come on chart cartridges or are downloaded from the Web. They are very useful when entering an area the mariner is not familiar with.

Bathymetric data also comes on chart cartridges or are downloaded from the Web. They give a 3-dimensional view of the bottom.

Slide 115

Radar overlay data comes from the vessel's radar set. The data is sent to the chart plotter via the vessel's communication data communication system. Overlaying the radar data adds greatly to situational awareness as it shows the location of other vessels in the vicinity clearly indicated with their proper location on the electronic chart. The screen shown is called a split-screen. On the left is the radar. One the right the radar over-layed on the chart.

Video comes from cameras located in various places on the vessel; the bow, living spaces, engine room, looking aft, etc. The example in the slide shows a video camera mounted on the fly bridge looking down at the bow.

Slide 116

Do remind students that most laptops are not waterproof and are not very rugged. One can purchase a laptop that meets the waterproof/water-resistant requirement but they are significantly more expensive that what most people purchase. Most laptops do not have sunlight visible screens although this may be less of an issue in the future as brighter screens become commonplace.

Slide 117

Tablets and cellphones are inexpensive substitutes. They are not full function GPSs Screens may not be bright enough to see in direct sunlight. They are most often not waterproof or moisture resistant. However, the market changes quickly

Slide 118

Power source – batteries or connection to ship's power?

Portability – handhelds can go anywhere!

Most marine GPS displays are bright enough to be seen in direct sunlight. Check this before purchase. Note that cell phones and tables may not be very readable in direct sunlight although manufacturers are constantly making improvements in screen brightness. Again, test before buying.

Small screens can be difficult to see especially when the boat is moving around a lot. Large screens are better in such conditions. Larger screens may permit more rapid consumption of information and therefore less time focusing on the GPS instead of looking around for other vessels and dangers to navigation.

Color screens for different GPS models will have differences in amount of information available, screen resolution and overall visual quality. Higher priced units usually have better performance with the ultimate being large color chartplotters. Evaluate performance verses need before you buy!

Slide 119

Adding charts, either by purchasing plug-in charts or access to download data can be expensive. It sometime is less expensive to purchase a more expensive GPS that comes with the charts needed than to purchase a less expensive unit where the needed charts have to be purchased separately. Check before you buy!

Mounts can usually be purchased for hand-held units and even larger units that must be fixed-mount can usually be moved between other vessels by purchasing an additional mounting kit. Fixed-mount units do not have that flexibility.

More expensive units are often easier to use; larger screens, touch screens, friendlier man-machine interface and so forth. Try before you buy!

Portable units usually do not have the capability of using an external antenna. If the unit is to be used at a lower steering station or inside an enclosed cabin with heavy fiberglass or metal surround then an external antenna may be a requirement.

Most any of today's GPS units, portable or fixed-mount will interface to a computer. A special cable is needed. Make sure the cable is available and compatible with the unit you plan on purchasing.

Slide 120

Accuracy – 30 feet almost anywhere in the World! 10 feet North America with WAAS.

Stress that a GPS is an aid to navigation and should not be used as the only navigational device/method. Chart backup is actually mandatory on very large vessels

Devices are available from $100 to many thousands of $. Choose the device that is right for your intended use.

Devices are capable of furnishing a lot of information but with that comes some complexity. Practice until proficient when not underway. Use simulator mode.

GPS units are electronic devices and as such they can fail or give incorrect information. Cross check position frequently using other navigation methods; compass bearings on known objects, observing nearby aids to navigation, radar, etc.).

You must look around for other vessels and dangers to safe vessel operation when interacting with your GPS. A GPS does not see other vessels. Either have a look-out when you are concentrating on your GPS or frequently check surroundings yourself. Do as much GPS data entry as possible before getting underway.

Slide 121

Time to ask questions

Slide 122

Notice that there are additional optional slides

Slide 123

GPS does this calculation for you. Sometimes doing a quick mental check on the GPS will disclose a major problem. Often an operator error

Slide 124

A typical calculation.

Slide 125

Routes can have a number of waypoints. Some mariners setup a route for an entire journey -sometimes in small groups. Such a route, in inland waters, may have 20-40 waypoints or more.

Slide 126

The GPS devices available today for recreational and smaller commercial vessels are all considered Electronic Charting Systems (ECS).

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