***Radar Trainer** v2.0*

User's Guide

by

David Burch

Starpath Corporation

Seattle, Washington

Printed in the United States of America
Document Number: RT200799

Note: This document is adapted from the on-line User's Guide which is your primary help reference. The on-line version is more convenient as it has all terms cross referenced with direct links to related subjects in the Guide and in the Tutorial, and there is more detail included. There is much information in the Tutorial about the use of various options in the Radar Trainer.

Table of Contents

Getting Started

Radar Trainer 2.0 requires Windows 3.1, 95 or 98 or NT or newer operating system with a 486 or newer processor. The program will require about 2 MB on your hard drive — possibly less if certain runtime programs are already installed on your system.

The program installs in the conventional manner using **setup.exe** on disk 1. It is recommended that you close other Windows programs before installing Radar Trainer. If you have an earlier version of Radar Trainer installed, this program will not overwrite that one. This is an entirely new program. You can remove the earlier one (ver 1.7) completely after installing 2.0. Setup will install the main program plus 3 help files which are linked to it or which can be run independently. There will also be a notepad file on release notes and one that can be used for registration.

It is good practice to back up your disks before installation and to set the write protect tab on each disk to prevent accidentally corrupting the original disks.

With disk 1 in drive A, use File Manager (Win 3.1) or Start (Win 95) to execute **Run** and from there enter **a:setup** and follow the instructions on the screen.

To start the program from Win 3.1, open the group you named from Program Manager and click the radar icon. In Win 95, the group created will be minimized but still on the task bar. Click that open, and then click the radar icon.

If it should be of interest, a complete list of all files loaded into or updated in your computer when you install Radar Trainer is included in the Release Notes file. It includes directories affected, file dates and file versions as appropriate.

IMPORTANT NOTE ON INSTALLATION. If you experience difficulty with installation and receive notices of files locked or in use or other errror messages, then it almost certainly means there is some program running in the background that interferes with installation. The simplest solution then is to install the program using the Windows Safe Mode option. This is explained in the Windows help file on the Start Button, or see **www.starpath.com/support.htm** for more specific instructions. Installing in Safe Mode has solved every problem we have encountered with this program. Note it is best to install using the Run setup.exe from the Start button. Do not use the Add

new programs function of the Control Panel.

Introduction

Greetings from Seattle, and welcome to the Starpath Radar Trainer, version 2.0.

You have in front of you a versatile radar simulator and a Tutorial for teaching and practicing marine radar observations. And as an owner of this program, you also have the invitation and encouragement to call us if any questions arise about the use of it or of the content it is designed to teach. The DOS forerunner of this program has been in use throughout the world for more than six years, and we hope to continue its success by standing by every user till they are certain they are getting from it what they wish. Marine radar is arguably the most valuable of all electronic nav aids but it remains crucial to safety that it be well understood and properly applied.

When you first start the program it always begins in the default configuration, with the simulator running the same set of targets. There are 3 targets on the screen, the plot option is turned on which is making the gray trails behind the targets. The simulator is running with a time factor of 30, which means the action is evolving 30 times faster than it normally would for the courses and speeds assigned to yourself and the targets.

You can push any buttons you like or the radar control panel or on the simulator control panel to the right of it. None of these actions will be permanently saved nor interfere with your future use of the program. Most functions can be executed from the screen buttons or from the main menu bar. The menu items and what they do are listed and briefly explained as a Help topic, along with jumps to more information about each of them.

The True View option (button in the middle of the simulator panel) shows what is actually taking place, as opposed to what appears to be when viewed on the radar screen. The actual display of the True View window can be varied by the user, and usually some adjustment of it will be required to best show what you might want to see. All of these features are explained in the following Help topics and used in the Tutorial.

It is recommend that new users work through the Tutorial to become acquainted with the operation of the program and how to best use it to learn radar observations and maneuvering. Note that the simulator (the main part of this computer program) does not do anything you do not tell it to do. Once

you tell it what targets you want to observe and then start it, it simply runs as if you were looking at a real radar of that situation. The targets move on the simulator, just as they would at sea.

The training features of the simulator come into play by offering you the option to request various information about any of the targets and your interactions with them. This in turn lets you practice maneuvers or see what various true life situations might look like when viewed from radar. You can also speed up or slow down the action to facilitate your practice, and do other operations which are not typically available on real radars. The Tutorial guides you through this process step-by-step.

You can read about the default targets by clicking the “Demo targets” pull down box on the right of the computer screen, then click the highlighted “Demo targets,” then select “Default targets” from the list, and click “Description.” There are several different ways to define the targets you see, including a random targets generator for later practice.

Quick Help is available throughout the program in a contact sensitive format.

Quick Help

Contact sensitive Help is available throughout the Radar Trainer program.

To use this feature, set the cursor focus on the feature of interest in the program and then press the F1 key. This will open the User’s Guide to the appropriate place that explains that feature.

Clicking any button or drop-down box will set focus to it. Active focus is indicated by the presence of a dotted border on the button or its caption.

To set focus to a button without executing that button, left click the button and hold the left mouse button down as you drag the cursor off the button.

Other Help tips

- Each item in the menu bar is defined and linked to further explanations in the Menu items section of the on-line Guide.

- The on-line Glossary is also structured to provide links to further explanations of key terms.

- Since both the on-line User's Guide and the Radar Tutorial are WinHelp files, it will pay to spend a moment reviewing how to use the special features of WinHelp... especially if you are new to Windows 95, coming from Windows 3.1 since there is a new look and structure to the presentation. Windows 95, for example, includes a full text search, whereas Windows 3.1 does not.

Click the Help button in the main menu bar of the Guide or Tutorial for instructions. There is also discussion there about printing parts or all of these documents. Use of these features is discussed in the Radar Tutorial.

About Radar Trainer

This program is based on its DOS predecessor which has been in use worldwide since 1989. The primary design of the original program has not changed, since it is its basic simplicity and ease of use that led to its being the most popular PC radar simulator in the world for more than 6 years. User reviews can be seen on our web page at http://www.starpath.com. We have, however, added several features and improvements to this Windows version.

Beyond the new Windows format which modernizes the operation, primary new features include:

- extensive on-line help (The User's Guide)
- extensive on-line Tutorial on radar use
- innovative sea state option to simulate the effect of yaw on echo trails
- optional target vessel classes to simulate maneuvering limitations of larger vessels
- convenient procedure for storing target scenarios with annotation
- optional north-up display
- simultaneous display of True view and Radar view
- optional trackball simulation for EBL and VRM operation

The goal of the program remains the same: to provide users a convenient means of learning radar maneuvering and collision avoidance for safe efficient operation underway. And this version remains the same in that land masses are not included as a simulator feature. It is certainly true that chart navigation with radar is an important use of radar and we do cover this in some detail in the Tutorial, but we continue to believe that this aspect of radar usage can be taught from textbooks in the classroom (or printed tutorials). It is difficult to produce *realistic* simulation of how land will look in radar, so we have put off this challenge in favor of improving those aspects of radar training that are unquestionably best taught from an interactive simulator.

Please send in the registration form. It is your surest guarantee of being informed of new developments related to the product. You can also periodically check our web page (http://www.starpath.com) which will include announcements and news related to all of our products.

Technical Support

Starpath School of Navigation can be reached for technical support at:
Web: www.starpath.com, E-mail: info@starpath.com
Fax: 206-783-9209, Voice: 206-783-1414.

Please contact us if you have any questions at all about the functioning of this program or the content of it — or of related matters of navigation and weather. We are a marine navigation school and are standing by to help in any way we can.

Product notices and Frequently Asked Questions are presented on our web page at http://www.starpath.com. This page also includes valuable links to other navigation and marine weather resources.

Radar Terminology

In the Radar Trainer's on line User's Guide, the boxed terms in the graphics are directly linked to the Glossary, and from there to the pertinent sections of the Tutorial. A copy of the Glossary entries are included at the back of this publication. There is also a list of illustrations in the on-line Guide for quick reference to all graphics.

Radar Terms...

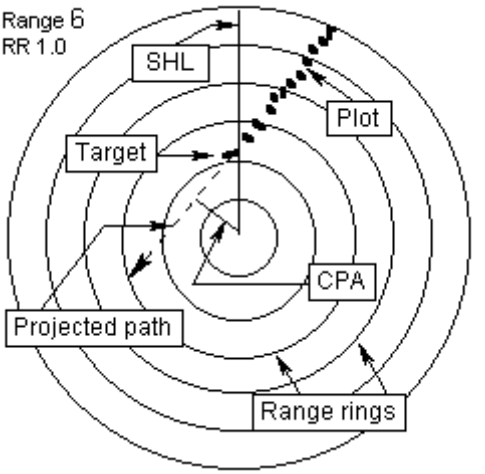


Figure 1

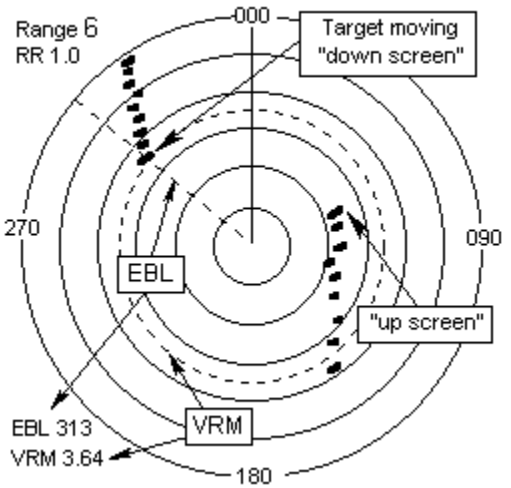


Figure 2

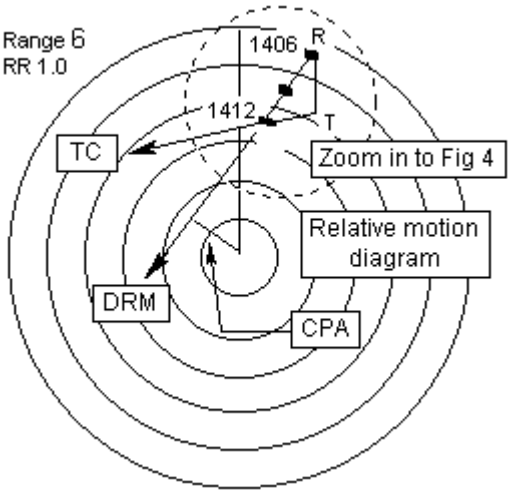
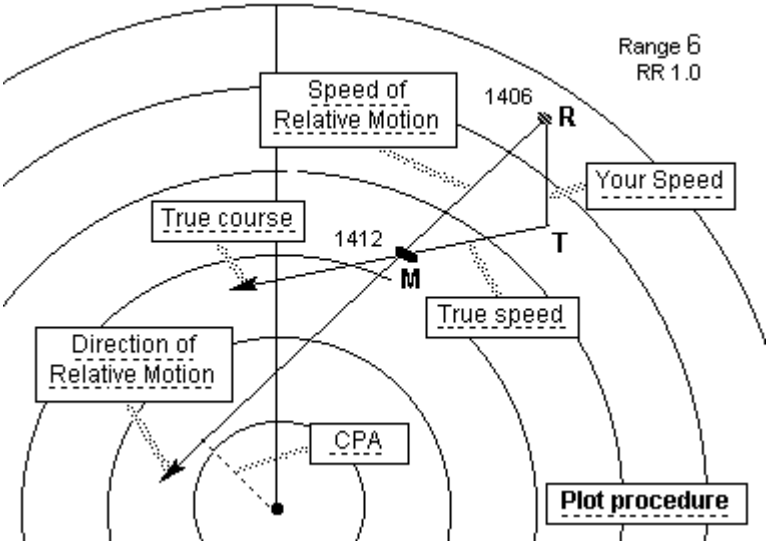


Figure 3

Figure 4 — Relative Motion Diagram



See Tutorial Lesson 4.2 for more on solving this diagram.

Plotting procedure

1. Mark target when first seen. Call the point R. Record the time.

2. Six minutes later, mark the target again. Call it point M.

3. Mark a point d miles directly below R, where d = your speed / 10. Call it point T

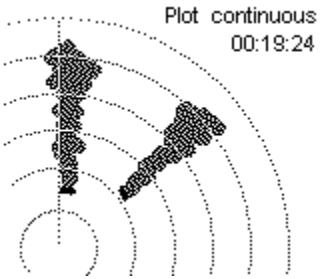
4. The direction T to M = true course of the target

5. The distance T to M x 10 = the true speed of the target

6. The direction R to M = the direction of relative motion of the target

7. The distance R to M x 10 = the speed of relative motion of the target

Figure 5. Effect of sea state on plot trails



As the heading yaws about in a seaway, the plot trail of targets smears out in normal (unstabilized) radar. See discussion under sea state (page 20) and in Tutorial Lesson 2.1. This effect can be simulated in Radar Trainer with the sea state option.

Simulator Operation

Radar mode (Heads-up, North up)

This control changes the radar display from the Heads-up mode to the North-up mode. This mode can only be changed from the Simulator controls in the menu bar.

The heads-up mode could be called the traditional or standard mode of radar display. Only in fairly recent times and on larger vessel radars would you typically see other optional displays, such as a north-up — although this could well change in the future as more sophisticated radars become available to the small craft operator. For now, most small craft radar models run only in

the heads-up mode. In head's-up mode, the ship's heading line remains oriented toward the top of the radar screen regardless of your actual heading.

Unless you have a North-up option on your own radar, it is best to keep the simulator set to the heads up mode.

More sophisticated (and expensive!) radars include the option to display your position on the radar screen as if on a chart, with north remaining toward the top of the screen. This mode requires a gyro compass input and special circuitry. Simply having available a gyro compass or a digital magnetic compass is not enough to make a conventional head's up radar work in this mode. In a north-up display, the ship's heading line turns on the radar screen as your vessel does. The actual headings displayed on the rim of the radar screen, however, can typically still be adjusted to true or relative. See discussion under radar headings (page 37).

EBL / VRM mode

An electronic bearing line and a variable range marker are standard options on all modern radars, from the simplest model to the most elaborate. How these options are operated on actual radars, however, is not at all standard. There are generally two basic styles. One operated by push button keys alone and the other operated with a combination of track ball and keys. We try to offer here some flexibility in training by providing simulated versions of both basic styles of operation.

It is intended that the user would choose the style that matches their own radar, or if they do not own a radar, to practice with both to see which they like best. Note that real radar units do not offer this choice. It is a decision of the manufacturer as to which style to use.

We call the two options Keys mode or Cursor mode. You make this change between these modes at the bottom of the radar panel on the computer screen or from the Simulator controls in the menu bar.

Operation of the functions in both modes are explained under radar controls in the sections on Electronic Bearing Line and Variable Range Marker.

True view

True view is a powerful feature of the Radar Trainer that lets you view the action seen on the radar screen in true perspective, with all vessels moving. It is the best way possible to understand the relative motion problem that must be solved when interpreting the radar screen for risk of collision and ways to avoid it.

This view of the traffic is presented in a separate window and can be viewed simultaneously with the action on the radar screen.

To toggle the True View on and off use the button on the simulator panel or use the menu bar under Simulator. You can also close True View with the system menu button in the window caption bar.

Since this is an artificial view to begin with, the display has been designed to most conveniently show what is taking place. The plot option, for example, is always on, and simple dots are used for the trails, and the target ID letters are showing at all times. In other words, no attempt has been made to make this look like a “true motion radar screen;” it was designed and intended as a training tool for conventional radar. We mention this only because there is such a thing as true motion radar, as discussed in the Tutorial, but that form of radar is not a subject of this course.

Once activated, the True View window can be repositioned and sized to best meet your needs. The scale of the display can be changed and the display can be re-centered at the center vessel at any time. The grid option is intended to help with your personal design of the layout. These controls are executed from buttons in the menu bar of the display.

The “+” and “-” keys can be used to change the effective range of the view. They increase and decrease the number of miles between grid lines. The “Grid” button toggles on and off the grid lines. The current scale of the grid is shown in the caption bar. The “Center” button relocates the center vessel in the center of the view, but does not interrupt the radar view.

The “Repeat” button starts the entire run over, radar view and true view. It is the same as the Repeat button in the simulator panel.

The size of the window can be varied by dragging the window corners, but it is best to keep it nearly square or the motion is distorted. To confirm this, turn on the Grid temporarily to check it. This need not be precise; the entire presentation is intended for comparisons only.

Note the default scale that appears on first viewing the window is effectively a square “radar screen” with range (out from the center) set to 12 miles. From this, you can shape it and scale it as you see fit. Whenever it is changed or centered, the trails will start over.

The intended operation would be to set it up as you like by trial and error and when right, simply press “Repeat” and watch the run evolve. Then move it off to the side so you can compare this true view with the radar view, as discussed in Lesson 2.2.

Sea State

The sea state option is a unique feature of the Radar Trainer simulator. It is used to simulate the effect of a seaway on the radar image of targets in the neighborhood. When using normal unstabilized radar, the yawing of your own vessel tends to smear out the plot trials of targets you are monitoring on the radar screen. This is a key limitation to the interpretation of the true motion of approaching traffic and it is very valuable to learn about this effect before meeting the problem underway.

The option can only be changed from the menu bar under Sea state. When it is changed, the graphic in the bottom right of the radar screen will change with it, so you have a decorative reminder of the conditions selected — although it should be pretty obvious from the target trails on the radar screen.

As with any simulated feature, however, there are some compromises that must be reckoned with when using innovative features or combinations of features. We also, for example, include a time factor option, which is another powerful training tool that lets users speed up the action seen on the radar screen. These two features are inherently incompatible, in that one shows what happens over some period of time, and the other is trying to skip this time.

Consequently, to see a realistic picture of the effect of yawing in a seaway, you must run the time factor at a low value, close to real time. At higher time factors, you do indeed see the trails wander around the screen, but they are rather artificial looking. The use of the sea state option is discussed in more detail in the Tutorial under Lesson 2.1 on Setting simulator options.

It is recommended that you set sea state to “calm” for most operations, and then later on practice with this important addition to realism.

The yawing patterns used in the program are from actual data taken under-

way in a 72-foot vessel along the California coast. The data were obtained by simply recording the heading of the vessel from a digital readout for 30 minutes or so under various conditions. Recordings were made about once every one or two seconds or so! It was an interesting exercise. A small craft vessel heading moves around in the waves much more than one might guess.

Schematic illustrations of the effect on plot trails are presented in Figure 5 (page 16).

Time factor

The time factor is a unique feature of the Radar Trainer which lets users control how fast action develops on the radar screen. A choice of x1 corresponds to real time, x60 increases the rate by a factor of 60 — 20 minutes of actual radar target motion would develop in 20 seconds.

The adjustments are made with a drop-down box in the simulator panel or from the menu bar under simulator. Options are x1, x5, x10, x30, x60, and x 120. The active value of the time factor is displayed on the radar clock and on the label in the drop-down box on the simulator panel.

Note that your choice of the time factor does not affect the locations of targets at any specific time in the future, but it can affect the display of the plot trails left behind the targets. See discussion under sea state. Also the time factor can affect the apparent motion of targets whose maneuvering is limited by the class of vessel. A large vessel, for example, which has a limited rate of turn, could appear to turn more rapidly if the action is accelerated by a high time factor. See discussion under vessel class (page **xx**).

Maneuver (course, speed)

To maneuver a vessel means here to change its course or speed once the radar simulator is running. You can maneuver your vessel or any of the targets. Each target is given an ID letter which can be determined from the Identify button on the right of the screen. The center vessel is indicated with a blue letter. It is “A” to begin with, but this can be changed once the simulator is running with the Jump option.

Procedure: Click the **Maneuver** button at the top of the simulator controls

panel, then click the vessel letter you wish to maneuver from the panel of buttons below the Identify button. This will bring up the maneuver window, where you enter your changes. It will also temporarily change the color of the target on the radar screen that you are maneuvering to red to confirm its identity.

To change speed, press the **Change Speed** button and enter the new speed. You can type it in where the cursor is blinking or use the number pad shown. Then press **Do it** and then **Close**.

To change course you have two options: either enter the new course directly by pressing the **Turn to Course** button or select **Turn Left** or **Turn Right** options. Enter the new values either directly where the cursor blinks, or use the number pad. The first option takes you directly to the course you enter, the second ones just alter course by the amount you enter. Then press **Do it** and then **Close**

The number pad automatically enters numbers where the cursor is activated.

You can make course and speed changes in the same maneuver if you care to, but remember the type of vessel (small, medium or large) will determine how fast the actual maneuver takes place. See vessel class.

To cancel an operation, just **Close** the maneuver window without pressing **Do it**.

Note that if you maneuver a vessel and then press **Repeat**, the targets revert to where they were before your maneuver and to the original courses and speeds. If you wish to keep new settings so **Repeat** takes you back to them, then use **Set your own targets** option to lock in that target scenario. See Repeat.

If you are maneuvering a large vessel (see vessel class) and have the time factor set to 1 or other low value, then this maneuver will not take place immediately but will respond more like a real vessel of that class might do. While the vessel is still maneuvering, a red arrow head will appear next to course or speed that is changing to let you know what direction it is changing in at the moment. Also if you make such a maneuver with these settings, the CPA info will be changing as well during the maneuver. See present data vs. final data.

Pause/Resume

Pause and **Resume** stop and restart the movement of the targets, but lets the rest of the radar functions operate. This is clearly an artificial operation, but useful for some training purposes — or to just stop to answer the phone or eat lunch!

Another way to slow down the action is to change the time factor to 1. This brings the motion into real time, which is perhaps a better approach. You have the opportunity to do multiple operations with the system paused, which could well confuse the simulator in some cases. This is best used for simple tasks, to stop and explain some aspect, or make simple investigations — or to answer the phone. Or just forget it and use the Repeat option.

Repeat

Repeat is a convenient option of the simulator that simply stops the action and begins it again from where it last started. This is very useful in training sessions to go back over situations. It is also useful for testing your setup of the True View window. It is important, however, to understand how this works, since you can maneuver targets underway and lose track of what you are repeating to.

You can start the targets running several ways. One is to press Repeat which we are discussing now, another is the default launch when you first turn on the machine. These are special cases. Normally all target runs begin by pressing the **Run** button on one of the Target options (Demo targets, Set your own targets, or Random targets). All of these options are internally linked to the Set your own targets option, which has a table of target settings which is displayed when you make that selection. When you press any Run button, the program stores these initial settings in the Set Targets table. It is these settings that the Repeat button takes you back to.

Course and speed changes made underway (Maneuvers) do not change the data in the Set targets table, they just change what is happening in the simulator. Consequently, maneuvers made underway are lost once you press the Repeat button. Naturally there are various conventions we might have chosen in this regard, but this one has proven the most useful. If you find that you want targets with slight alterations, just note which ones you want differ-

ent and then make these changes in the Set targets option. These settings can even be saved permanently if you like.

Note that the default launch is just running a particular demo target scenario called Default targets, so it is these that get stored in the Set targets table at the beginning.

The target selection process is discussed more under Target Selection (page 39).

CPA info

A key training feature of the Radar Trainer is its ability to display the full interaction information between your vessel (center vessel) and any of the targets on the radar screen. This information includes details of the closest point of approach, as well as the target's true and relative course and speeds.

To obtain this information, select the "CPA info" option from the simulator panel, and then click the target letter you wish to inquire about. Targets can be identified with the identify button if its letter label is not known. The target you have selected will temporarily be displayed in red to confirm your selection. Note that the center vessel is not an option here, since we can't ask for interaction with ourselves.

The information provided is:

TS = Target's True speed

TC = Target's True course

SRM = Speed of Relative Motion

DRM = Direction of Relative Motion

CPA = Closest Point of Approach

MCPA = Minutes to CPA

BCPA = Bearing to CPA

This information is useful for evaluating risk of collision, but calling it up this way from the computer is obviously not available underway — unless you have ARPA radar used on large ships. The task of the small craft radar operator is to learn how to figure this information from what can be measured from the screen, which is the range and bearing of a target at two different times. The process of solving this problem is covered in the Lesson 3 of the

Tutorial.

Another valuable use of this information in training is to execute practice maneuvers. You can, for example, estimate the CPA (see Lesson 3) and then check it with the “CPA info” option. Then you might try some maneuver of your vessel or the target vessel and then check again to see how the CPA changed in response to that maneuver.

The option at the bottom of the CPA info window marked “Present data” versus “Final data” has no affect on the output in most circumstances. The exception is when you are running on real time (Time factor of 1) and have inquired about a large vessel that is still in the process of maneuvering. In this case, you have the option of displaying the instantaneous data or what the final data will be after the maneuver is completed.

Jump to

This option changes the center vessel — that is, it changes who’s radar you are viewing. It is often instructive to simply jump over and take a look at what your approaching traffic would be seeing on their radar image of you. The distinctions are most striking when there is more than 1 target on the screen. Needless to say, this is a training option, there is no form of this option on any kind of real radar.

This is also a good way to investigate how Rule 19d is intended to work for maneuvering in the fog by radar contact alone.

To execute the jump, select “Jump” from the top of the simulator panel and then press the letter key of the vessel you wish to jump to. Target letters can be found with the “Identify” button.

CPA computer

The CPA computer is a Radar Trainer feature designed to help mariners learn how to plot the relative motion diagram. This feature essentially generates an unlimited number of practice problems with answers and provides a means of checking the answers to problems from textbooks or other sources.

CPA stands for closest point of approach. The relative motion diagram (RMD)

does not directly provide information about the CPA itself — we have somewhat of a misnomer here — but we use the term CPA info more generally in this course to mean all relevant information about our interaction with a specific target.

The RMD can be plotted off line on paper or directly on the radar screen. Direct on-screen plotting is sometimes called “rapid radar plotting.”

The Radar Trainer’s CPA computer is used this way: you tell it the range, bearing, and time of a radar target observation and then tell it these same things again some time later — 6 minutes later is the conventional interval, but any time interval will do.

The CPA computer then tells you, how close the target will pass (CPA), when this will happen, what the bearing to the target will be at CPA, the true speed and true course of the target, and the speed of relative motion and the direction of relative motion of the target. See definitions in CPA info (page 25).

This is precisely the information a mariner needs to determine underway from the radar to meet the “systematic observations” requirements of Rule 7 on evaluating risk of collision.

Note that we certainly don’t need to do this when running a computer simulator, since we can get this information directly from the CPA info option. And doing it that way will even get the right answer(!), which the CPA computer won’t necessarily do if you give it the wrong input.

The value of the CPA computer is it tells what you should get if you plot the values properly that you started from. It does not know if these values happen to be right or wrong. Which is the same situation you have in real plotting underway. You can be expert at plotting, but if you read the wrong data off the radar screen, you get wrong answers.

The CPA computer operates in two modes. You can either type in the input data — from a textbook or imagined problem — or you can use the EBL and VRM to mark targets on the simulator and use this data. Just set the markers where you want them, then open the CPA computer (alt SC), then press “Copy EBL/VRM.” Then close the CPA computer and let the action evolve and then do this again and copy into the second observation, and then press compute.

When copying the input data from the radar screen, your own course and speed are automatically entered into the computation, but if you want to enter arbitrary data from an outside source, you must first set your own course and speed to match the problem. You can do this with the maneuver option, or to make it permanent, use the Set Targets option.

Sample computation using CPA computer

We will use the target approach shown in Figure 4 (page 15) as an example. This problem is worked out graphically in Tutorial Lesson 4.2.

The speed of the center vessel for that example is 13.0 knots. To solve any porblem with the CPA computer, you must first enter the proper center vessel speed. Regardless of what targets are running on the simulator, select Maneuver A, and change speed to 13.0 kntos. Then open the CPA comptuter (alt S C) and enter the following:

First mark at 1406 with R1 = 5.6 and B1 = 035.

Second mark 1412 with R2 = 3.3 and B2 = 027.

Then press Compute CPA, and you should get:

True course = 246

True speed = 18.7

CPA = 1.08

Bearing to CPA = 316

SRM = 23.8

DRM = 226

You can compare these with the values obtained in Lesson 4.2 by graphic methods. Note that they will be close, but we cannot achieve precise answers with graphic methods unless we make large plots and do very careful plotting.

More information on the use of the CPA comptuer is given in Plotting practice section of the Tutorial.

Radar Controls

Range and range rings

The **range** control defines the scale on the radar screen, or more specifically on the PPI. Your vessel's antenna position is in the center of the radar display and the range value selected on the radar is the radial distance represented by the outer edge of the display. If the PPI happened to have a radius of 5

inches, for example, and the range was set to 12 miles, then a target seen on that radar screen at a distance of 2.5 inches from the center of the screen would be 6 miles away. If you changed the range to 6 miles, then that target would appear on the rim of the screen at 5 inches away from the center.

A circular grid of constant range values can also be shown on modern radars to help read the range of targets. This grid is called the **range rings**. At a range setting of 12 miles, these rings might be shown at 2.0 miles apart, for example. At a range of 6 miles, the rings might be 1.0 miles apart. In some radars, the user can define the spacing of the range rings, but this is not a common feature. A sample setting is shown in Figure 1 (page 13), which shows a single target at a distance off (range) of about 2.2 miles. The range selected is 6 miles and the range ring spacing is 1.0 miles as indicated by the numerical display at the top left of the radar screen.

In Radar Trainer, the radar range is set by the large arrows at the top of the radar panel. The up arrow increases the range (6 to 12, for example), and the down arrow decreases the range. Using these buttons the step size and sequence will always be the same. If you wish to jump ranges, then this operation can be carried out from the menu bar under Radar, which lists the typical radar controls. The former method is typical of most real radars, the latter is simply a convenience of the simulator.

To read the range of a target, you can turn on the range rings and then estimate its position between the rings, as done in the above example. Alternatively, and more accurately, you can turn on the Variable Range Marker and adjust it to align with the target and read off its range numerically from the screen display. See Variable Range Marker (page 31).

Use of range and range rings is covered in Lesson 2 of the Tutorial.

Electronic Bearing Line (EBL)

An electronic bearing line is referred to so often as EBL that it is essentially an acronym. It is a (usually dotted) radial line on a radar screen that can be rotated by the user to read a numerical value of a particular bearing on the screen. The bearing of the line is shown continuously on the (usually) lower part of the radar screen. In Radar Trainer, it is on the lower left. An example of its use is shown in Figure 2. This is a powerful and useful tool of all modern radars. Some units have two separate EBLs; other's have just one.

One important use of the EBL is to mark the collision course path of an

approaching target. If you place the EBL onto a distant target when first observed and the target progresses to move straight down that line, then that target is on a collision course with you. If it moves forward of the EBL, it will pass forward of you; if it moves aft of the EBL it will pass aft of you. This important observation and other uses of the EBL is discussed in detail in the Tutorial.

In Radar Trainer, the EBL is operated in one of two methods depending on your selection of the EBL/VRM mode.

In the keys mode, the EBL control buttons are on the bottom of the radar panel. The button marked “EBL” toggles the function on and off. Once turned on, it can be moved clockwise or counterclockwise with the buttons marked with the circular arrows just below the “EBL” button. Note that the default location of the EBL is at a bearing of 000, so when the program is first turned on and the EBL has not been moved, it will be hidden by the ship’s heading line. Later it will stay where it was when the function is turned off. In this keys mode, that is all there is to the operation: turn it on, and rotate it left or right to use it. Read the bearing from the bottom left of the radar screen.

In cursor mode, we simulate some models of track ball radar. With these you move a cursor on the radar screen using a track ball to where you want the EBL to be located and then press the “EBL” button. These radars have the nice function of displaying the range and bearing of the cursor at all times. Our version does not work exactly that way, but you can left click the mouse at any time to read the present range and bearing of the cursor.

To set the EBL in the cursor mode, first switch to the cursor mode if not already in it. This will first of all, remove the keys mode buttons from the radar panel and replace them with a picture of a track ball. This is pure decoration to remind you that you are in this mode. At the same time the cursor will change to a small broad vertical arrow.

Use the mouse to locate the position you want to mark on the radar screen, then left click the mouse. This will mark the spot with a cross hair and simultaneously read out the range and bearing of that spot on the lower right side of the radar screen. Then click the “EBL” button and it will draw the EBL through that cross-hair location. Each subsequent click of the “EBL” button will redraw the EBL at the new position of the cross hair.

If the position of the cross hair had not changed, the simulator will interpret that click of the “EBL” button as your desire to turn off this function.

In summary, the meaning and function of the “EBL” button is different in keys mode and cursor mode. Note that the functions of the VRM in keys mode

versus cursor mode is very similar to that of the EBL just described. See also discussion in Tutorial Lesson 2.3.

Variable Range Marker (VRM)

A variable range marker is referred to so often as VRM that it is essentially an acronym. It is a (usually dotted) circle on a radar screen that can be expanded and contracted by the user to read a numerical value of a particular range on the screen. The range of the circle is shown continuously on the (usually) lower part of the radar screen. In Radar Trainer, it is on the lower left. An example of its use is shown in Figure 2 (page 14). This is a powerful and useful tool of all modern radars. Some units have two separate VRMs; other's have just one.

One important use of the VRM is to determine whether or not a particular target (vessel or landmass) is getting closer to you with time. Running up a coast, for example, you can set the VRM on the coast line and then tell at a glance if you are getting set in towards the shore. This and other applications of the VRM are discussed in Lesson 2 of the Tutorial.

In Radar Trainer, the VRM is operated in one of two methods depending on your selection of the EBL/VRM mode.

In the keys mode, the VRM control buttons are on the bottom of the radar panel. The button marked "VRM" toggles the function on and off. Once turned on, it can be moved in or out with the buttons marked with inward or outward pointing arrows just below the "VRM" button. Note that the default location of the VRM is at a range of 0.0, so when the program is first turned on and the VRM has not been moved, it will be hidden in the center of the screen. Later it will stay where it was when the function is turned off. In this keys mode, that is all there is to the operation: turn it on, and expand or contract its range to use it. Read the actual range of the ring from the bottom left of the radar screen.

In cursor mode, we simulate some models of track ball radar. With these you move a cursor on the radar screen using a track ball to where you want the VRM to be located and then press the "VRM" button. These radars have the nice function of displaying the range and bearing of the cursor at all times. Our version does not work exactly that way, but you can left click the mouse at any time to read the present range and bearing of the cursor.

To set the VRM in the cursor mode, first switch to the cursor mode if not already in it. This will first of all, remove the keys mode buttons from the radar

panel and replace them with a picture of a track ball. This is pure decoration to remind you that you are in this mode. At the same time the cursor will change to a small broad vertical arrow.

Use the mouse to locate the position you want to mark on the radar screen, then left click the mouse. This will mark the spot with a cross hair and simultaneously read out the range and bearing of that spot on the lower right side of the radar screen. Then click the “VRM” button and it will draw the VRM through that cross-hair location. Each subsequent click of the “VRM” button will redraw the VRM at the new position of the cross hair.

If the position of the cross hair had not changed, the simulator will interpret that click of the “VRM” button as your desire to turn off this function.

In summary, the meaning and function of the “VRM” button is different in keys mode and cursor mode. Note that the functions of the EBL in keys mode versus cursor mode is very similar to that of the VRM just described. See also discussion in Tutorial Lesson 2.3.

Ship’s Heading Line (SHL)

The location of your vessel, or more specifically, of your radar antenna, is shown schematically on the radar screen as the center of the display — formally known as the plan position indicator (PPI). The space around you on the PPI represents the space around your vessel. The direction your vessel is headed through this space is marked on the PPI with the ship’s heading line. This is a usually solid line on the radar display from the center to the outer rim.

In Radar Trainer, as in most real radars, you can toggle this line on and off of the radar display with a button on the radar panel marked “SHL.” This option is offered so you can periodically shut off the SHL to look for faint targets that might lie dead ahead.

Note that in the Heads-up mode, the SHL remains oriented toward the top of the screen but in the North-up mode, the SHL will rotate to follow the actual heading of your vessel (center vessel) as you alter course. The SHL is illustrated in Figure 1 (page 13).

Plot option

Modern radars offer the option of configuring the radar display so as to leave a visible trail of the target's past positions on the radar screen. The trials are usually gray or light green smears that follow behind the target as it moves across the screen. This is an extremely valuable option for collision risk analysis and avoidance maneuvers. Without such an electronic option, the past locations of targets must be somehow marked on the radar screen with grease pencil or other marker, or alternatively the positions must be periodically read from the radar screen and recorded on a paper plotting sheet marked with the times of observation. The importance and use of this option is discussed in Lesson 2 of the Tutorial.

This option is activated in Radar Trainer with the "Plot" key on the radar panel. This turns on the plotting and indicates it has done so with a note on the top right side of the radar screen. The frequency of plotted marks is set with the adjacent "Freq" button. The options are: Continuous plot (meaning a mark at every radar sweep), Every 3 minutes, Every 6 minutes, or Every 12 minutes. The choice of Every 6 minutes is especially convenient for determining the speed of relative motion as discussed in Lesson 3. The plotting frequency is also indicated on the radar screen. The plot option can also be activated and adjusted from the menu bar under Radar.

Note that as in real radars, if you change the range of the radar, the plot trials will be lost. This is important to know and to take into account when operating underway as stressed in the Tutorial. In this simulator, however, the trials will also be lost if you add or remove the range rings or the ship's heading line. Most real radars do not behave this way; this is just an artifice of how this computer program functions. If you want to view the screen without rings, for example, just turn the rings off and then press the "Repeat" button to start the run again and new trails will be generated.

The actual appearance of the plotted trail will depend on several factors besides the frequency selected because of other options available in the Radar Trainer. One is the time factor the other is the sea state setting.

Effect of time factor on plot display

If you have the plot frequency set to "continuous," meaning a mark every sweep (about every 3 seconds), then with a low time factor you would get a continuous plot as you would with real radar underway. But if you then changed the time factor to 30, meaning every sweep is not 3 seconds but 90 seconds, then the marks that would appear, even in "continuous" mode,

would no longer be continuous but would be marking where the target was every 90 seconds, which for a faster target would show separated marks along the trail. Likewise, if you increased the time factor to 60, the “continuous” marks would be twice as far apart.

In short, if you want to see what real continuous trails might look like then you must run for some period of time at a low time factor. On the other hand, if choose a plot frequency of 6 minutes, then these marks will indeed show where the vessel was every 6 minutes, regardless of the setting of the time factor. They would just appear sooner with a faster time factor.

Effect of sea state on plot display

A second important contribution to the appearance of the trails is the setting of the sea state option. This is a unique feature of the Radar Trainer in that it can simulate the effects of sea state on an unstabilized radar. This is a major — if not the major — factor in the actual evaluation of collision risk underway. As the heading of your vessel swings around in a seaway, the apparent position of the target on the radar screen moves with it. Hence the trail of a vessel on a perfectly straight course will appear broad and smeared out since this is just a record of its locations when the radar beam hit it. This makes it difficult to evaluate its actual course, and in turn its CPA in approaching you.

A “calm” sea state will yield straight trails, with “moderate” and “heavy” seas causing broader more erratic trail patterns. To see a realistic view of the trails in a seaway, however, you must run at a low time factor. The accelerated sampling of the trails done in higher time factors will present an artificial picture of the trails.

For initial use of the Radar Trainer (as suggested in the Tutorial), it is best to keep the sea state factor set to “calm” and only for later practice switch it to moderate or rough to investigate these important effects. In other words, it is best to learn to use radar in good conditions, before moving on to the difficult ones.

See discussion under sea state and also in Lesson 2 of the Tutorial.

Navigation

Modern radars can be interfaced to other instruments which permits them to offer the option of various extra display readouts on the radar screen. Ex-

amples would be a Lat-Lon position from GPS, a knotmeter speed or speed over the ground, and a compass heading or course over the ground. Some can show other factors such as depth, water temperature, etc. In short, they simply offer the radar screen as another means of data read out. The data are usually presented in the corners or across a bar at the bottom of the screen.

One particular interface feature that is particularly useful is the option to display the range and bearing to a selected waypoint from the GPS. These show up on the radar screen as a circle about the waypoint position whenever it is within the present setting of the radar range with a line drawn to it marking its direction. This is a very convenient way, for example, of discovering that the actual position of a buoy that you used as a waypoint is not located where it was supposed to be. This feature is also valuable in yacht racing.

The Radar Trainer does not simulate any of these features other than displaying on screen your course and speed — the same information you would get by pressing the “Maneuver” button followed by the “A” button, or whichever one happened to be blue at the time. This extra course and speed display can be a convenience in some applications of the Tutorial, but for the most part, it is just a reminder that such features exist and could be useful.

It is also a reminder that on real radars these displays can be toggled off. In some models, the navigation display takes up so much of the radar screen that it interferes with radar observations to have it showing all the time.

The “Navigation” button on the radar panel toggles on and off the course and speed display on the radar screen. This can also be activated from the radar controls on the menu bar.

Bearings

Regardless of what radar mode you might be operating in, most radars typically offer the option to mark the perimeter of the radar screen with angular bearings. These bearings can be expressed in relative units or in true or magnetic units. The Radar Trainer allows you to switch between these two modes with a toggle on the radar panel or from the menu bar under Simulator.

In relative bearings mode, the ship’s heading line marks the 000 position, the starboard beam is at a relative bearing of 090; aft is 180; and the port beam is at 270. When the bearings are set to relative, the EBL will read out relative

bearings as well.

Course bearings, as used in the Radar Trainer, implies that the radar has an input (interface) with a gyro compass which then allows for true bearings to be displayed on the perimeter of the radar screen. In this mode, the number at the top of the ship's heading line is the actual true course of the vessel as read from the gyro compass. The remainder of the circle is then marked with the corresponding bearings. When the heading of the "center vessel" is changed with the maneuver option, this change in course will show up on the top of the screen.

Most small craft do not carry gyro compasses, but many do have digital magnetic compasses. Small craft radars offer the option of a digital magnetic compass (fluxgate) input, which then puts the magnetic course on the ship's heading line, and the corresponding bearings around the perimeter.

In the Radar Trainer, you would practice with this mode by selecting "course bearings," and just understand that in this case these would be magnetic headings in a typical small craft installation. The main point is that in this mode, it is the vessel heading at the top of the screen, which changes with course changes, whereas in the relative headings mode this readout remains 000.

Target Selection

About the Simulated targets

The presentation of targets in Radar Trainer is meant to simulate what might be seen on a real radar screen. We have added several features to help with that, and for the most part the presentation is fairly realistic, nevertheless, some compromises had to be made. First, there is a practical limit to programming complexity that can be justified for the training value to be gained from it, and second, a strictly realistic presentation may not be the most instructive for new users of radar.

To simplify the presentation, the targets shown are generally somewhat larger

than would be expected for the larger ranges, and distinctly smaller than they would be on the smaller ranges, especially for larger vessels. A large ship viewed up close, for example, will appear in real radar as a great bright smear across the radar screen, just as if passing a large land mass. Since our primary goal here is to teach radar maneuvering, these close-in targets appear automatically as if the radar had been adjusted and tuned for the close range scales. We do not simulate the radar tuning and other adjustments which would be necessary when viewing a large target up close.

On the other hand, you will notice that target size does increase somewhat as the range decreases. The shape of the target echo is also made to match real radar in that it is represented as a small arc segment rather than a simple dot or circle. This shows how apparent targets tend to "rotate" as they pass, although this aspect may be somewhat more prominent in the simulator than in real radar.

Also new to this version of the program is the vessel class which is assigned to each target and to the center vessel who's radar is being observed. This option sets limits on the maneuvering rates of the vessels and also changes the size of the radar echo presented. Again, this is a simulation compromise, in real radar it is not often possible to evaluate the size of a target from the size of its radar echo when the vessel is some distance off. See Tutorial discussion under Target identification.

These limitations on maneuvering are intended to be a continual reminder to small craft operators that larger vessels have strict limits on how fast they can turn or stop and this must be taken into account when interacting with them. See Tutorial discussion under Maneuvering. The actual limits imposed and a discussion of these choices are presented in the section on Vessel class.

Demonstration targets

The demonstration targets are a series of target patterns that are stored within the program. They are used in the Tutorial but they can also be used for any application where these particular pre-set target configurations might meet your needs.

Each set of targets includes a text window describing the pattern along with other discussion related to its usage. You can interact with these targets once a run is started, and change the course and speed of any while underway. But when you repeat a run, they will revert to the initial values.

To view the list of “demo targets,” select demonstration targets from the drop-

down box in the simulator panel or select it from the Targets menu. You will then see a list of the stored demos, and you can sequentially go through the list to read the text description of each. The relevant parts of the Tutorial that apply to each is referenced in those descriptions.

To run a demo, select it from the list then press “Run,” or double click it on the list.

Working through the demo targets, reading each and carrying out the exercises presented in their descriptions, is like a mini tutorial, though it will be more instructive to follow through the full Tutorial and come to each of them as they are presented. In any event, after you have finished the full Tutorial, these descriptions offer a quick review and practice of selected exercises.

To store your own demo: You can, if you like, make permanent changes to these demo targets, or add new ones to the list. Since the ones provided are used with the Tutorial, however, it is much better to make new ones, based on the existing ones, if you want modified versions. Or make entirely new configurations of your own devising. How to store targets with annotation is discussed in the Set targets (page 40) option, since that is the place where it is done. If you do make and store your own Demo, you must restart the Radar Trainer to read it into the list of Demos.

To print a copy of the demo description, highlight the text of the description and then copy it to the clipboard with ctrl+C. From the clipboard it can be pasted (ctrl+V) into MS Notepad or any word processor for printing.

To view the initial conditions used in the demos, see procedures under Set Targets (page 40) option.

Range settings: The demos always start out on range 12 miles. If there is one you want to run from the beginning at a different range, just start it, set the range where you want it, and then press Repeat.

Set your own targets

How to set targets. This option lets users define what targets they wish to see on the radar screen. You can set up to 5 targets. They are set by specifying the initial range and true bearing to the targets, along with their true course and true speed.

This option is also used to check the initial conditions of whatever target combinations were last run on the simulator, regardless of how they were originally set up. This usage is discussed further below.

To open the Set Targets window, use the drop-down box in the simulator panel, or select Targets from the menu bar. The current target selection mode can be read from the display on the drop-down box.

To set a new target pattern, open the Set Targets window, set the number of targets you want, set you own course and speed, and then set the courses, speeds, ranges and bearings of the targets. See notes below on bearings and courses. Various applications of the Set Targets function are covered in the Tutorial.

Target bearings. Note that the specified bearing to a target is a true bearing, which means you must do the arithmetic if you want some specific relative bearing and you are not headed 000. On the other hand, if you choose 000 for your own heading — which is always vessel A to begin with — then true bearings and relative bearings are the same. This is the simplest way to set the screen to be what you want.

For example, if you want your own heading to be 205, and you want a target at 45° on the port bow, then you must set that target bearing to 205 — 45 = 160. Alternatively, you could set your course to 000 and the target's bearing to 315 and you would get the same picture.

Target courses. The same considerations mentioned above apply to target courses. The true courses are what is needed here. Hence, in the last example, if you want the target headed downscreen when you are headed 205, then you must enter 205 — 180 = 025. Again, though, if you choose 000, for your own course, you can choose 180 for the target.

Saving target patterns. The demonstration targets are a series of stored target patterns used in the Tutorial. You can make and store your own patterns using this same Set Targets option. To do this, set up the targets you want as outlined above, and then run the targets. You must run the pattern once before they can be saved (you don't have to run for any specific time period, you can just click "Run" and then click "Set Targets" again, if you like — it is just a way to be sure you are saving what you want).

Then click "Description" to alter or completely rewrite the description you want to save with the targets and then click "Store as demo" and enter a name for the pattern. This is the name that will appear in the list of demos when you select Demonstration Targets.

Next you will be asked for a file name to assign to that demo. You can use

any file name, but all Demo files must have the extension .dem. Naturally it is best to select a file name that is not already in use as this will otherwise overwrite that file name. Note that all demos must be stored in the same working directory that has been assigned to the Radar Trainer on installation. This should be the default choice offered. To see your new Demo on the list, you must first Exit and then restart the Radar Trainer.

From then on, you can run this target pattern by selecting Demonstration targets and selecting the name you gave it from the list presented.

Viewing initial target settings. The table of target data you see when you select Set Targets is always the initial conditions of the last set of targets that ran on the simulator. When you first start the program, these are the default targets. This feature was designed specifically so users could see the details of whatever target pattern is running.

In particular, when running the Random targets generator, this can be especially valuable since there is no other way of knowing what was selected. Also since the selections are random, you won't see them again. If you see a set of random targets that are interesting to you, then you can view them by selecting the Set Targets option before running any other targets.

Likewise this option can be used to view the initial settings of the various demo targets.

Random targets

The random target generator is a unique feature of the Radar Trainer. With it you can produce an unlimited number of new target patterns for practice. Several of the exercises and games in the Tutorial make use of this feature.

Access the option from the Targets menu or by selecting "Random Targets" from the drop-down box in the simulator panel. Then choose "Level of difficulty" — which is simply an arbitrary name for establishing how random is random. Then press "Run."

In all cases (Easy, Moderate, and Difficult), you will be presented with 4 targets somewhere in the range of 1 to 12 miles off.

In the "Easy" mode, there will be one or two on a collision or near collision course, with the remainder of the targets on truly random courses — they could be headed away from you as well as toward you.

In the "Difficult" mode, the targets will all be headed in toward you, and the

"Moderate" mode is somewhere in between. Periodically targets will appear that are not underway.

To get new targets, just click the "Random Targets" box again, and click "Run" again.

If you care to see what the initial conditions of the targets were for any random selection, just go to the Set Targets option before doing anything else and they will be displayed there. This feature is explained in the Set Targets discussion.

Use of the random targets generator is covered in the Tutorial under Practice Exercises and Games.

Other ways to vary targets

Besides the three basic means of target setup using the Demos, Set your own targets, and Random targets, you can also get new and varied target scenarios by maneuvering the targets once they start running. Simply change course and speed of any of them to see how various circumstances might evolve. If you find a target scenario this way that you want to modify permanently from how it started, go to the Set your own targets option and change them in the Set targets table. These can then be stored for later use and even annotated if you choose.

Another way to get new target perspectives is simply to use the Jump to target option and jump over to the radar of one of the running targets. This is a good practice exercise, and it is often surprising to see how very different the radar screen looks on the radar of another vessel, especially when there are more than 2 vessels approaching each other.

Speed, time, and distance problems; great circle and rhumbline sailings; all forms of current, leeway, COG, and SOG problems; true and apparent wind; waypoint and route logs; dead reckoning; all forms of celestial computations; marine weather computations; compass deviation compiler; log and knotmeter calibrator; visible range of lights and land; double linear interpolator; metric units converter; and more.

Starpath NavTools will be available in April of 1997. Look for earliest announcement of shipping date at http://www.starpath.com.

Glossary

Note: in the on-line Glossary, accessible from User's Guide or Tutorial, these terms include cross links to related parts of the User's Guide and Tutorial. "See Lesson..." refers to the Tutorial.

alarms

Radar alarms can be set to notify users when a target has approached within a user-set range limit (guard ring) or within some specific sector. This radar feature is not simulated in Radar Trainer.

Aspect

The angular perspective at which we see a vessel approaching or leaving. It is defined as the relative bearing of our vessel as seen from the other vessel. It is measured from 0° to 180° and labeled red when we are on the port side of the vessel or green when we are on the starboard side.

Automatic Radar Plotting Aid (ARPA)

A computerized function of some modern radars that can track, determine, and analyze CPA data for targets on the radar screen.

bearings

Here used to mean the azimuth ring on a radar screen, which can be set to course-up display or relative display. See course up display and relative display.

Bearing to CPA (BCPA)

This is the direction to a target vessel as it passes at its closest point of approach. The computer’s specification of this direction in the CPA info option will always be in the units chosen for the main radar headings display.

brilliance

A radar adjustment that controls how bright targets and other screen features appear. This is not simulated in Radar Trainer, but can be an important part of tuning.

Calm seas

Here used to mean a setting of the radar simulator that implies the yaw of the vessel whose radar you are observing is at a minimum so that unstabilized radar trails (plots) are more or less straight lines.

Cathode Ray Tube (CRT)

The “picture tube” of a radar screen. “Cathode ray” is the 19th century term for electrons. A radar’s CRT works (very roughly) the same way a TV screen does. A beam of electrons impinging on the phosphor of the screen is focused and deflected to match and display the information obtained from the radar’s microwave analysis. The front face of the CRT is called the PPI (Plan Position Indicator) or the radar screen.

Center vessel

This is your vessel, which is located at the center of the radar screen (PPI). Simulator vessels are identified with letters for the purposes of maneuvers and the evaluation of CPA info. The center vessel is marked in blue on the buttons used to access the targets. It is “A” by default, but this can change with the Jump option once the simulator is running.

Closest Point of Approach (CPA)

The minimum distance between you and an approaching radar target vessel that will occur as the target passes if no course or speed changes are made. This distance can be determined (anticipated) from radar observations while the target is still some distance away and used to evaluate risk of collision. This is a fundamental concept in radar usage. The CPA shown in Figure 1 is about 1.6 miles. See also CPA info.

Course over ground (COG)

The actual direction or track a vessel is following across the chart, as opposed to its present heading or desired course. This is usually measured by GPS, but it can also be determined from a series of position fixes obtained by other means.

Course-up display

Here used to indicate a radar control which displays true or magnetic bearings on the rim of the radar screen as opposed to relative bearings. This display mode in real radar operation underway requires the input (interface) of

a gyro compass or digital magnetic compass.

Course

See true course, direction of relative motion, course over ground. How to change courses is covered in Maneuver.

CPA Computer

A Radar Trainer feature that calculates the closest point of approach for targets viewed on the simulator. The computation is based on user observations of the target's range and bearing made at two different times. A similar calculation can be made from data numerically entered into the computer.

CPA Info

Here used to describe a set of information about the interaction of a specific target vessel with your vessel. This includes the size, time, and bearing of the closest point of approach; the true course and speed of the target, and its relative course and speed.

Cursor mode

A simulator control that lets you run the EBL and VRM with a cursor on the radar screen. This is intended to simulate a trackball radar, as opposed to those that do this operation with keys (keys mode).

Demonstration targets

One of three ways of generating targets to be seen on the radar simulator. This option offers several preset traffic patterns, each intended to illustrate some aspect of radar observing. You can interact and change the traffic once underway, but they always start out the same. The demonstrations are used in the Tutorial.

differential GPS (DGPS)

An electronic nav aid which is an enhancement of normal GPS with an additional signal that removes a degree of uncertainly in the position accuracy. DGPS positions are more accurate than unmodified GPS (± 10 meters, or so) and, more important, it provides accurate values of COG and SOG.

Direction of Relative Motion (DRM)

The direction a radar target moves toward as it crosses the radar screen. This direction depends on the target's course relative to yours, as well as its speed relative to yours. This is a fundamental concept in radar observing. See Figure 3. See Lesson 3.2 of the Tutorial.

down screen

Motion of a radar target (in a heads-up display mode) toward the bottom of the screen, usually implying in a more or less vertical line. It is a target whose true speed is slower than yours. See Figure 2. See Lesson 3.

EBL / VRM Mode

A simulator control that toggles the VRM and EBL styles between keys mode and cursor mode. Modern radars use one or the other of these styles to operate these functions, so we include both, leaving it a user option.

echo stretch

A radar adjustment that stretches out the size of the targets (echos) so that weaker targets can be enhanced and monitored.

Electronic Bearing Line (EBL)

An electronic means of measuring the radar bearing of a target with a rotating radial line on the radar screen. Adjust the position of the line until it overlaps the target and read the bearing from numbers on the radar screen. See Figure 2. See also EBL/VRM mode.

Exit Radar Trainer

Closes the program. Current simulator settings are not saved. Targets can be saved (if you care to) from within the Set your own targets option.

False echoes

Apparent radar targets and other images (echoes) on the screen that show up on the screen but are not real radar targets. They are artifically caused by some interaction of the radar beam with other nearby objects. There are several types of false echoes and it is important to understand the potential of these and their sources.

Gain

The radar control that determines the amount of signal amplification applied. It is one of the key elements in radar tuning.

GPS

Now an acronym for Global Positioning System which is a US satellite navigation system used as the primary means of electronic navigation by most vessels worldwide. With GPS equipment on board, especially differential GPS, accurate position, COG, and SOG are available continuously. GPS output data can often be interfaced to the radar and displayed on the radar screen.

grid scale

A Radar Trainer option for setting the range shown in the True view display. The grid can be toggled on and off with a button in the tool bar of the True view window. The grid scale is changed with the “+” and “-” buttons provided. The active value of the grid scale is shown in the caption bar of the True view window.

Guard rings

User defined range rings that can be used to set alarms to signal whenever a target enters the sector defined.

Heads-up

A radar display mode wherein the present heading of the vessel remains at the top of the radar screen (PPI) regardless of your actual vessel heading. This is the most basic and most common type of radar display used on small craft radars. See also stabilized radar.

Heavy seas

Here used to mean a setting of the radar simulator that implies the yaw of the vessel whose radar you are observing is large and erratic so that unstabilized radar trails (plots) are significantly distorted for distant targets. See more info.

Identify

Simulator operation that places a letter label on each visible radar target for a few seconds. Labels are needed to execute target maneuvers or for requesting CPA info.

Interfaced

Two electronic instruments are said to be interfaced if they are hard wired together and share information. The interface can be one or two directional. Radars are often interfaced to gyro or magnetic compasses, to GPS units, or other devices.

interference rejection

A radar control that electronically reduces interference from other radars seen on your radar screen.

Jump to Vessel

Changes the radar simulator screen from that of the present vessel to that of one of the targets on the screen. Note that this is clearly a simulator or training function. There is no way in the real world underway to view an approaching vessel's own radar screen. Select Jump, then the target vessel letter. Targets can be identified for one radar sweep with the Identify button on the control panel.

Keys mode

Our name for the user selected option of running the radar's EBL and VRM with keys as opposed to a track ball as is done in our cursor mode. Note that in this computer simulator, we operate the keys with a mouse driven cursor, so there is a bit of wiggly semantics here.

Knotmeter speed (S)

Speed of a vessel through the water, as opposed to speed over ground which is the actual speed the vessel is progressing "across the chart."

Magnetron

The electrical component of a radar unit that produces the high intensity pulse of microwave radiation transmitted from the antenna. It has two terminals, plus and minus. One terminal is a hollow cylindrical block of copper with cylindrical cavities in its wall, which is situated between the poles of a strong permanent magnet. When a square-wave dc pulse is applied to the terminals, it breaks into rapid oscillations for the duration of the pulse, the frequency of which is governed by the dimensions of the device. It is the only device capable of producing high-powered electrical oscillations at microwave frequencies. The invention of this device at the University of Birmingham,

England, in 1940 was a milestone in the practical implementation or radar.

Maneuvering board

The name given to radar plotting sheets used to solve the relative motion diagram and other radar problems. They generally consisist of concentric circles marked off in range and angle. Sometimes nomograms are presented to allow for speed, time, distance computations. Sample government products are: DMA Pub 5090 and Pub 5089.

Maneuver

The simulator mode that lets you change course and speed of your vessel or any of the targets. Select Maneuver, then the target vessel letter. Targets can be identified for one radar sweep with the Identify button on the simulator panel.

Minutes to CPA (MCPA)

The time interval in minutes between some specified time (usually that of the last observation) and the time of closest point of approach. See Time of CPA . See also CPA info.

Moderate seas

Here used to mean a setting of the radar simulator that implies the yaw of the vessel whose radar you are observing is at a moderate level so that unstabilized radar trails (plots) are only partially distorted by the motion of the vessel

Radar controls

Here used to mean that set of controls that are representative of actual radars as opposed to those on the simulator or computer program. The EBL and VRM, for example, are radar controls, whereas the Jump to or Time factor controls are not. The latter we call simulator controls.

sea state

The combination of wind waves and swells that determine the motion of a vessel underway. Here used to name a simulator option that controls the amount of yaw simulated by the program. Settings are calm, moderate, and heavy. The sea state affects the appearance of the plot trails.

North-up

A radar display mode wherein north (000) remains at the top of the radar screen (PPI) regardless of your vessel's heading. This display requires the input (interface) of a gyro compass or digital magnetic compass. See also heads-up and stabilized radar.

Offset

A radar display option which allows a shift of the center of the display to a user-selected location.

Pause/Resume

Stops and restarts the action of the simulator leaving most radar controls operational in the paused mode.

Plan Position Indicator (PPI)

The front face of the radar's CRT. In particular that central circular part which maps out the location (range and bearing) of radar targets centered about our (antenna) position in the middle. A "plan view" of an object is the general term for the top view, looking down on the thing, which is schematically what this is intended to represent — a chart-like view of what is around us.

Plot clock

The time display shown in the upper right hand side of the radar screen when the plot option has been activated. It records the length of time the plot has been on. The rate of advancement of this time is determined by the time factor. Note this shows a duration of time, not a specific time as shown on the radar clock.

Plot

Here used to describe a trail of radar echo images left on the radar screen. This trail or trace maps out the past locations of that radar target. This is an extremely valuable option for evaluating risk of collision. The frequency of marks recorded can be varied from continuous up to every 12 minutes in several steps set by the "Freq" button on the radar panel. The duration of the plot is recorded on the plot clock. See Figure 1.

Portable range scale

Any device contructed to help interpolate the spacing between range rings on the radar screen. See more info in Figure 3.1-2.

Present data vs. final data

In the CPA info window, you can view the interaction data between yourself and any of the targets. With a Time factor of 1, and a slow maneuvering large vessel, this info will be changing with time during the maneuver. This option lets you ask for the present values or the final values after the maneuver is completed.

Projected path

Most radar analysis is based on projecting the past track (plot) of a target forward to evaluate risk of collision. This process makes the crucial assumption that course and speed of your vessel and that of the target will not change — and that current or leeway also do not change. See Figure 1. See also Lesson 3.3.

racon

An active radar beacon located on a buoy or other structure which transmits back to your radar a signal which identifies it on your radar screen whenever it is struck by your radar beam. These are valuable nav aids as they are unmistakable when triggered. The signals appear as bright broad (5° or so) signal on your radar, often divided into sections to represent a Morse code letter. The radial length of the signal can be a mile or more, and if seen for the first time up close they can be startling. You are not being invaded from space, just given a handy nav aid. They are marked on charts.

radar clock

The time displayed at the top of the radar panel. It begins at 12:00:00 each time a new run is started or repeated on the simulator. The radar clock advances at a rate determined by the time factor which is indicated by (for example) “x10” following the time. See also plot clock.

radar etiquette

Here used loosely to refer to the good practice of checking with person in charge before adjusting radar and not runing the radar in marinas or locks where people may be exposed to the radar beam.

Radar Mode

A simulator control, used here to toggle radar display type between Heads-up and North-up displays.

Radar Panel

Our name for the panel of radar controls located just to the right of the radar screen. This includes typical controls for actual radars (Range, EBL, VRM, etc.) as opposed to the simulator panel which operates simulator features not found on typical radars (Time factor, Jump, etc.). Most radar panel controls are found in the menu bar under Radar.

Radar screen

Generic and common name for the front face of a radar's CRT. Also known as the PPI, although the latter refers more often to just the radar data, whereas the "radar screen" often includes other data such as display settings and Lat-Lon position and other derived functions from a GPS interface.

Radar

Electronic navigation instrument that measures the range and bearing of landmasses and vessels in your vicinity by sending out a rotating beam of microwave pulses and detecting the pulses reflected back from them. RADAR is an acronym for RAdio Detection And Ranging. See general disussion on radar in Tutorial Lesson 1.

radiation hazard

Microwave pulses sent out by a radar antenna pose potential health risks to people exposed to them. Most radar manuals present guidelines for safe application and installation.

rain clutter

Radar interference caused by reflections from nearby precipitation. The name is also used for the electronic filter used to remove or diminish this interference, which is also called Fast Time Constant mode.

Random targets

One of three ways of generating targets to be seen on the radar simulator. This option will randomly generate traffic to be viewed, and no two selections will be the same. The degree of randomness is set by the Level of difficulty. An "Easy" level generates very random traffic patterns, "Difficult" has most of the randomly located traffic headed toward you, and "Moderate" is somewhere in between.

range limits

There are fairly well defined limits to the effective range of any radar installation and these are not equal to the maximum range scale which can be selected. They are determined primarily by the height of the antenna and the height and size of the targets.

Range rings

On the radar screen, the circles that mark fixed ranges. On the 6-mile range, for example, range rings are shown at 1.0 mile intervals. See Figure 1. See also portable range scale.

Range

As used in radar applications, the distance (in nautical miles) from your vessel to a target vessel viewed on the radar screen. It can also refer to the maximum range setting of the radar screen. See also range rings and portable range scale.

Rapid radar plotting

A method of solving radar problems — primarily the relative motion diagram — by directly plotting on the radar screen, as opposed to transfer plotting.

Relative headings

Here used to indicate a simulator control which displays relative headings on the rim of the radar screen as opposed to true headings. In relative headings, the top of the radar screen is always at 000. Target bearings are then measured with the EBL in relative units, starboard = 090, aft = 180, and port = 270.

Relative motion diagram (RMD)

A vector plot of the relative motion of a target vessel and your own vessel used to determine the true course and true speed of the target from the observed values of its speed of relative motion and direction of relative motion. See Figure 4. See also Lesson 4.

Rendezvous

The radar maneuver of setting a course to intercept another moving target. The problem can be solved graphically or analytically. It is the opposite of what we call here storm avoidance.

Repeat

Stops the simulator action and restarts it where the targets were when last started. Course and speed changes made since the last start are also undone. Present radar settings are not reset.

Resolution

The resolving power of a radar, meaning its ability to show two close targets as separate echoes. Resolution in range and in bearing are governed by separate factors. It is an important concept when it comes to identifying landmasses or close vessels.

sea clutter

Radar interference caused by reflections from nearby waves. The name is also used for the electronic filter used to remove or diminish this interference, which is also called Sensitivity Time Control or Anti Clutter mode.

Set your own targets

One of three ways of generating targets to be seen on the radar simulator. In this choice, the user simply specifies the initial location (range and bearing), course, speed, and vessel type for each target they wish to observe.

Ship's Heading Line (SHL)

A line on the radar screen from the center to the outer edge which marks the dead ahead direction of your vessel at the moment. For heads-up radar this is always a vertical line to the top of the screen, but in north-up radar this line will point in the direction of your heading and rotate on the screen as your vessel turns to a new course. On most radars, this line can be temporarily hidden to look for weak targets dead ahead. See Figure 1.

Simulator Panel

Our name for the panel of simulator controls located on the far right of the computer screen. Compare with Radar panel. Most controls in the radar panel can also be found under Radar in the menu bar.

Six-minute rule

The common trick used in radar analyis to quickly compute distance run in 6 minutes (speed divided by 10) and the speed made good in 6 minutes (distance times 10). See Tutorial Lesson 4.2.

Speed of Relative Motion (SRM)

The speed at which a radar target moves across your radar screen, which is its speed relative to you. This observed speed depends on the target's course relative to yours, as well as its actual speed. This is a fundamental concept in radar observing. See Lesson 3.2 of the Tutorial.

Speed over ground (SOG)

The actual or true speed of a vessel from point to point on a chart. This is usually measured by GPS, but can be determined from any two position fixes spanning some time interval.

Speed

See True speed, Speed of relative motion, Knotmeter speed, Speed over ground. How to change speeds is covered in Maneuver.

Stabilized radar

A computerized radar function which displays the motion of radar targets on a PPI which remains oriented in the same direction, usually north up. In these displays, the location of a target on the PPI is independent of heading alterations of your vessel and so the plotted tracks of the target more closely represent their true motion. See unstabilized. See also Lesson 2.1.

Stand-by mode

Means the radar is on and warmed up, but the unit is not transmitting. This is a power-saving mode, also sometimes used for transiting close quarters in locks or channels.

Storm avoidance

Here used to label the radar maneuver of setting a course to but the maximum CPA between yourself and another moving target. It is the opposite of rendezvous.

Sweep

A 360 degree rotation of the radar beam or simulated radar beam. The sweep period is typically 2 or 3 seconds on most radars as it is on the simulator.

Target

The “blip” or “echo” seen on the radar screen that marks the position of the object sending the reflected microwave signals back to your antenna. A radar target can be a vessel, buoy, landmass, or other objects in sight. They usually first appear as tiny faint line segments for distant targets which can grow into huge bright smears for close large objects. See Figure 1. Targets for the simulator are explained in Target selection.

Time Factor

The multiplication factor that controls the rate of advancement of target positions and trails by increasing the speed of the simulator clock shown on the radar panel. At x60, for example, you see 1 minute of action evolve in 1 second. This factor can be changed back and forth to study various parts of an interaction at different rates.

Time of CPA (TCPA)

The actual clock time of the closest point of approach. See Minutes to CPA.

Transfer plotting

The method of solving radar problems such as the relative motion diagram using graphical methods and in particular by doing this on plotting sheets (maneuvering boards) after transfering the pertinent data from the radar screen to the plotting sheet.

True course (TC)

The actual course of a vessel as opposed to the direction of relative motion detected for that vessel on an observer’s radar screen. Note that this usage of “true course” is common in radar discussions, but remains unfortunate as it is not consistent with the more common use of the term, which implies a direction specified relative to true north. See Lesson 3.

True headings

Here used to indicate a simulator control which displays true (or magnetic) headings on the rim of the radar screen as opposed to relative headings. This display mode in real radar operation underway requires the input (interface) of a gyro compass or digital magnetic compass.

True speed (TS)

The actual speed of a vessel as opposed to the speed of relative motion that might be detected for that vessel on an observer's radar screen. See Lesson 3.

True View

Used here to name and activate the pop up window showing all vessels moving in true motion, as opposed to the relative motion seen on the radar screen. Motion in the true view is always synchronized with that seen on the radar screen, although the scales can be adjusted independently.

Tuning

General name for selecting the optimum radar settings of gain, brillance, display, and filtering. One such adjustment on some units is actually called "tuning," which is a synchronization of the reflected signal and the dislay frequency. Some do not include this and are called auto tuning.

Unstabilized radar

This is the name used for conventional radar as opposed to a very special kind of radar called stabilized radar. In unstabilized radar, if the vessel heading shifts (yaws) in a seaway, the recorded positions of targets on the radar screen also shift proportionally. This is "normal" radar behavior. The term is a bit misleading. It is like referring to normal cars as non-amphibious. See also Lesson 2.1.

Up screen

Motion of a radar target (in a heads-up display mode) toward the top of the screen, usually implying in a more or less vertical line. It is a target whose true speed is faster than yours. See Figure 2. See Lesson 3.

Variable Range Marker (VRM)

An electronic means of measuring the radar range of a target with an expanding circle or equal ranges. To operate it, adjust the radius of the circle until it overlaps the target and read the range from numbers on the radar screen. See Figure 2. See also EBL / VRM mode.

Vessel class

Target vessels and the center vessel (own ship) can be assigned a class which sets limits on their rates of maneuvering. Both speed and course

changes are affected. The options are “Small,” “Medium,” and “Large.”

Warm-up period

Radars do not become active the moment they are turned on, but require some 1 or 2 minutes to warm up before ready to transmit. It is an important delay to keep in mind. See stand-by mode.

Yaw

One of several vessel motions in a seaway, this one being the oscillation left and right of the vessel’s heading about the desired course. In this simulator application we also consider yaw to include the helmsman’s willful heading alterations to safely navigate an erratic seaway. See discussion under sea state.

Zoom

A radar control that expands the range about a user selected point on the screen. Not available on all units.