NAVIGATION AND PILOTING : OLD AND NEW pdf

1: Pilot Capless/ Vanishing Point: Old Vs. New - Japan - Asia - The Fountain Pen Network

Over Henriques' suggestion of New London, Connecticut, the Service selected New Bedford, Massachusetts, as the School's first homeport. By , the School of Instruction had enjoyed a year of successful operation.

The History of Navigation Navigation is the art of getting from one place to another, safely and efficiently. Whenever you find a store in a mall or walk home from school, you are using the tools of the early navigators. The first record of boats large enough to carry goods for trade is around B. These first navigators stayed close to shore and navigated by sight of landmarks or land characteristics that they could see. Usually they traveled by day and sought a calm harbor or anchorage at night. Experienced mariners were said to plot their course by major constellations, though this was not an exact science. However, the navigator had no way to accurately determine longitude and therefore, once out of sight of land, had no idea how far east or west he was. Estimates were made based upon the time it took to get there, a simple form of dead-reckoning still used by navigators today. Using this system, the navigator can determine the distance traveled from one point to another by multiplying the time underway by the speed of the vessel. Since time was measured with a sandglass and speed was estimated by watching pieces of seaweed pass by the hull, these early calculations were often way off. Coastal navigators relied upon the sounding reed c. Egypt BC to measure shallow water depths and the wind rose which described the eight major winds attributed to their originating countries. Using a combination of depth soundings, the sun or stars and the wind rose, these early navigators had to guess where they were when land could not be seen. The Vikings regularly sailed to Iceland and Greenland between and AD, apparently using only the sun, stars and wind as their guide. As brave as these early navigators must have been, they were also creative in compensating for their lack of technology. Floki Vilgjerdarsson, a great Viking explorer credited with the discovery of Iceland, carried aboard a cage of ravens. When he thought land should be near, he would release one of the birds. If it circled the boat without purpose, land was not near, but if it took off in a certain direction, the boat followed, knowing the bird was headed toward land. Of course, this only worked if the navigator could get close to land. And not too close! Initially used only when the weather obscured the sun or the North Star, these first compasses were very crude. The navigator would rub an iron needle against a lodestone, stick it in a piece of straw and float it in a bowl of water. The needle would point in a northerly direction. At the time, they could not explain these variations and could not put much trust in the readings when navigating an unknown area. The most practical use of the compass at this time was to identify the direction of the wind to help the navigator determine which of the eight winds on the wind rose they were experiencing. Even after the development of more modern compasses with pivoting needles, until variation was understood and documented, the compass was not as valuable to navigators as it is today. Much more valuable, at the time, was the invention of the lead line c. This line was weighted with lead and had graduated markings to determine sea depth. The lead was coated with wax to bring up samples of the bottom. A method of navigating from one depth to another based upon the condition of the bottom developed, with sailing directions from the 14th Century reading "Ye shall go north until ye sound in 72 fathoms in fair grey sand. Then go north until ye come into soundings of ooze, and then go your course east-north-east. The development of better navigational tools was motivated first by commerce and trade, then by the riches of discovery. The Phoenicians and Greeks were the first of the Mediterranean navigators to sail from land to land and to sail at night. Often they navigated by bonfires set on mountaintops the earliest known system of Aids to Navigation. At this time, mariners began to realize that maps would be helpful and began keeping detailed records of their voyages that land-based mapmakers used to create the first nautical charts called Portolan Charts c. The charts, created on sheepskin or goatskin, were rare and very expensive, often kept secret so that competing mariners would not have access to this knowledge. What they lacked in accuracy they made up for in beauty. Lands and ports on the chart were highly decorated with depictions of buildings and flags. The size of the lands on the chart was more a reflection of their importance to trade routes than their actual geographical size. The charts did not have latitude or longitude lines but did have compass roses indicating bearings between major ports. They were, of course, not very accurate because the ability to measure distances at sea had not yet developed, nor was there an accurate method to portray the spherical surface of the earth on a flat piece of material. Mariners at this time also used the cross-staff and the astrolabe c. The forerunner of the much more portable and accurate sextant, the astrolabe was used to measure the altitude of a sun or star. Heavy and clumsy, it was very difficult to use aboard a rolling ship, however, when new land was discovered and the astrolabe taken ashore, it was valuable in fixing the approximate latitude of the new discovery. His journal reveals that he did not even know how to calculate latitude properly, his determinations being far too high. And like all sailors at the time, he was unable to calculate longitude. When he encountered the Americas he actually thought he had reached India which explains why the names Indies and Indians are still attached to the lands he found. After a few weeks at sea the inaccuracies in the clocks could produce an error in longitude of thousands of nautical miles. It is likely that the best clocks at the time lost 10 minutes a day which translates into an error of miles. This daily loss was not consistent, so it could not be compensated for. A major advance that made dead-reckoning much more accurate was the invention of the chip log c. Essentially a crude speedometer, a light line was knotted at regular intervals and weighted to drag in the water. It was tossed overboard over the stern as the pilot counted the knots that were let out during a specific period of time. From this he could determine the speed the vessel was moving. Interestingly, the chip log has long been replaced by equipment that is more advanced but we still refer to miles per hour on the water as knots. The first accurate representation of the spherical earth surface was the Mercator Projection Gerardus Mercator Of great value to navigators because a compass bearing could be shown as a straight line and they could, therefore, sail the shortest distance between two points , but the problem of determining longitude delayed the use of these charts for some seventy years after they were introduced. In , charts of magnetic variation in different parts of the world were available, making the magnetic compass a valuable and consistent navigational tool. But the key to determining longitude how far east or west they were located lay in the invention of an accurate time-keeping device. It had long been known that the earth was a globe and rotated one complete revolution in relation to the sun every 24 hours. Navigators knew that the sun reached its maximum altitude at noon, no matter where on earth they were. This was considered so important that countries offered prizes for the invention of an accurate chronometer. The British prize was won by John Harrison in for his seagoing chronometer accurate to one-tenth of a second per day. A scientist and accomplished surveyor, Cook completed such accurate and detailed charts during his voyage that he changed the nature of navigation forever and charts were rapidly developed around the world. Prior to that, all of the seafaring nations had their own prime meridians, causing longitude to be different on charts created in different countries. The radio receiver provided a continuously updated time signal from the Prime Meridian in Greenwich, England. The 20th century has seen advances in navigation tools beyond anything Columbus might have imagined. The impetus for these developments was no longer trade and exploration, but for use in war. However, many of these instruments and technologies have been adapted for peacetime use. In Elmer Sperry introduced the gyroscopic compass which is unaffected by variation or deviation as it points to true north, not magnetic north. British physicist Robert Watson-Watt produced the first practical radar radio detection and ranging system in It is used to locate objects beyond the range of vision by projecting radio waves against them. Radar can determine the presence and range of an object, its position in space, its size and shape, and its velocity and direction of motion. In addition to its marine uses, it is also used for controlling air traffic, detecting weather patterns and tracking spacecraft. It uses pulsed radio transmissions from master and slave stations that are received onboard and recorded as small waves on the screen of a cathode-ray tube. The distance between the waves corresponds to the difference in time between the arrival of the signals from the two stations. This difference is represented by a curve hyperbola. Another set of loran transmitters repeats this process and position is determined by the intersection of the two curves called loran lines of position. Accuracy ranges between a few hundred meters and a few kilometers. Used mainly by US ships it is an expensive system with a limited coverage area and will ultimately be phased out in favor of a newer, more accurate navigation system called GPS. This space-based radio-navigation system consists of 24 satellites and provides accurate positioning to within about 30 feet as well as velocity and time worldwide in any weather conditions. GPS works the same way as Loran time difference between separate signals but the signals come from satellites. Because you can receive GPS signals using small, inexpensive equipment it is being used in many new applications.

2: Recommended Nautical Books

This new volume offers a complete, highly readable assessment of marine navigation and piloting. It addresses the application of new technology to reduce the probability of accidents, controversies over the effectiveness of waterways management and marine pilotage, and navigational decisionmaking.

Latitude Roughly, the latitude of a place on Earth is its angular distance north or south of the equator. The height of Polaris in degrees above the horizon is the latitude of the observer, within a degree or so. Longitude Similar to latitude, the longitude of a place on Earth is the angular distance east or west of the prime meridian or Greenwich meridian. For most of history, mariners struggled to determine longitude. Longitude can be calculated if the precise time of a sighting is known. Lacking that, one can use a sextant to take a lunar distance also called the lunar observation, or "lunar" for short that, with a nautical almanac , can be used to calculate the time at zero longitude see Greenwich Mean Time. A mariner with a chronometer could check its reading using a lunar determination of Greenwich time. Rhumb Line In navigation, a rhumb line or loxodrome is a line crossing all meridians of longitude at the same angle, i. That is, upon taking an initial bearing, one proceeds along the same bearing, without changing the direction as measured relative to true or magnetic north. Modern technique[edit] Most modern navigation relies primarily on positions determined electronically by receivers collecting information from satellites. Most other modern techniques rely on crossing lines of position or LOP. If the navigator draws two lines of position, and they intersect he must be at that position. There are some methods seldom used today such as "dipping a light" to calculate the geographic range from observer to lighthouse Methods of navigation have changed through history. The new position is called a DR position. It is generally accepted that only course and speed determine the DR position. Correcting the DR position for leeway , current effects, and steering error result in an estimated position or EP. An inertial navigator develops an extremely accurate EP. Pilotage involves navigating in restricted waters with frequent determination of position relative to geographic and hydrographic features. Celestial navigation involves reducing celestial measurements to lines of position using tables, spherical trigonometry , and almanacs. Used primarily as a backup to satellite and other electronic systems in the open ocean. Radio navigation uses radio waves to determine position by either radio direction finding systems or hyperbolic systems, such as Decca , Omega and LORAN-C. Losing ground to GPS. Radar navigation uses radar to determine the distance from or bearing of objects whose position is known. Satellite navigation uses artificial earth satellite systems, such as GPS, to determine position. The practice of navigation usually involves a combination of these different methods. Pilotage Manual navigation through Dutch airspace Piloting also called pilotage involves navigating an aircraft by visual reference to landmarks, [20] or a water vessel in restricted waters and fixing its position as precisely as possible at frequent intervals. Celestial navigation A celestial fix will be at the intersection of two or more circles. Celestial navigation systems are based on observation of the positions of the Sun , Moon , Planets and navigational stars. Such systems are in use as well for terrestrial navigating as for interstellar navigating. That height can then be used to compute distance from the subpoint to create a circular line of position. A navigator shoots a number of stars in succession to give a series of overlapping lines of position. Where they intersect is the celestial fix. The moon and sun may also be used. The sun can also be used by itself to shoot a succession of lines of position best done around local noon to determine a position. Marine chronometer In order to accurately measure longitude, the precise time of a sextant sighting down to the second, if possible must be recorded. Each second of error is equivalent to 15 seconds of longitude error, which at the equator is a position error of. The spring-driven marine chronometer is a precision timepiece used aboard ship to provide accurate time for celestial observations. The sextant, an optical instrument, is used to perform this function. The sextant consists of two primary assemblies. The frame is a rigid triangular structure with a pivot at the top and a graduated segment of a circle, referred to as the "arc", at the bottom. The second component is the index arm, which is attached to the pivot at the top of the frame. At the bottom is an endless vernier which clamps into teeth on the bottom of the "arc". The optical system consists of two mirrors and, generally, a low power telescope. One mirror, referred to as the "index mirror" is fixed to the top of the index arm, over the pivot. As the index arm is moved, this mirror rotates, and the graduated scale on the arc indicates the measured angle "altitude". The second mirror, referred to as the "horizon glass", is fixed to the front of the frame. One half of the horizon glass is silvered and the other half is clear. The observer manipulates the index arm so the reflected image of the body in the horizon glass is just resting on the visual horizon, seen through the clear side of the horizon glass. Adjustment of the sextant consists of checking and aligning all the optical elements to eliminate "index correction". Index correction should be checked, using the horizon or more preferably a star, each time the sextant is used. The practice of taking celestial observations from the deck of a rolling ship, often through cloud cover and with a hazy horizon, is by far the most challenging part of celestial navigation. Inertial navigation system Inertial navigation system is a dead reckoning type of navigation system that computes its position based on motion sensors. Once the initial latitude and longitude is established, the system receives impulses from motion detectors that measure the acceleration along three or more axes enabling it to continually and accurately calculate the current latitude and longitude. Its advantages over other navigation systems are that, once the starting position is set, it does not require outside information, it is not affected by adverse weather conditions and it cannot be detected or jammed. Its disadvantage is that since the current position is calculated solely from previous positions, its errors are cumulative, increasing at a rate roughly proportional to the time since the initial position was input. Inertial navigation systems were in wide use until satellite navigation systems GPS became available. Inertial Navigation Systems are still in common use on submarines, since GPS reception or other fix sources are not possible while submerged.

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Dutton's Navigation & Piloting. This is the textbook for ship board navigation. You need to have a Bowditch and a Knight's as well as a Dutton's for references when it comes to navigation or Seamanship.

Page Share Cite Suggested Citation: Marine Navigation and Piloting. The National Academies Press. The marine operating environment is a complex, highly interdependent system. It encom- passes waterways, vessels, human operators, navigational aids, and a supporting infrastructure for pilotage, vessel and port management, policy and regulation, and professional development. When the system performs well, the regional and national economies, the vessels and their crews, populations near ports and wa- terways, and the natural environment all benefit. But over the past decade, the safety, effectiveness, and efficiency of navigation and piloting have become ma- jor concerns. Clearly, major marine accidents deserve attention, particularly in terms of prevention or mitigation measures. Public attention has opened a window for reasonable and positive changes in the marine navigation and piloting system. System improvements need to be carefully crafted and implemented to avoid unintended side effects. A steady hand at the helm is needed to steer implemen- tation through the changes projected in Chapter 9. The following recommenda- tions are intended to help chart a well-informed, prudent course. The Committee on Advances in Navigation and Piloting accepts and endors- es the traditional concept that pilots are local experts in whom special trust and confidence are placed for the safe navigation of the vessels they serve. By longstanding maritime tradition, they are held to high standards of professional competence and official accountability. This tra- dition should continue. The conclusions and recommendations expand on this fundamental view by prescribing a strategy for reducing operational and envi- ronmental risk and for improving safety performance, thereby enhancing public confidence in the marine navigation and piloting system and its pilotage compo- nent. Whether or not pilotage as practiced in the United Estates satisfies this fundamental view of the pilot is a central focus of this chapter. Recommenda- tions are numbered for convenience of reference; no priority order is implied. System organization, operation, and overall performance could be substan- tially improved to reduce operational risk by a more systematic accounting of interactions among system components. The marine navigation and piloting sys- tem is characterized by large disparities in its administration and standards of performance and by limitations in safety data that constrain intorrned oversight. The system is also characterized by considerable polarization over safety, eco- nomic, and jurisdictional issues that have prevented resolution of conflicts over marine pilotage and inhibited system-wide regulation of vessel traffic. Specific improvements can be made in system organization and integration, human sys- tems, marine pilotage, waterways management, navigation and piloting technol- ogy, and marine research and development, as described in following sections. The loose nature of organizational structures contributes to lapses in human performance. These varying organizational structures, and the decision making that results from them, are proximate or contributing causes in many marine accidents. Little attention has been paid to marine navigation and piloting as a system; instead, previous assessments and investigations have focused principally on performance of specific vessels in specific circumstances. The systemic ele- ments navigation and piloting tasks, technology, human systems, governance, and the organizational environment in which they operate- have been assessed in varying degrees, but their interactions and relative importance in reducing operational and environmental risk are not well understood. This lack of understanding, together with the informal integration of the marine navigation and piloting system, inhibits re.

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