Postgraduate Certificate in Marine Navigation and Nautical Technology

Navigation Electronics and Equipment

A AIS (Automatic Identification System) – a VHF-based transponder that automatically exchanges vessel identity, position, course and speed with nearby ships and shore stations. Related terms: VDM, S-AIS. Example: A cargo ship broadcasting its MMSI and ETA to improve situational awareness. Challenges: Signal interference in congested ports and the need for regular firmware updates to maintain compliance with evolving standards.

AB ABR (Acoustic Beacon Receiver) – a hydroacoustic device that detects underwater acoustic beacons such as racons and SARTs. Related terms: Racon, SART. Example: A research vessel using ABR to locate a deployed acoustic tag on a marine animal. Challenges: Ambient noise and variable sound-speed profiles affecting detection range.

AD ADCP (Acoustic Doppler Current Profiler) – an instrument that measures water-column velocity profiles using the Doppler shift of acoustic pulses. Related terms: DVL, current meter. Example: An offshore platform monitoring tidal currents for turbine alignment. Challenges: Beam alignment errors and interference from surface waves.

AR ARPA (Automatic Radar Plotting Aids) – a computer-based radar function that automatically tracks targets, calculates CPA (Closest Point of Approach) and provides collision-avoidance information. Related terms: Radar, CPA, R/V. Example: A ferry using ARPA to monitor crossing traffic in a narrow channel. Challenges: Target clutter, false tracks, and reliance on accurate radar calibration.

AT ATON (Aids to Navigation) – electronic and physical devices such as buoys, beacons, and lights that assist mariners in safe navigation. Related terms: Buoy, lighthouse, e-NDB. Example: A GPS-enabled buoy transmitting its position via AIS. Challenges: Maintenance in harsh marine environments and integration with digital chart systems.

B B&G (Brookes & Gatehouse) – a leading manufacturer of integrated navigation systems, including chartplotters, autopilots and radar overlays. Related terms: Chartplotter, integrated bridge system. Example: A yacht equipped with a B&G H5000 chartplotter that fuses GPS, AIS and radar data. Challenges: Software compatibility with third-party sensors and periodic firmware upgrades.

BF BF (Beamforming) – a signal-processing technique used in sonar and radar arrays to steer the reception pattern toward a desired direction, enhancing target detection. Related terms: Phased array, sonar. Example: A modern hull-mounted sonar employing beamforming to locate underwater obstacles. Challenges: Computational load and side-lobe interference.

BR BRG (Bearing) – the angular direction from the observer to a target, measured clockwise from true north. Related terms: Azimuth, heading. Example: A handheld compass giving a bearing of 045° to a lighthouse. Challenges: Magnetic deviation and sensor drift in electronic compasses.

C CHARTPLOTTER – an electronic device that displays digital nautical charts (ENC) and overlays real-time position data from GNSS, radar, AIS, and depth sounders. Related terms: ECDIS, ENC, DGNSS. Example: A coastal patrol boat using a chartplotter to navigate narrow inlets. Challenges: Chart update latency and the need for rigorous validation against paper charts.

COMPASS Magnetic Compass – a traditional navigational instrument that aligns with Earth's magnetic field, providing a reference direction. Related terms: Deviation, variation. Example: A small fishing vessel relying on a magnetic compass when GNSS signals are lost. Challenges: Local magnetic anomalies and the requirement for regular deviation card updates.

CR CR (Compass Rose) – a graphical representation on charts or displays indicating the cardinal directions and often the magnetic variation. Related terms: Chart symbols, north arrow. Example: An ECDIS screen showing a compass rose that rotates with the vessel's heading. Challenges: Misinterpretation when the rose is locked to true north versus magnetic north.

D DOP (Dilution of Precision) – a numeric factor that describes the geometric strength of satellite configuration in GNSS positioning; lower values indicate higher accuracy. Related terms: PDOP, HDOP, GDOP. Example: A survey vessel noting a PDOP of 0.8 before commencing a high-resolution seabed survey. Challenges: Satellite geometry changes with time, leading to fluctuating position quality.

DVL DVL (Doppler Velocity Log) – a sonar-based instrument that measures the vessel's speed through water by detecting the Doppler shift of acoustic beams reflected from the seabed. Related terms: ADCP, speed log. Example: An offshore support ship using a DVL for precise dynamic positioning. Challenges: Bottom loss in deep water and beam-angle errors.

E ECDIS (Electronic Chart Display and Information System) – a mandatory bridge navigation system that integrates ENC charts, GNSS position, AIS targets and other sensor data to provide real-time situational awareness. Related terms: ENC, S-57, IHO. Example: A container vessel complying with IMO regulations by operating an ECDIS in the open ocean. Challenges: Data integrity, cybersecurity threats and the need for regular chart updates.

EPIRB EPIRB (Emergency Position Indicating Radio Beacon) – a satellite-linked device that transmits a distress signal, vessel identity and location when activated, facilitating SAR (Search and Rescue) operations. Related terms: PLB, COSPAS-SARSAT. Example: A fishing boat automatically activating its EPIRB after a hull breach. Challenges: Battery life management and ensuring the beacon is registered with correct vessel details.

F FOG (Fiber-Optic Gyro) – a solid-state gyroscope that measures rotation rates using the interference of light in a coiled fiber, providing high-accuracy heading information without moving parts. Related terms: MEMS gyro, inertial navigation. Example: A modern icebreaker employing a FOG for precise heading control in polar regions. Challenges: Sensitivity to temperature fluctuations and the need for periodic calibration.

GPS GPS (Global Positioning System) – a satellite-based navigation system operated by the United States that provides worldwide positioning, timing and velocity information. Related terms: GNSS, L1, L2. Example: A pleasure craft using a handheld GPS receiver to plot a coastal cruise. Challenges: Multipath interference

near cliffs and vulnerability to intentional jamming.

GNSS GNSS (Global Navigation Satellite System) – an umbrella term for all satellite constellations that provide positioning services, including GPS, GLONASS, Galileo, BeiDou and QZSS. Related terms: SBAS, DGNSS. Example: A research vessel employing a multi-constellation GNSS receiver to achieve sub-meter accuracy in open seas. Challenges: Managing inter-system biases and ensuring compatibility with legacy equipment.

GYO GYO (Gyrocompass) – a non-magnetic compass that finds true north by exploiting the Earth's rotation; it remains stable regardless of magnetic anomalies. Related terms: FOG, magnetic compass. Example: A naval frigate relying on a gyrocompass for precise heading during missile engagements. Challenges: Power consumption and the need for warm-up time after power loss.

H HOD (Heading) – the direction in which the vessel's bow is pointing, expressed in degrees relative to true or magnetic north. Related terms: Course, track. Example: A pilot entering a heading of 270° to steer westward across a channel. Challenges: Drift caused by currents and wind, requiring frequent correction.

IBS IBS (Integrated Bridge System) – a suite of interoperable electronic devices (ECDIS, radar, AIS, autopilot, etc.) that provide a unified interface for navigation and vessel control. Related terms: Bridge management system, IACS. Example: A cruise liner using an IBS to coordinate navigation, engine order and alarm management from a single console. Challenges: System interoperability, user training and redundancy planning.

IEC IEC (International Electrotechnical Commission) – the global organization that develops standards for electronic equipment, including maritime navigation devices (IEC 61970, IEC 61162). Related terms: IEC 61162-1 (NMEA 0183), IEC 61162-2 (NMEA 2000). Example: A shipyard ensuring that a new radar complies with IEC 60945 for marine equipment. Challenges: Keeping pace with evolving technology while maintaining compliance.

J JRC (Joint Radio Communications) – a coordinated system that integrates VHF, MF/HF and satellite communication channels to provide seamless voice and data exchange. Related terms: VHF, MF, SATCOM. Example: A fleet commander using JRC to relay tactical orders to multiple vessels. Challenges: Frequency congestion and the need for robust encryption.

K KDM (Kalman Filter) – an algorithm that fuses multiple sensor inputs (GNSS, gyro, speed log) to produce optimal estimates of position, velocity and attitude. Related terms: Sensor fusion, INS. Example: An autonomous surface vehicle employing a Kalman filter to smooth GNSS jitter. Challenges: Tuning filter parameters and handling sensor outages.

L LORAN (Long-Range Navigation) – a terrestrial radio navigation system that measures the time difference between pulses from paired transmitters to determine position; largely superseded by GNSS. Related terms: eLORAN, hyperbolic navigation. Example: A coastal rescue craft retaining LORAN as a backup in GNSS-denied environments. Challenges: Limited coverage and lower accuracy compared with satellite systems.

M MARPA (Mini-Automatic Radar Plotting Aids) – a simplified ARPA function typically found on smaller vessels, providing basic CPA and TCPA calculations for a limited number of targets. Related terms: ARPA, radar. Example: A pleasure yacht using MARPA to monitor a nearby fishing boat. Challenges: Reduced target capacity and susceptibility to clutter.

N NMEA 0183 – a serial communication protocol for exchanging marine sensor data (e.g., GPS, depth, wind) using ASCII sentences; widely used for legacy equipment. Related terms: NMEA 2000, IEC 61162. Example: A chartplotter receiving $GPRMC sentences from an external GPS receiver. Challenges: Limited bandwidth and single-talker restriction.

NB NB (Nautical Beacon) – a shore-based radio transmitter that provides a fixed reference point for bearing measurements, often used in harbor approaches. Related terms: NDB, lighthouse. Example: A vessel taking a bearing on a coastal NB to verify its position in fog. Challenges: Signal attenuation over water and interference from nearby transmitters.

O OBS (Obstruction) – a charted feature such as a wreck, rock, or submerged structure that poses a hazard to navigation. Related terms: Wreck, hazard, depth contour. Example: An AIS-enabled buoy marking a newly discovered shoal as an OBS. Challenges: Accurate survey and timely chart update.

P PNT (Position, Navigation and Timing) – the three core services provided by GNSS and other navigation systems, essential for vessel control, communication and synchronization. Related terms: GNSS, UTC. Example: A container terminal relying on PNT to coordinate crane operations. Challenges: Vulnerability to spoofing and dependence on satellite integrity.

Q QZSS (Quasi-Zenith Satellite System) – a regional augmentation satellite constellation operated by Japan that provides additional GNSS coverage, especially in urban canyons. Related terms: SBAS, GPS. Example: A vessel navigating the East China Sea using QZSS to improve GNSS reliability. Challenges: Limited footprint outside the service area and the need for compatible receivers.

R RADAR (Radio Detection and Ranging) – an active sensor that emits microwave pulses and processes returned echoes to display surrounding objects on a screen. Related terms: ARPA, Racon, SAR. Example: A ferry using X-band radar to detect small craft in heavy rain. Challenges: Clutter from sea returns, rain attenuation and the necessity of regular calibration.

RACON RACON (Radar Beacon) – a transponder that, upon receiving a radar pulse, retransmits a coded signal on the same frequency, producing a distinctive echo on the radar screen. Related terms: Radar, beacon. Example: A lighthouse equipped with a RACON that appears as a Morse-code “A” on a vessel’s radar. Challenges: Power supply reliability and maintenance in remote locations.

S SART (Search and Rescue Transponder) – a radar-active device that, when illuminated by a ship’s radar, responds with a series of dots that appear on the radar display, aiding SAR crews. Related terms: RADAR, EPIRB. Example: A lifeboat deploying a SART after a man-overboard incident. Challenges: Limited range and the need for proper orientation toward the interrogating radar.

SBAS SBAS (Satellite-Based Augmentation System) – a system that improves GNSS accuracy, integrity and

availability by broadcasting correction data from geostationary satellites (e.g., WAAS, EGNOS). Related terms: DGPS, RTK. Example: A coastal survey vessel using WAAS to achieve Challenges: Dependency on satellite health and regional coverage constraints.

SEC SEC (Shipboard Electronic Chart) – a digital chart file conforming to the IHO S-57 or S-100 standards, used by ECDIS and chartplotters to display navigational information. Related terms: ENC, CDM. Example: An offshore supply vessel loading the latest SEC updates before a charter. Challenges: Ensuring timely distribution and managing chart version control.

T Tidal Prediction – the process of forecasting sea-level changes caused by astronomical forces, often delivered via electronic tidal tables integrated into navigation systems. Related terms: Tidal datum, harmonic constituents. Example: A coastal tanker checking electronic tide predictions to select a safe loading window. Challenges: Local bathymetric variations and the need for frequent updates.

U UHF (Ultra-High Frequency) – a radio frequency band (300 MHz–3 GHz) used for maritime satellite communications, including AIS VHF extensions and certain SAR links. Related terms: VHF, L-band. Example: A vessel employing a UHF satellite terminal for high-speed data exchange. Challenges: Atmospheric attenuation and antenna pointing accuracy.

V VHF (Very High Frequency) – the primary maritime radio band (156–162 MHz) used for voice communication, AIS, and certain navigation aids. Related terms: AIS, VHF-RDS. Example: A pilot transmitting a VHF call to a harbor pilotage office. Challenges: Limited range in mountainous coasts and susceptibility to interference from nearby transmitters.

W WAV (Waveform) – the shape of a transmitted or received signal in radar or sonar, influencing resolution and detection capability. Related terms: Pulse compression, chirp. Example: A modern hull-mounted sonar using a linear-frequency-modulated WAV to improve target discrimination. Challenges: Designing optimal waveforms that balance range and resolution.

X X-Band – a radar frequency range (8–12 GHz) offering high resolution and short range, commonly used for navigation and collision avoidance. Related terms: Radar, Ka-band. Example: A pilot boat employing X-band radar to detect small fishing vessels in congested waters. Challenges: Rain attenuation and the need for frequent antenna alignment.

Y Yaw Rate Sensor – a gyroscopic device that measures the rate of rotation about the vertical axis, providing essential data for heading control and stability systems. Related terms: Gyro, INS. Example: An autopilot using yaw rate data to maintain a steady course during heavy seas. Challenges: Sensor drift and temperature sensitivity.

Z Z-Navigation – a term for emerging zero-emission navigation technologies, such as electric propulsion integrated with advanced navigation electronics to reduce fuel consumption. Related terms: Green shipping, hybrid systems. Example: A coastal ferry operating on battery power while relying on high-precision GNSS for docking. Challenges: Energy management and ensuring reliable positioning when power is limited.