Navigation

Navigation is the method for determining position, speed, and direction of the object. Also, Navigation is moving from point to anther safely.

Navigation is classified into two categories:

1. Physical model-based methods (PMMs)
2. External data-based methods (EDMs).

Examples of PMMs are inertial navigation systems (INS) and dead-reckoning navigation. They determine the existing position of an object by measuring various changes in its state, such as velocity and acceleration. The global navigation satellite system (GNSS) is an excellent representative of EDMs.

The accuracy of PMMs is exponentially proportional to the cost, and the error increases over time.

Representative PMMs include dead-reckoning navigation (DR) and the inertial navigation system (INS). **They determine the current position by measuring the vehicle's own velocity and acceleration in addition to initial position data.** Due to the nature of PMMs, the error increases with time

Dead-reckoning navigation is a method of estimating the current position using the moving direction, velocity, and time. It considers errors according to true north and magnetic north.
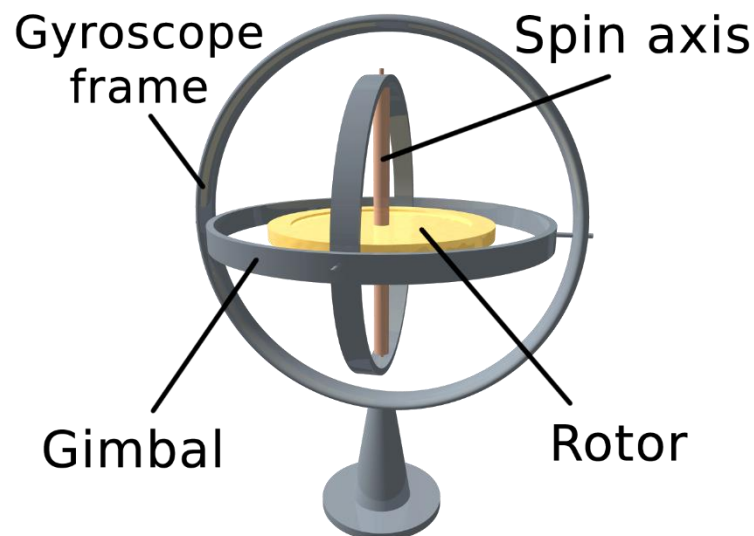

In the case of ground vehicles, only their own velocity needs to be considered, but aircraft and ships must calculate positions by considering ocean currents, wind, and so on.

All navigation systems currently use this dead-reckoning method. Because the accuracy of this method decreases as time and distance increase, celestial navigation is used to determine the accurate position, and then the dead-reckoning method is used from that point forward.
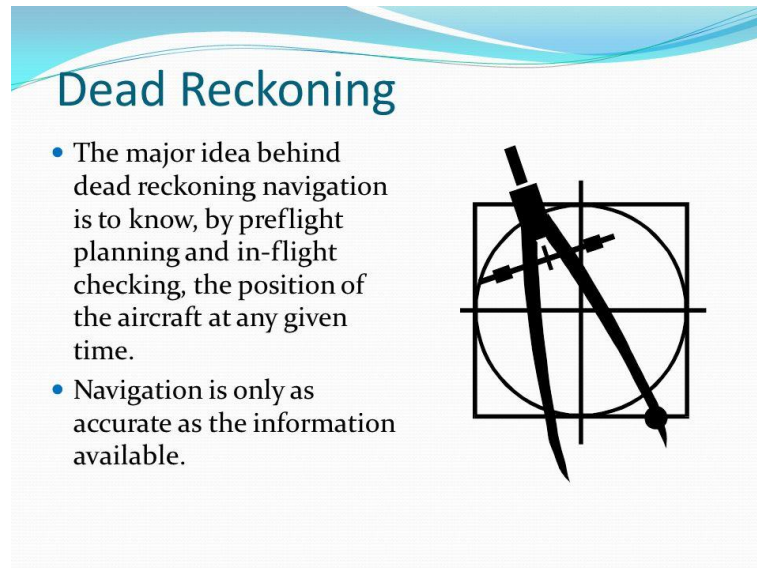
The Inertial Navigation System (INS) is a stand-alone navigation system that continuously calculates the position, direction, and velocity of the main body through its own accelerometer, rotation sensor, and arithmetic unit, without receiving any external information.

Although GPS offers a precise navigation system, it has limitations in space, deep seas, tunnels, and similar places because the GPS operates only when it can receive signals from the satellite. Furthermore, INS can avoid GPS jamming issues. Because an INS is a PMM, the error increases with time.
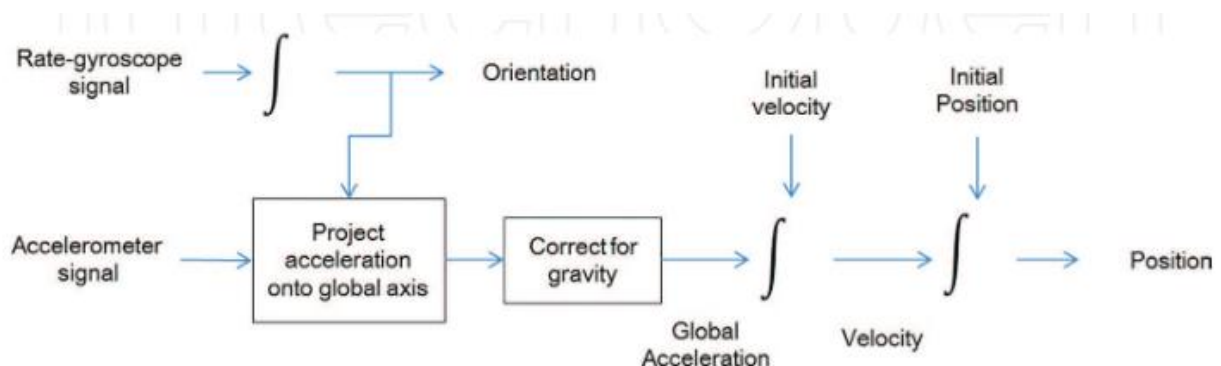

EDMs include GNSS, which is represented by GPS. The application scope is very broad, and includes ground vehicles, ships, and airplanes.

Types of the navigation System:

1. Dead reckoning Navigation
2. Pilotage Navigation
3. Radio-Navigation
   a. Automatic direction finder (ADF)
   b. VOR/DME/RNAV
4. Celestial Navigation
5. Electronic Navigation
   a. LORAN
   b. GPS
   c. Inertial

In radio navigation, a **VOR/DME** is a radio beacon that combines a **VHF omnidirectional range** (VOR) with a **distance measuring equipment** (DME). The VOR allows the receiver to measure its bearing to or from the beacon, while the DME provides the slant distance between the receiver and the station. Together, the two measurements allow the receiver to compute a position fix.
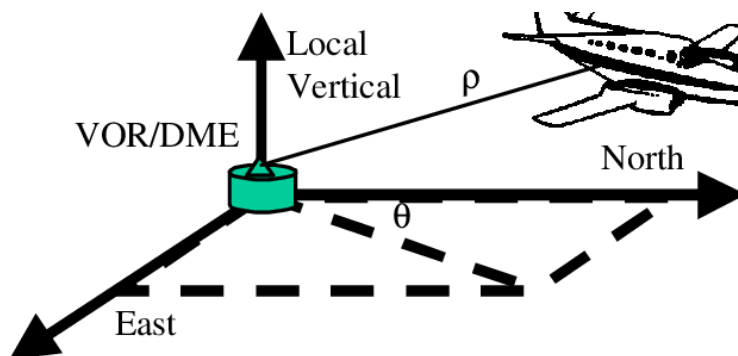
An **automatic direction finder** (**ADF**) is a marine or aircraft radio-navigation instrument that automatically and continuously displays the relative bearing from the ship or aircraft to a suitable radio station.

LORAN, short for **long range navigation** was a hyperbolic radio navigation system