



VICTORIA FLYING CLUB

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Instrument Flying

- Review Instruments and Human Limitations
- Definition and Motivation
- *Basic Instrument Flying*
- **Full Panel, Partial Panel, Unusual Attitudes**
- *Basic Radio* and **Satellite Navigation**
- Summary and Questions
- Pre-Flight Briefing



Review Human Limitations

- How do visual, vestibular and kinesthetic senses provides us with cues for orientation?
- Explain the mnemonic IMSAFE and how individual components affect our flying performance?
- How does hypoxia affect our flying performance and what can be contributing factors?



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Definition and Motivation



- Flying by **reference to instruments *only***
- Human **senses** are prone to **miss-interpretation**
- Instrument flying overcomes human limitations
- Essential skill for higher ratings and flight in IMC



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Basic Analog Instruments



- **Control** Instruments – Pilot Input (Attitude & Power)
- **Performance** Instruments – Aircraft Response
- *Attitude plus Power equals Performance*
- **Navigation** Instruments – Lateral and Vertical



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Glass Cockpit Instrumentation





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Radial Scan

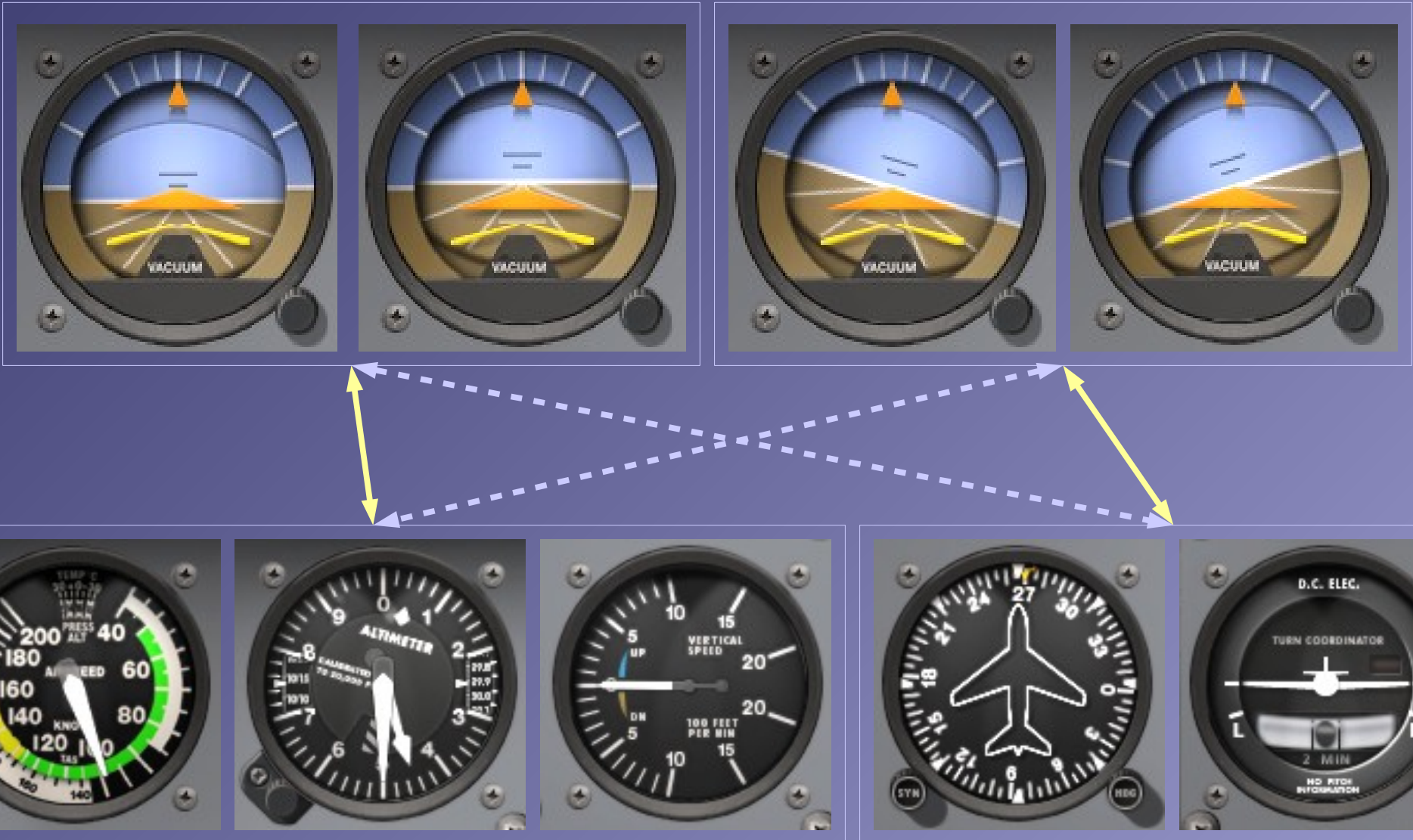


- Adjust **attitude** and **power** for *estimated performance*
- Scan **performance** instruments for actual response
- Re-adjust and **trim controls**, and *scan systematically*



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Attitudes and Movements



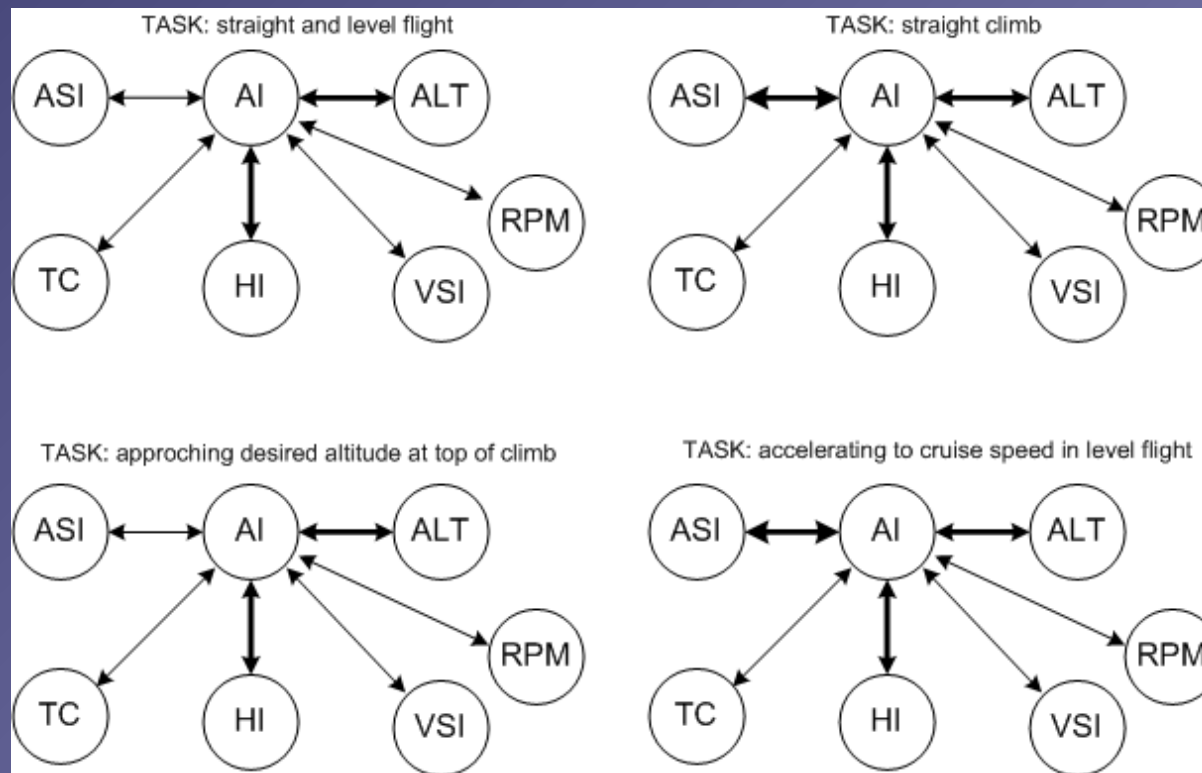


Review Instruments

- Which are the standard instruments that are driven by gyroscopes and how do gyroscopic instruments they operate?
- What errors can be expected with gyroscopic instruments and how do they occur?
- Which are the standard instruments that rely on air pressure and how do they operate?
- What errors can be expected with pressure instruments and how do they occur?



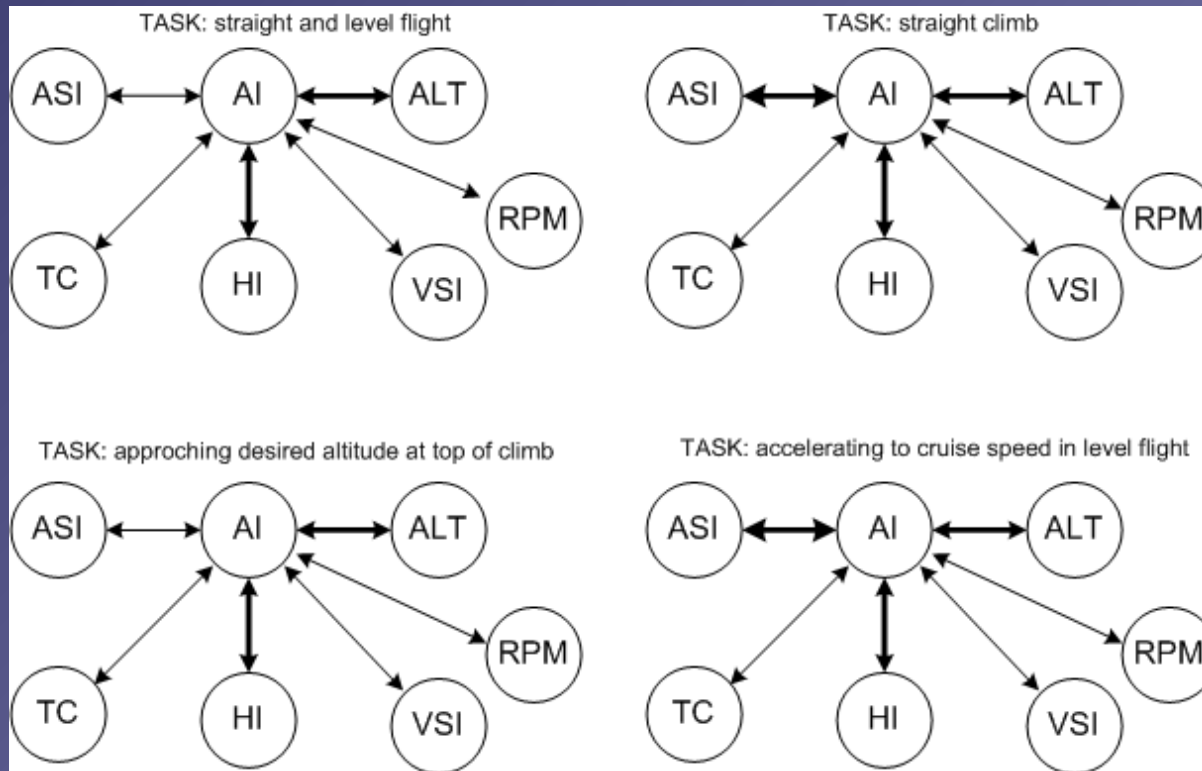
Selective Radial Scan – Definition



- Each maneuver requires *particular* **performance**
- **Scanning** pattern should **prioritize** *accordingly*
- Selective scan should *not* lead to fixation



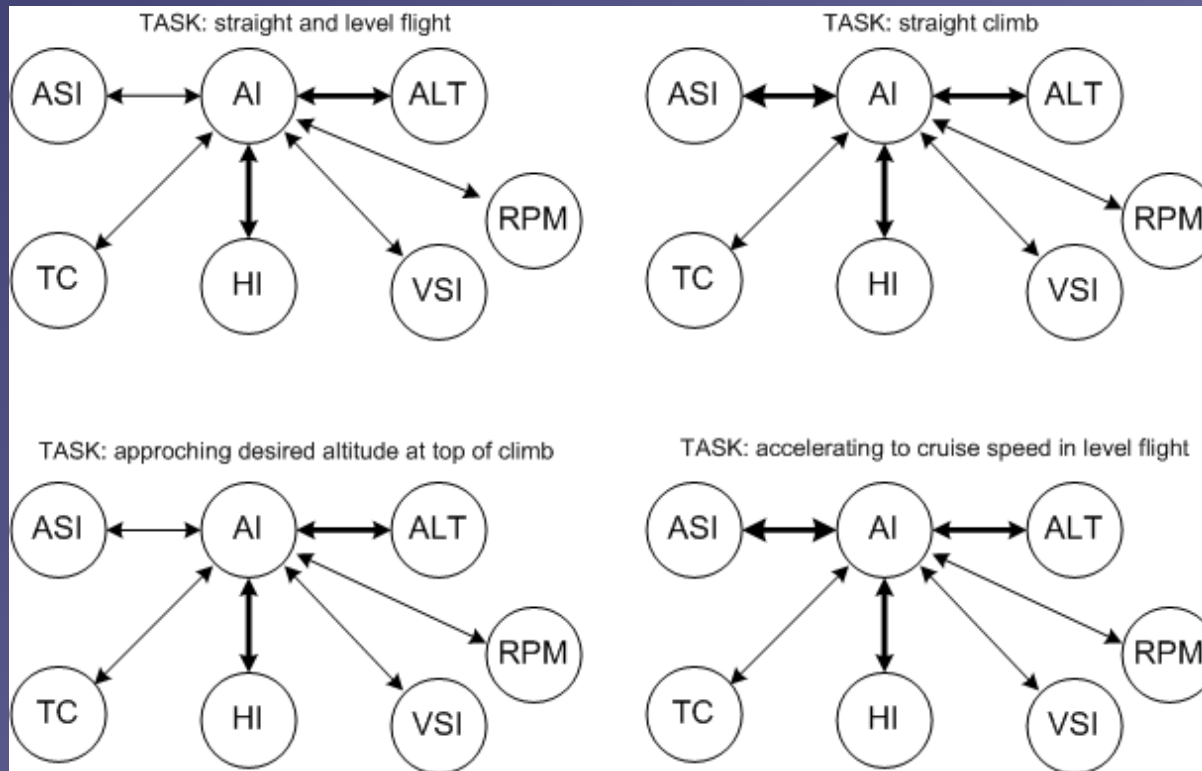
Selective Radial Scan – Method



- What **information** do I need?
- Which **instruments** give me the needed information?
- Is the information **reliable**?



Selective Radial Scan – Method



- Which instruments need to remain **constant**?
- Which instruments need to **change** and at what **rate**?
- Which instrument **lag** can be expected?



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Straight and Level Flight



- *Attitude plus Power equals Performance*
- Remember the **power curve** for adjustments
- Scan **altimeter** and **heading** indicator *more frequently*



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Climbing and Descending



- Climbing – **attitude**, **power**, trim (APT)
- Descending – **power**, **attitude**, trim (PAT)
- Scan **airspeed** and **heading** indicator *more frequently*



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Leveling Off



- Scan **altimeter** and **heading** indicator *more frequently* when approaching desired altitude
- Increase **airspeed** indicator scan during transition to straight and level flight - anticipate level-off **10% VSI**



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Turns



- Perform standard – rate one – turns at **3 °/s**
- Establish and adjust bank angle at **$IAS / 10 + 7$**
- Lead the desired heading using **half bank angle**



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Safety Considerations



- Check **airspace clear** with instructor before maneuvers
- Particularly ensure clear during instrument **turns**
- Student: *“All clear left (right)?”*
- Instructor: *“All clear left (right)!”*



Full Panel – Summary / Quiz

- What instrument *directly* indicates an immediate attitude change?
- How do the altimeter and airspeed indicators *indirectly* indicate nose-up / down attitude changes? Why do these instruments not serve as primary indicators for attitude changes?
- How does apparent precession affect the heading indicator and how it has to be corrected?



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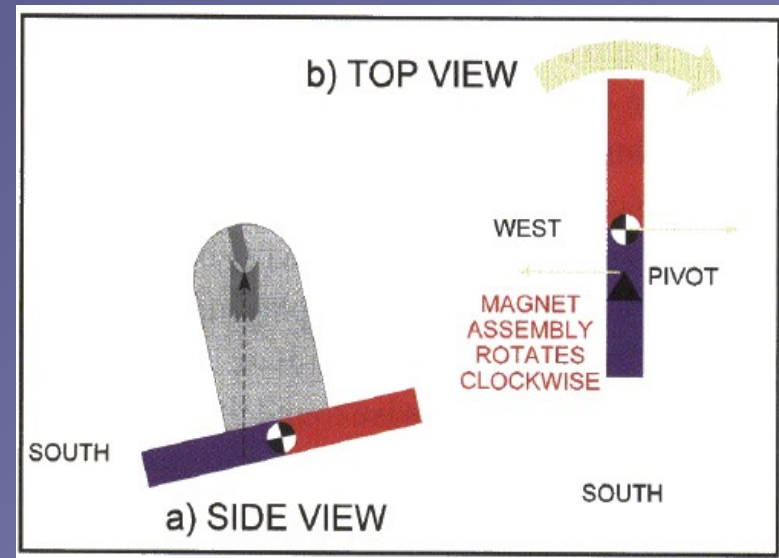
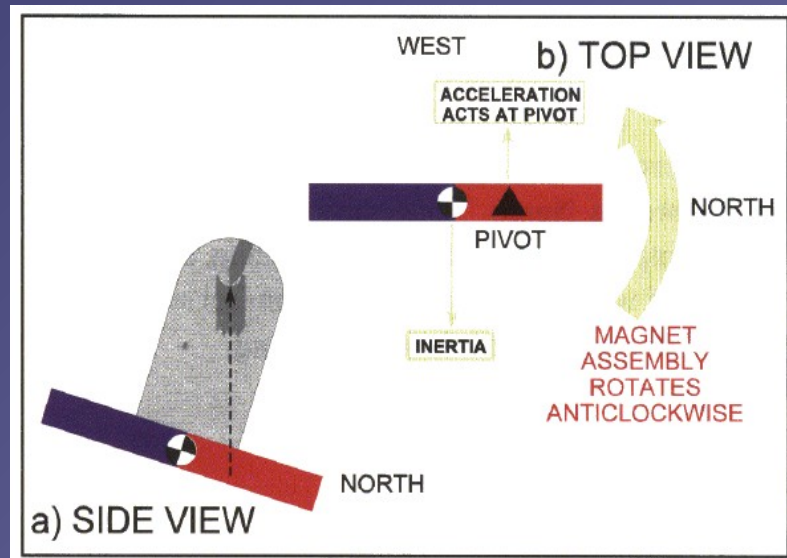
Partial Panel



- **Attitude** and **heading** indicator *not available*
- *Indirect* attitude and more attention to **TC** / **TBI** and **MC**
- Focus on **timing** in turns due to **magnetic dip** errors



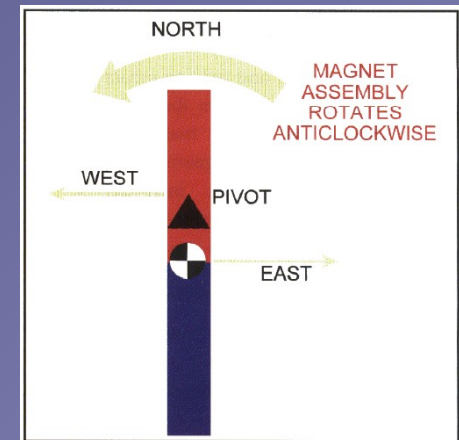
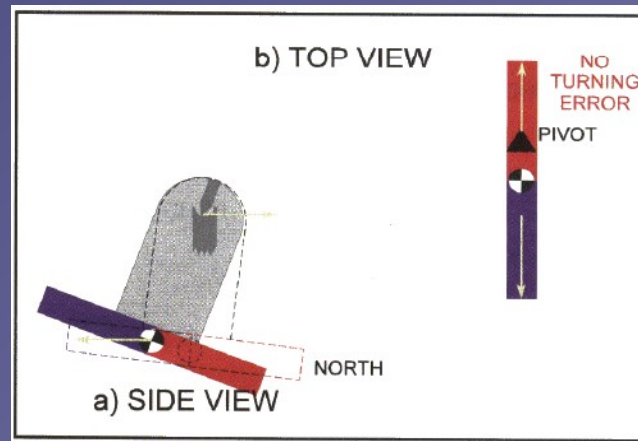
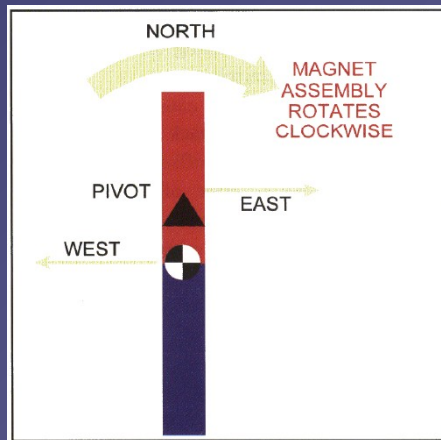
Magnetic Dip



- Magnetic dip is the reason for dip errors (acceleration / deceleration, turning)
- Magnetic dip shifts the **pivot** point away from the magnet's **center of gravity**



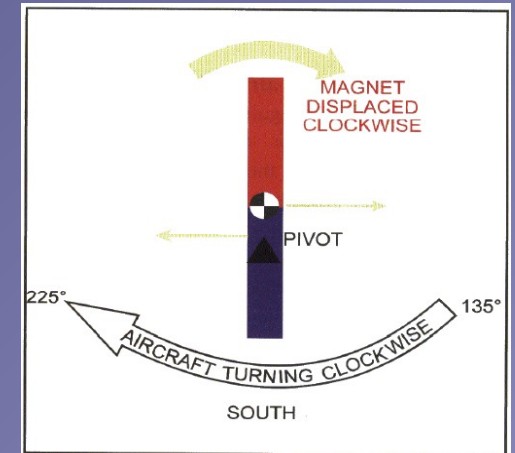
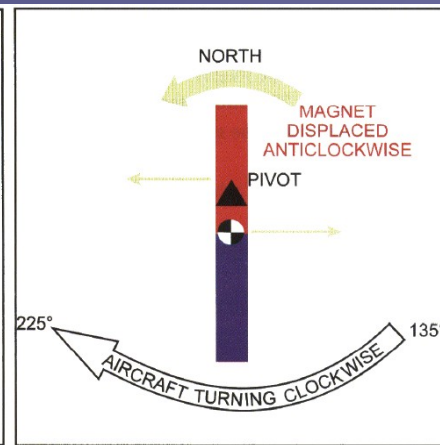
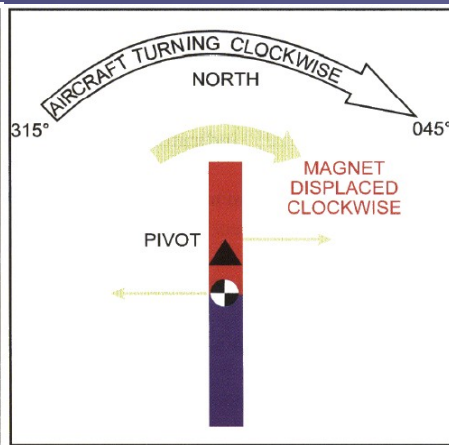
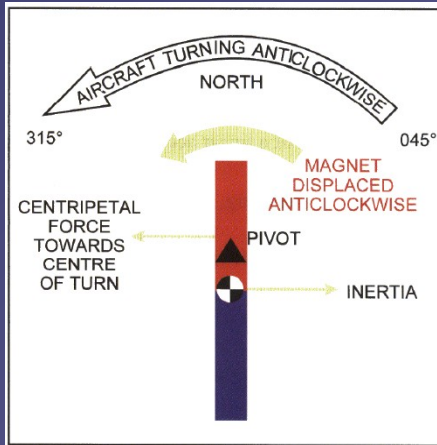
Acceleration/Deceleration Errors



- **Accelerate North Decelerate South (ANDS)**
- Opposite behavior on the southern hemisphere
- *More* pronounced on easterly / westerly headings
- *Less* pronounced on northerly / southerly headings



Turning Errors



- **Undershoot North Overshoot South (UNOS)**
- Opposite behavior on the southern hemisphere
- *More* pronounced on northerly and southerly turns
- *Less* pronounced on easterly and westerly turns



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Partial Panel – Straight and Level



- Maintain **coordinated** and **straight** with **TC** and crosscheck **MC** *occasionally*
- Scan **altimeter** and **VSI** *more frequently* (level)



Straight Climb / Descent

- Maintain **coordinated** and **straight** with **TC**
- Scan **airspeed** indicator *more frequently* (stable)



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Partial Panel – Leveling Off



- Maintain **coordinated** and **straight** with **TC**
- Scan **altimeter** *more frequently* (desired altitude)
- Increase **airspeed** indicator scan during transition



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Partial Panel – Turns



- Scan **altimeter** and **airspeed** indicator *more frequently*
- Timed **rate** one turns – **3 °/s**, divide desired heading change
- **360° → 120s, 180° → 60s, 90° → 30s, 45° → 15s**



Partial Panel – Summary Quiz

- What instruments are not available in a partial panel and what type of error might be the cause?
- During a turn from south to east you notice what type of magnetic compass error and why?
- Mentally perform a straight climb with partial panel and describe all observations and required actions.
- Mentally perform a 90° coordinated rate one turn with partial panel and describe all observations and required actions.



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Unusual Attitudes Recovery



- Nose-Up Attitude
 - Full Power
 - Forward Pressure
 - Wings Level

- Nose-Down Attitude
 - Power Idle
 - Wings Level
 - Back Pressure



Unusual Attitudes – Summary Quiz

- Which instruments should be disregarded during the recovery from unusual attitudes and why?
- Mentally determine and perform a recovery from an unusual nose-up attitude and state all observations and required actions.
- Mentally determine and perform a recovery from an unusual nose-down attitude and state all observations and required actions.



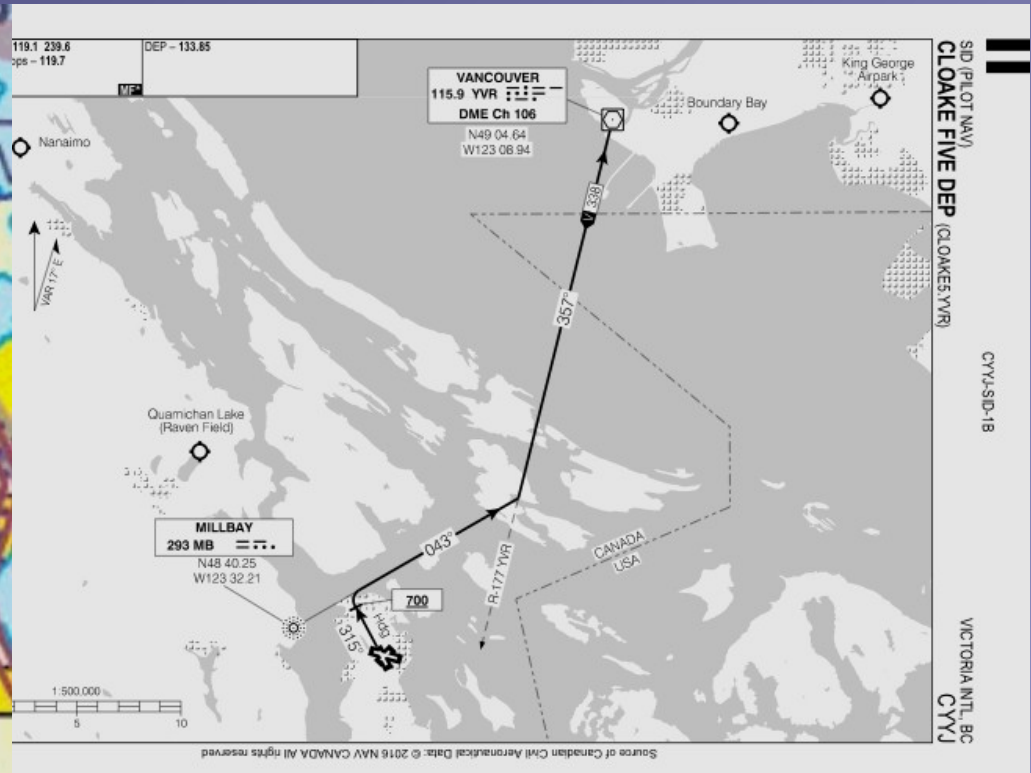
Review NDB Radio Navigation

- How do Non-directional Radio Beacons (NDBs) support en-route navigation?
- How do we determine whether or not a NDB station is serviceable?
- What errors can be expected when using NDBs?



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Motivation



- Navigational Support / Backup and Procedures
- *Homing, Tracking, Intercepts, SIDs, STARs*



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Using the NDB Overview

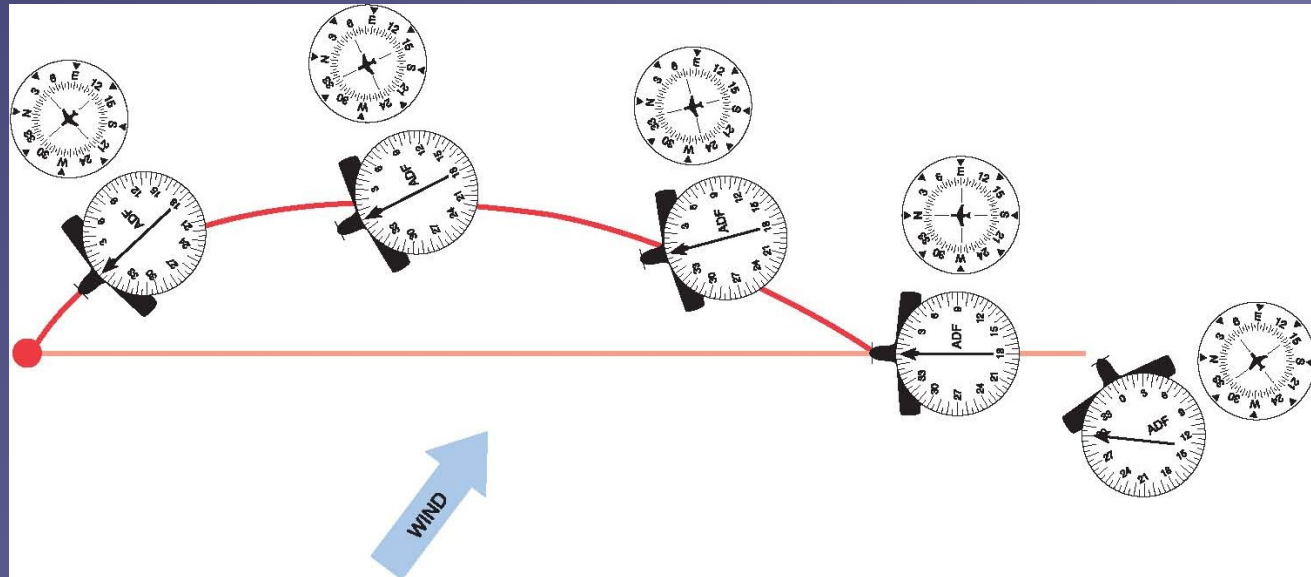


- **190** to **1750 kHz** – LF/MF *non* line-of-sight propagation
- Sensitive to aircraft position and heading
- Indicates **relative bearing** on the *fixed card* ADF
- **Tune** in frequency and **Identify** station **morse code**
- **Check** relative bearing to (BTS) or from (BFS) the station



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NDB Homing

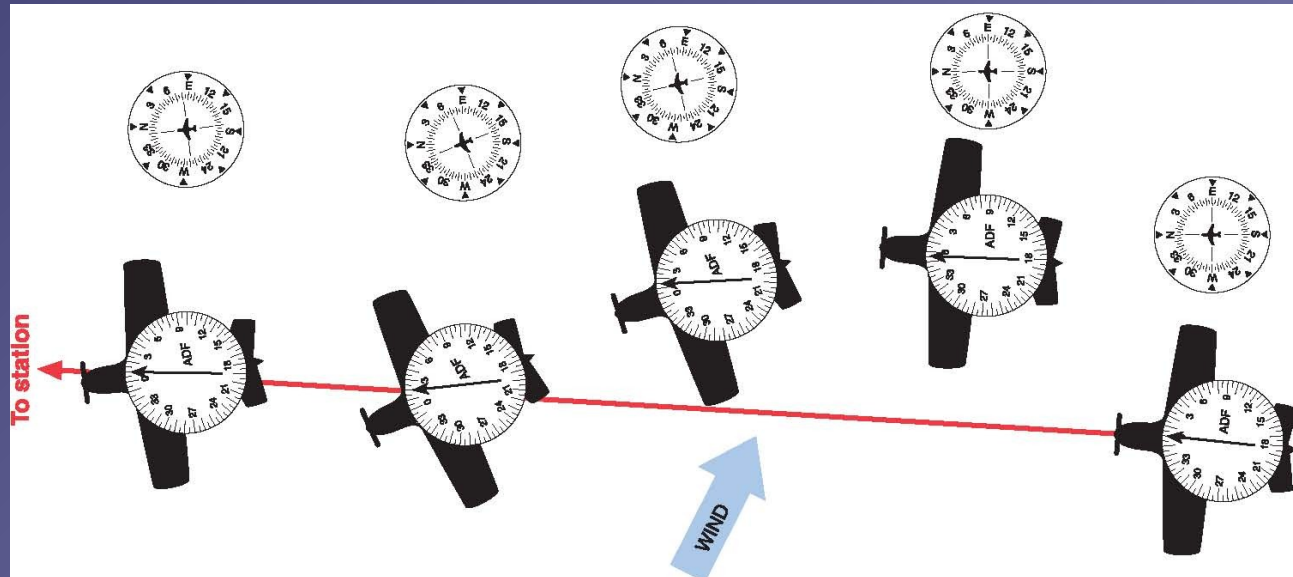


- **Tune** station frequency
- **Identify** station morse code
- **Turn** to ($RB = 0$) station ($MB = RB + MH$) – project onto HI
- **Correct** heading as necessary to maintain RB
- *Chase the arrow*



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NDB Tracking



- **Tune** station frequency
- **Identify** station morse code
- **Turn** to ($RB = 0$) / from ($RB = 180$) station ($MB = RB + MH$)
- **Correct** heading as necessary to maintain MB
- *Push the arrow (inbound), pull the tail (outbound)*



NDB Intercepts

- **Tune** station frequency
- **Identify** station morse code
- **Turn** parallel to *desired magnetic bearing* (BTS, BFS)
- **Crosscheck** inbound or outbound intercept
- *Push the arrow* (inbound), *pull the tail* (outbound) to *desired magnetic bearing* using intercept angle (**90°**)
- **Turn** onto *desired magnetic bearing* and continue tracking



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NDB Intercept 180 BTS Inbound





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NDB Intercept 360 BFS Outbound





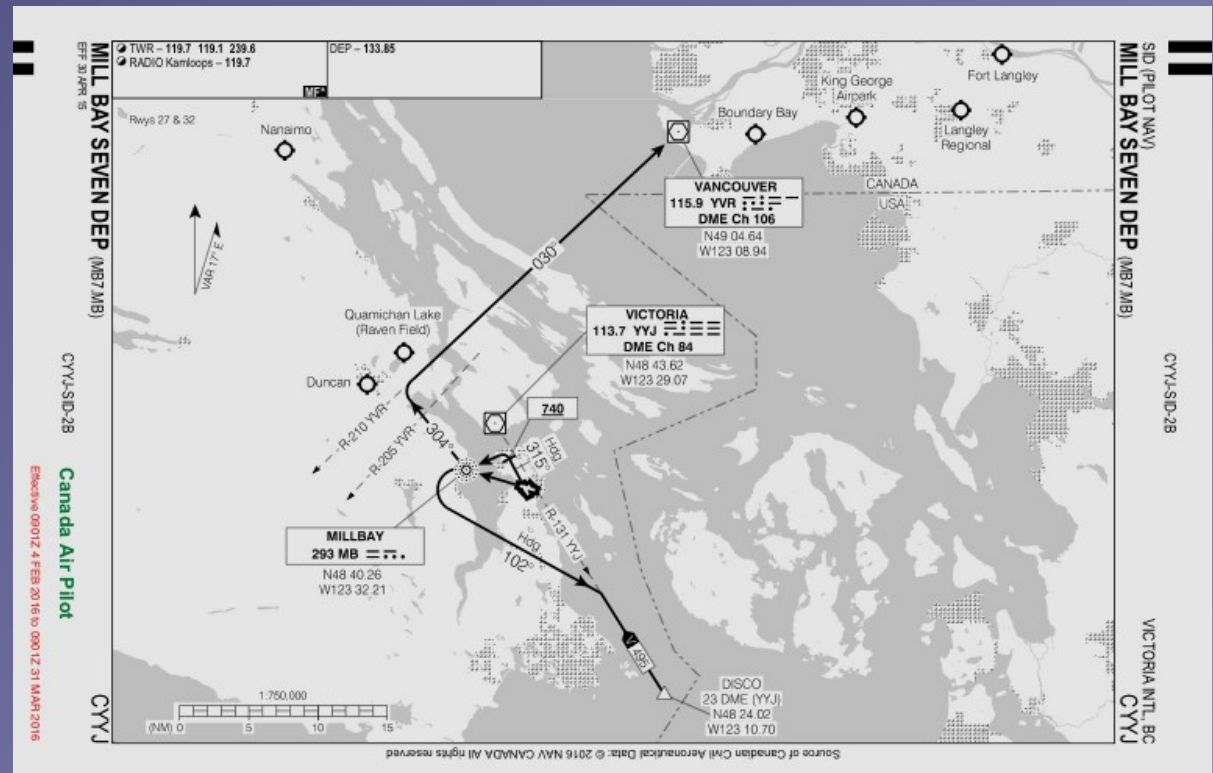
Review VOR Radio Navigation

- How do VHF Omnidirectional Radio Ranges (VORs) support en-route navigation?
- How do we determine whether or not a VOR station is serviceable?
- What errors can be expected when using VORs?



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Motivation

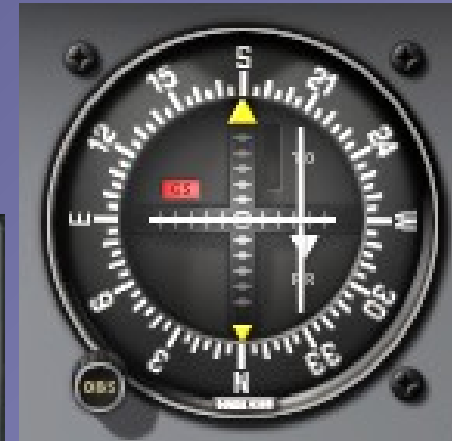


- Navigational Support / Backup and Procedures
- *Tracking, Intercepts, SIDs, STARs*



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Using the VOR Overview



- **108.1** to **117.95 MHz** – VHF line of sight propagation
- Sensitive to aircraft position but *not* aircraft heading
- Indicates radial deviation and sector – **CDI, TO/FROM/OFF**
- **Tune** in frequency and **Identify** station morse code
- **Select** desired (magnetic) radial using the OBS



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VOR Tracking



Tune

Select

Identify

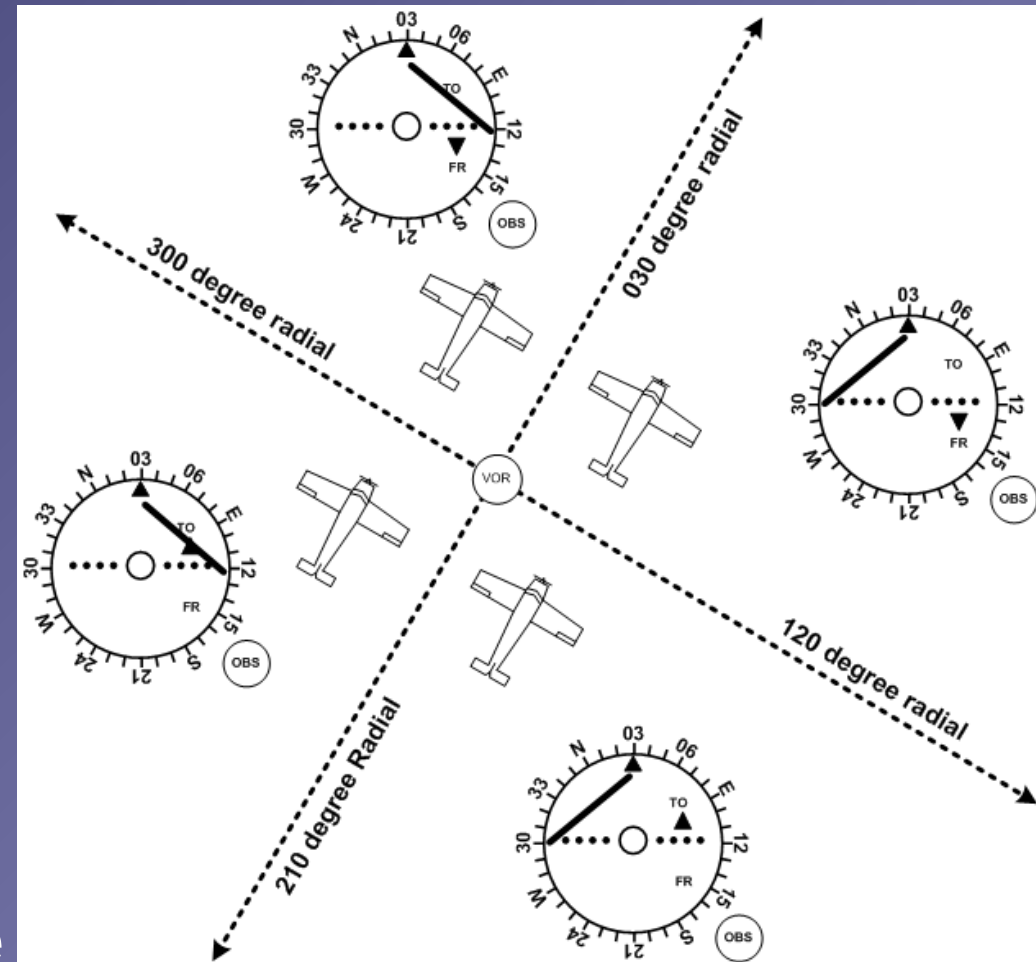
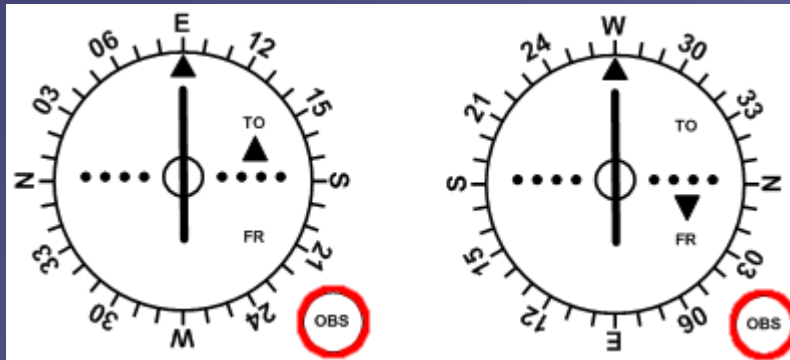
Turn

- **Tune** station frequency
- **Identify** station morse code
- **Select** OBS radial for centered CDI with TO / FROM indication
- **Turn** to / from station using found OBS radial *inbound / outbound*
- **Correct** for wind depending on method – **homing** or **tracking**



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VOR Intercepts



- **Tune** station frequency
- **Identify** station morse code
- **Select** OBS intercept radial *inbound* or *outbound*
- **Check** CDI *left* or *right* and *subtract* or *add* intercept angle
- **Turn** to intercept heading
- **Check** CDI *alive* and anticipate **turn** onto intercept radial



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VOR Intercept Radial 360 Inbound





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VOR Intercept Radial 180 Outbound





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Satellite Navigation



- Modern GNSS receivers provide *many* functions – always consult the applicable user manual
- **Direct-To, Flight Planning, Reversal, Radials**
- Always ensure correct **database** and **navigation source** for your navigation instruments



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G530 Direct To Function (1)





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G530 Direct To Function (2)





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G530 Direct To Function (3)





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G530 Direct To Function (4)





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G530 Direct To Function (5)





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G530 Direct To Function (6)





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G530 Flight Planning (1)





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G530 Flight Planning (2)





VICTORIA FLYING CLUB

G530 Flight Planning (3)





VICTORIA FLYING CLUB

G530 Flight Planning (4)





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G530 Flight Planning (5)





VICTORIA FLYING CLUB

G530 Flight Planning (6)





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G530 Flight Planning (7)





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G530 Flight Planning (8)





Learn and Practice

- Get NAV/GNSS **simulators** and learn playing with the features – *www.garmin.com*
- Knowing the features makes you a more proficient pilot and causes *less* **distraction** in the cockpit
- Let NAV/GNSS support you not distract you
- Visual navigation remains your primary means of navigation – *always* **maintain VFR**



Satellite Navigation – Summary / Quiz

- What are the most common functions of a GNSS user interface?
- Why has the database of a GNSS receiver to be up-to-date?
- The GNSS user interface can be complex and distracting. What are the consequences for using it as a navigational aid?
- How do we check and predict the GPS integrity?
- Why is it important to always check the correct navigation source?



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Pre-Flight Briefing

- Exercise
- Training Area
- Departure and Arrival Procedures
- Weather Briefing / NOTAMs
- Aircraft and Documents
- Time and Fuel Requirements
- Safety Considerations and Responsibilities



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Instrument Flying (Ex. 24, LP. ?)

- Objective
- Review
- Motivation
- Howto
- Summary / Questions
- Preflight Briefing