Agenda

- Examples taken from
  - Garmin GNS430
  - Bendix-King KLN-94
  - Garmin (UPS AT) Apollo GX60
- Not a "buttonology" course
  - Consult your pilot's guide
  - Use commercial training courses
  - Practice on the simulator

Flight Plans

- Waypoint entry notation
- Airport vs. navaid vs. waypoint
  - Early-generation units (GX60)
    - Identifier type plus identifier
      - **ARPT HWD**
      - **VOR OAK**
      - **INT SUNOL**
  - Late-generation units (GNS430, KLN-94)
    - Identifier only
      - **KHWD** (airport)
      - **OAK** (navaid)
      - **SUNOL** (fix, intersection, waypoint)

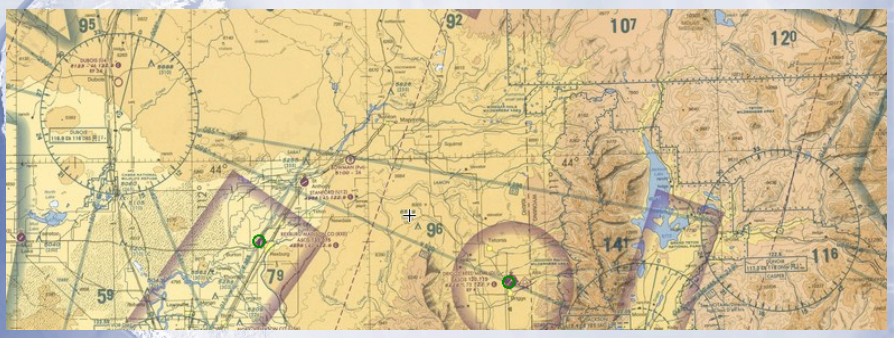
Flight Plans

- Waypoint entry notation
  - **ARPT MOD** distinct from **VOR MOD**
  - **KMOD** distinct from **MOD**
    - In some cases these similar waypoints can be miles apart
  - All-alphabetic airports entered via ICAO identifier
    - **KHWD**, **KMOD** in conterminous US
    - **PAxx** in Alaska
  - Airports containing digits entered via FAA identifier
    - **E16**, **027**, **308**, **103**, **1Q4**
    - Be careful to distinguish zero from letter O
      - Ignoring typeface, all above examples are letter O

Flight Plans

- When navigating a flight plan:
  - Called "automatic sequencing" or LEG mode
  - GPS *sequences* upon passing over a waypoint
  - GPS always directs you TO the next waypoint
  - Path between waypoints is a great circle
    - DTK may change from beginning to end, especially on east-west routings
  - Remember your navigation instrument (CDI, HSI) course needle is primary, *not the moving map*

Flight Plans



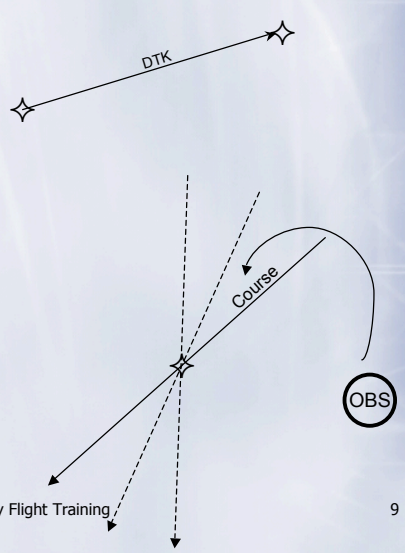
- Airway V298 segment DBS (ID) to DNW (WY)
  - Great circle
  - Flight plan: DBS DNW
  - DTK 085 leaving DBS
  - DTK 087 approaching DNW

OBS Mode

- Leg mode
  - GPS selects course
  - Flight plan waypoint-to-waypoint
  - Present position to waypoint (DIRECT TO)
- OBS mode
  - Pilot selects course
  - Typically using OBS knob on CDI
  - CDI must be channeled to GPS
    - External NAV/GPS button (Cessna)
    - GNS430 CDI button

OBS Mode

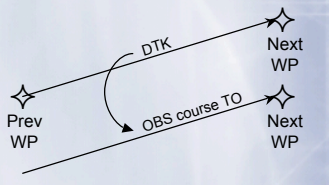
- Leg mode
  - Always TO
- OBS mode
  - TO or FROM

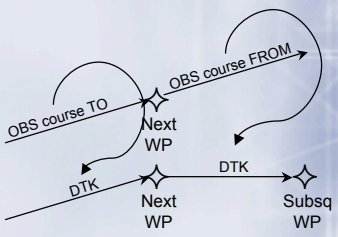


2009 Feb 25 Copyright © 2009 My Flight Training 9

OBS Mode

- Mode switch
  - Leg to OBS
    - OBS course set to DTK
    - OBS knob to change course
  - OBS to leg
    - If TO waypoint
      - DTK set to OBS course
      - DTK not set from flight plan
    - If FROM waypoint
      - DTK set from flight plan
      - Sequence to next flight plan leg





2009 Feb 25 Copyright © 2009 My Flight Training 10

Waypoint Terminology

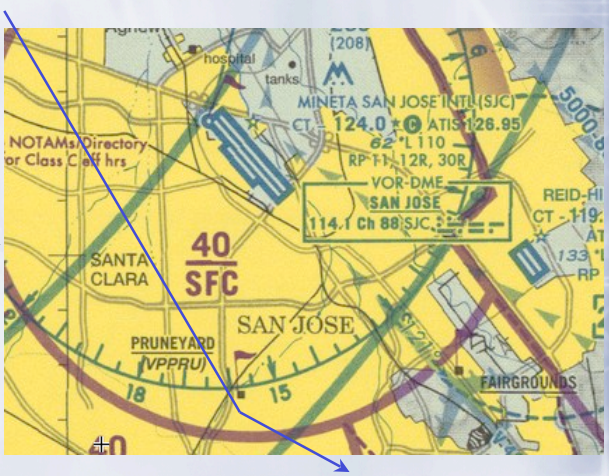
- Per AIM and Instrument Flying Handbook
  - *Fix*: bearing and distance
    - e.g., VOR radial + DME
  - *Intersection*: crossed VOR radials
  - *Waypoint*: RNAV latitude/longitude
- From GPS perspective, all are called "waypoints" and represented identically in database as five-letter (occasionally digit) identifiers

VFR Waypoints

- On VFR charts
  - Intersections
  - VFR waypoints
    - **VPxxx**
    - VFR terminal area charts (TAC)
    - Tabulated on end panel
    - Typically correspond to well-known (and charted) *visual* checkpoints
      - This means if you are unfamiliar with the visual appearance of a checkpoint from the air, you can still navigate to it via GPS

VFR Waypoints

- "Remain south and west of the Pruneyard enroute to South County"
  - What the heck does "The Pruneyard" look like?
  - **FPL**
    - **KPAO**
      VPPRU
      E16



VFR Waypoints

- "Fly to the Mormon Temple for sequencing to runways 27"
  - Where the heck is "The Mormon Temple"?
  - **FPL**
    - **KUKI**
      VPMOR
      KOAK

User Waypoints

- Creating
  - Latitude/longitude
  - Bearing/distance
  - Moving map

Creating User Waypoint

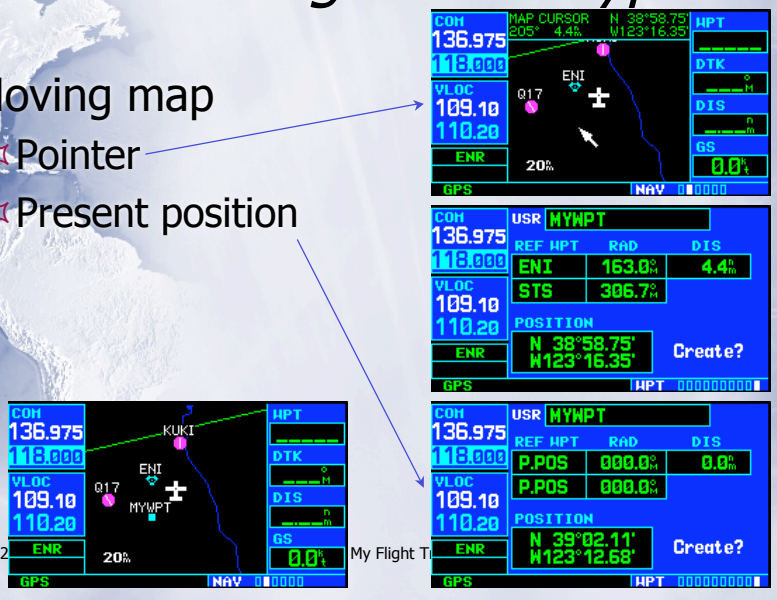
- Latitude/longitude
  - VFR sectional
  - Other chart

Creating User Waypoint

- Reference bearing/distance

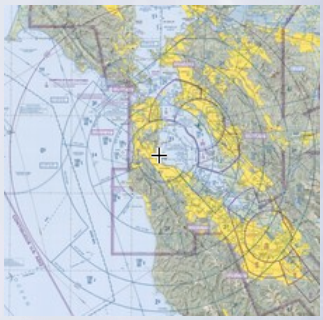
Creating User Waypoint

- Moving map
  - Pointer
  - Present position



Airspace

- How are you going to avoid Class B airspace:
  - SFO?
  - LAX?

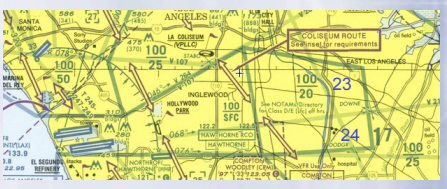


Airspace

- SFO?
  - Easy
  - SFO VOR/DME
    - Radial/distance
  - DIRECT TO SFO
  - OBS mode
  - Select course (DTK) 090°

Airspace

- LAX
  - Hard
  - Arbitrary corners
  - Sparse use of VOR
  - Class B tabulation
    - Reverse chart side
    - Latitude/Longitude
    - VOR radial/distance
  - Solution
    - User waypoint

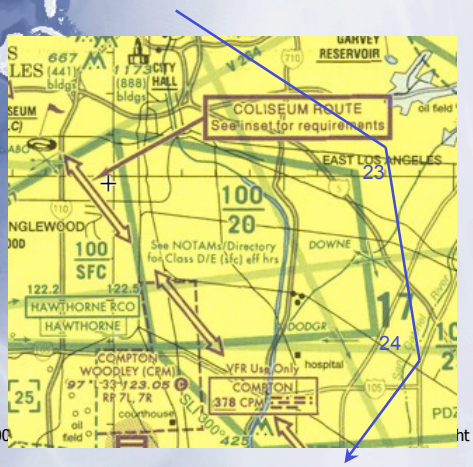


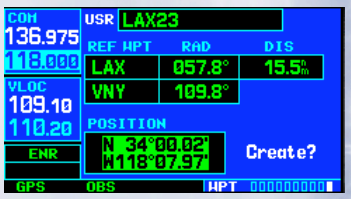
23 N34°00.02' W118°07.97'

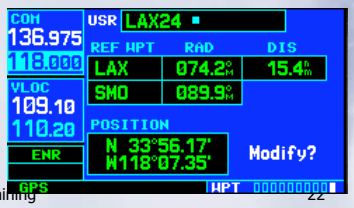
24 N33°56.17' W118°07.35'

Airspace

Point	Lat/Long
23	N34°00.02' W118°07.97'
24	N33°56.17' W118°07.35'





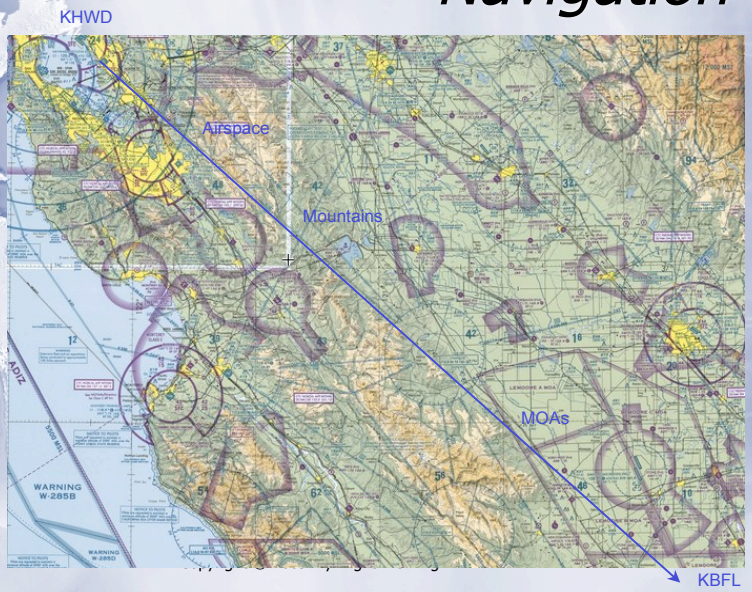


Navigation

- Why not just go DIRECT TO?
  - Terrain
  - Airspace
  - Pilotage and dead reckoning backup
    - You *do* remember how to do those, don't you?
  - Winds aloft
  - Situational awareness
    - You can't be in the loop if all the smarts are in the GPS

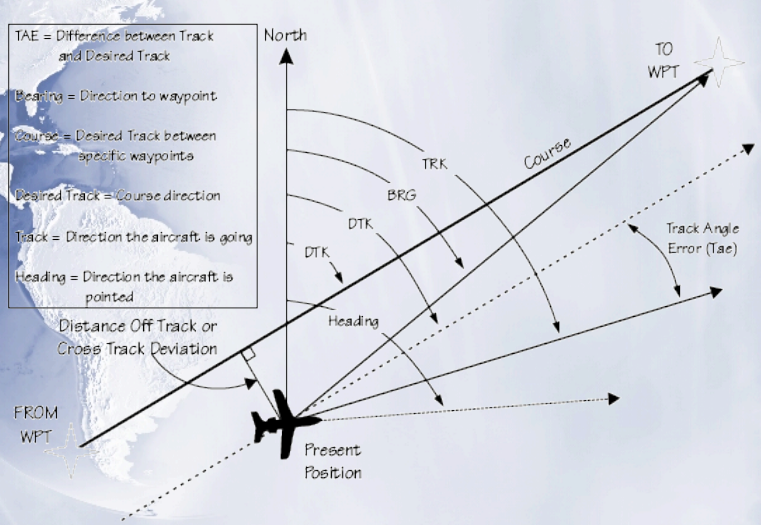
2009 Feb 25 Copyright © 2009 My Flight Training 23

Navigation



2009 Feb 25

Terminology



Navigation

- TRK vs DTK
  - If TRK is maintained equal to DTK, you will stay on course
  - TRK is heading with wind correction

Navigation

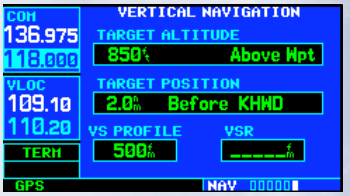
- Terrain avoidance
  - Terrain map
    - Red: terrain above or below aircraft –100 ft
    - Yellow: terrain below aircraft –1000 ft
    - Uncolored: aircraft clears terrain by ≥ 1000 ft
  - MSA/ESA display
    - Terrain clearance along your flight plan path
    - Uses IFR terrain rules
    - View on navigation pages

Vertical Navigation (VNAV)

- Motivation
  - Descend to selected altitude at waypoint
    - Descent planning (airport)
    - Descent planning (airspace)
    - Passenger comfort (500 fpm)
    - Comply with regulations (traffic pattern altitude)

Vertical Navigation (VNAV)

- Descend to airport
  - Traffic pattern altitude
    - AGL
  - 2–3 nm prior

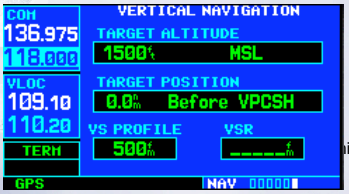


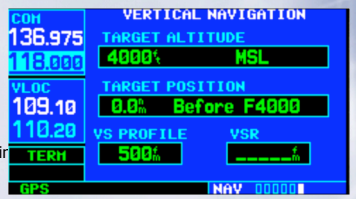
Vertical Navigation (VNAV)

- Descend below airspace
  - Class B shelf floor altitude
    - MSL
  - FPL
    - KSAC
      F4000
      VPCSH
      KHWD

Vertical Navigation (VNAV)

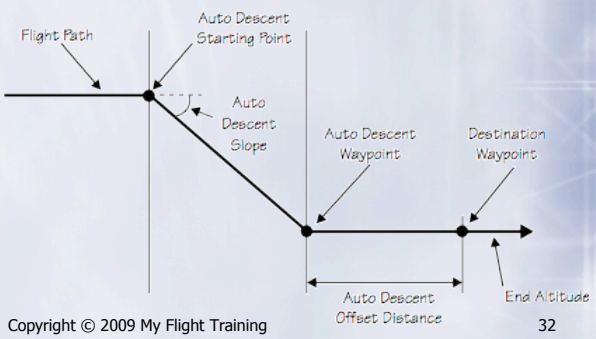
- Descend below airspace
  - Class B shelf floor
    - SFO 20.0 nm < 4000 MSL
    - SFO 15.0 nm < 1500 MSL
    - MSL
  - FPL
    - KSAC F4000 VPCSH KHWD





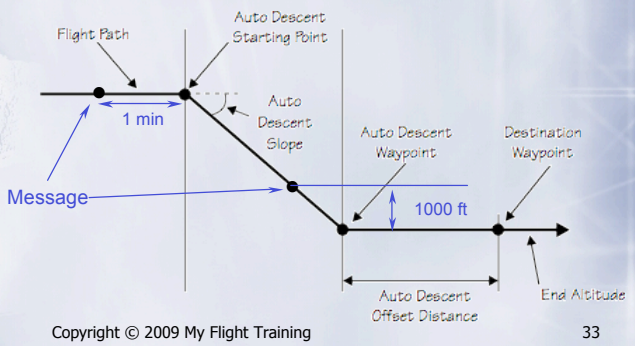
Vertical Navigation (VNAV)

- How to fly
  - Maintain aircraft actual vertical speed (VSI) equal to VNAV descent profile vertical speed
  - Vertical Speed Required (VSR)
    - Feedback about how good you are doing your job
    - Increase/decrease aircraft vertical speed to make VSR equal descent profile



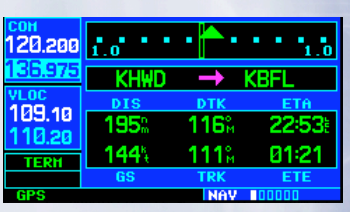
Vertical Navigation (VNAV)

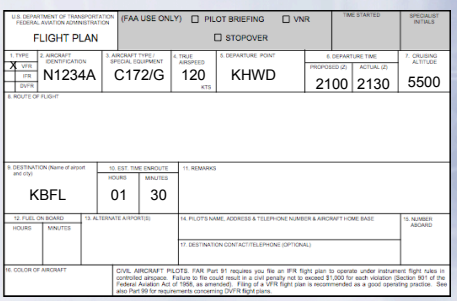
- How to fly
  - Message one minute prior to top-of-descent
  - Message 500–1000 ft prior to reaching bottom-of-descent



Flight management

- ETE, ETA
  - Flight plan
  - Position reporting
  - ADIZ crossing





Flight management

- Flight timers, general timers, scheduler
  - Starts automatically at takeoff (30 knots)
  - Scheduler
    - Fuel-tank switching
    - Position reporting
- Fuel monitor
  - Substitute for fuel-flow totalizer (Shadin)
    - Program fuel flow (gallons per hour)
    - Program initial fuel load
  - Some units receive actual fuel-flow

Aeronautical Information

- Aeronautical database contains much information equivalent to
  - Airport/Facility Directory (A/FD)
  - Sectional
  - Terminal Area Chart (TAC)
- Can be used to place this information quickly at hand
  - Good CRM practice: all available resources

Aeronautical Information

- Caveats
  - This is not a recommendation to abandon or not to carry paper charts or A/FD
  - Does not absolve requirement to check NOTAMs
    - Issued on a much more rapid cycle than charts or databases
  - Electronics can fail
    - But a battery-operated GPS is good backup

Aeronautical Information

- A current GPS database is only required for IFR
  - But if you are going to depend on the database for chart substitution, it should follow IFR rules and be up-to-date
  - Most fleet (e.g., rental) airplanes are flown IFR and have regularly-updated databases
  - Get in the habit of checking the database date at power-on
  - Have paper charts ready as backup
  - Remember there is no currency rule for portables

Aeronautical Information

- A/FD substitution
  - Runways
    - Designators
    - Length
    - Construction (hard-surfaced, soft)
  - Elevation
  - Fuel
  - Frequencies
  - Lighting

Aeronautical Information

- What's missing?
  - Displaced thresholds (landing distance)
  - Traffic pattern altitude
  - Traffic pattern direction
  - Noise abatement
  - Notes
  - Hours of operation (part-time tower)
  - Taxiways

Aeronautical Information

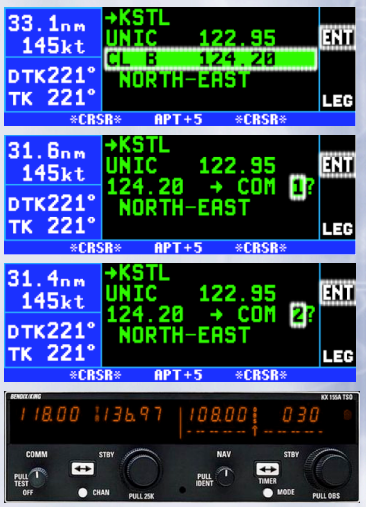
- Airport frequencies and tuning
  - Know how to find the frequencies page(s) for an airport
  - Know how to load a frequency into a comm radio automatically

Aeronautical Information

- Auto comm radio tuning: GNS430
  1. Cursor on
  2. Highlight frequency with large knob
  3. ENT to load frequency to standby
  4. Flip-flop ↕ to activate

Aeronautical Information

- Auto comm radio tuning: KLN-94, KX-155
  1. Cursor on
  2. Highlight frequency with large knob
  3. ENT to select
  4. Change target navcom (1, 2) with small knob
  5. ENT to send frequency to navcom
  6. Flip-flop to activate



Aeronautical Information

- Lighting, logging, currency
  - Sunrise/sunset
    - Position lights
  - Civil twilight
    - Night experience
  - Sunrise – 1 hour/sunset + 1 hour
    - Night passenger carrying
- AUX page
  - Present position
  - Selected waypoint