Navigation – Labs

Terrestrial navigation

Examples from marine navigation that were not covered in the labs

1 Dead reckoning plotting procedures

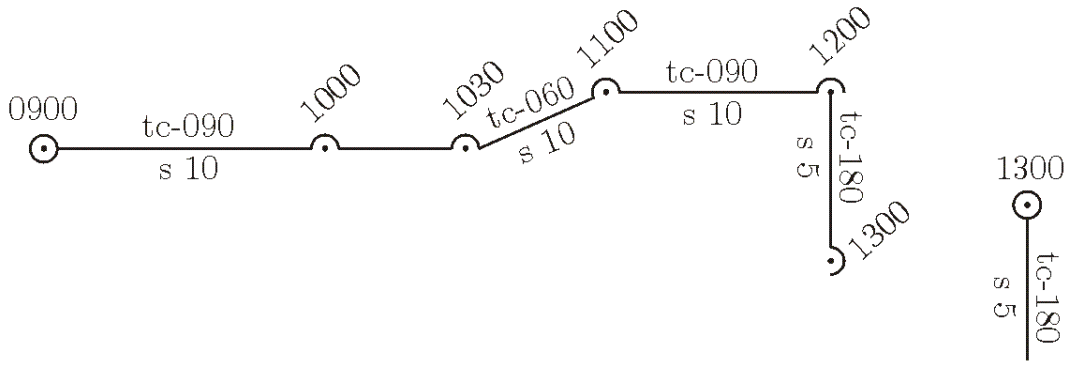

Fig. 1: Example of a DR plot (National Imagery and Mapping Agency 1995, Chap. 7)

Symbols and plotting rules

- Circle … position fix
- Semicircle … DR position
- Rectangle … estimated position (DR corrected for drift)
- All symbols should be labeled by their time next to the full minute. In case of a position fix, the time is written upright; in case of DR, the time is written inclined by about 45° (counter-clockwise).
- The course should be plotted using solid lines.
- The course angle is noted above the course line (usually, true courses are used).
- The speed is noted below the course line.

DR rules

The DR position of the vessel should be plotted:

1. At least every hour on the hour.
2. After every change of course or speed.
3. After every fix or running fix.
4. After plotting a single line of position.

Accuracy of DR positions

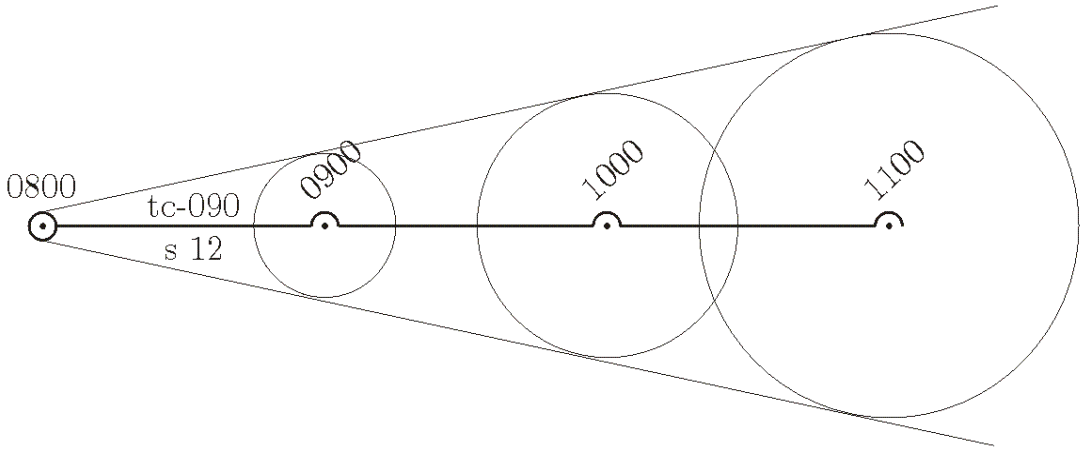

Fig. 2: Accuracy of DR positions

2 Non-simultaneous observations – Running fix

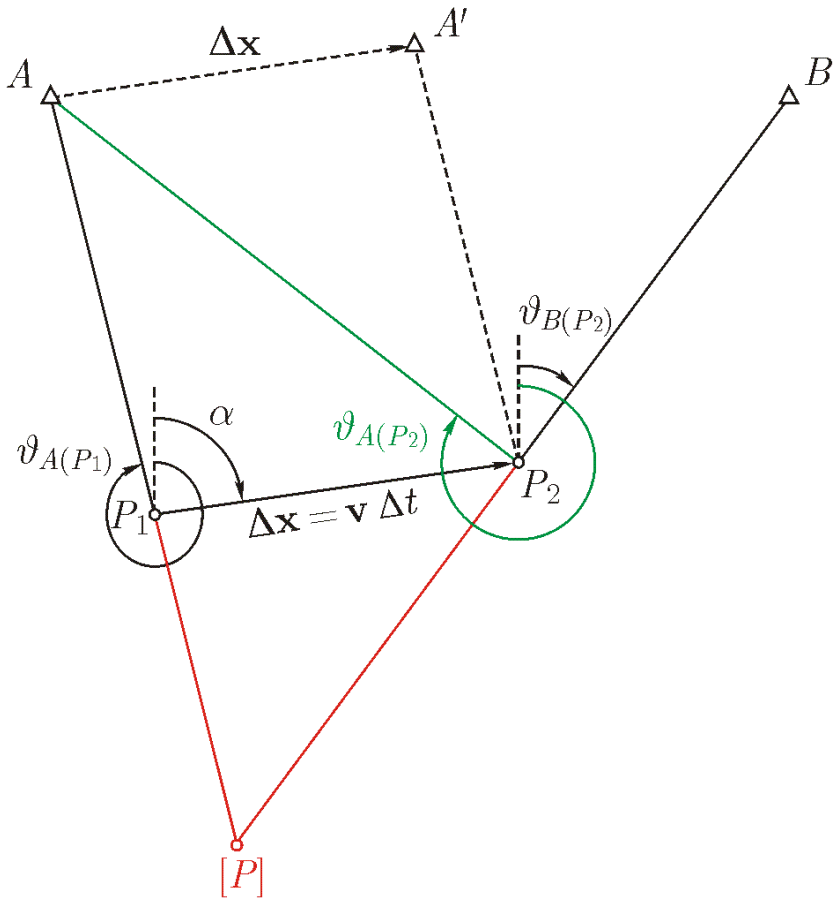

Fig. 3: Running fix

Mathematical quantities

- α course angle
- v speed of the vessel
- $\mathbf{v}$ velocity vector of the vessel
- Δt time interval the vessel takes to get from unknown position P_1 to P_2
- $\Delta\mathbf{x}$ difference vector between P_1 and P_2
- $\vartheta_{A(P_1)}$ bearing from P_1 to landmark A
- $\vartheta_{B(P_2)}$ bearing from P_2 to landmark B
- A' advanced position of landmark A
- $[P]$ position result if the motion of the vessel was neglected
- $\vartheta_{A(P_2)}$ bearing from P_2 to landmark A (if only one landmark is visible)

Procedure

- $\Delta \mathbf{x} = \mathbf{v}\,\Delta t = v \begin{bmatrix} \cos\alpha \\ \sin\alpha \end{bmatrix} \Delta t$
- Using $\Delta \mathbf{x}$, the position of landmark A is advanced to A'
- Theta-theta fix using either ($\vartheta_{A(P_1)}$ and $\vartheta_{B(P_2)}$) or ($\vartheta_{A(P_1)}$ and $\vartheta_{A(P_2)}$) at P_2
- Usually, a graphical solution is constructed within the Mercator chart (result is less accurate than in case of “conventional” theta-theta fixing).

3 Reference

National Imagery and Mapping Agency (1995): The American practical navigator. Publication no. 9, Bethesda (Maryland).
Available at: http://www.irbs.com/bowditch/ (March 2004)