Solutions to *http://fer3.com/arc/m2.aspx/Compare-Methods-LatLon-Near-Noon-FrankReed-aug-2021-g51028*

Date of drill : May 22, 2022

(1) - DATA

(1.1) SUN *(Source **VSOP 2013**)*

SUN	GHA	DEC	Distance, SD and μ Dec.
16:00 UT	60°49.56'	N + 20°28.18'	Distance : 1.012305 UA, SD : 15.80'
17:00 UT	75°49.51'	N + 20°28.66'	***μ Dec. : + 0.4862 '/h***

(1.2) OBSERVER

Over Surface : 4 kts True heading 185° , i.e. North speed -3.9848 kts, Speed to the East : -0.3486 kt
Current : 2 kts to true East, i.e. north Speed 0.0 kt, Speed to the East : +2.0000 kt
Speed Made Good : North Speed ***(NS) -3.9848 kt*** , Speed to the East : +1.6514 , i.e. **4.3134 kt 157.4898 °**

Your Sun sights, UT and altitude (raw, Hs):	Notes : (1) - All Height corrections forced to be equal to +13.0 ' (2) - Since both the ship is sailing towards the Southerly Sun, and the Sun Declination is sailing Northwards to the Observer, the Culmination (UT culm) occurs ***after*** the Sun has crossed the Observer's Meridian (UT transit).
1 - 16:17:20 -- 72°28.5'	
2 - 16:22:40 -- 72°44.5'	
3 - 16:36:45 -- 73°04.0'	
4 - 16:39:15 -- 73°04.5'	*We will use in 2.1.a here-after the following **first order formula** :*
5 - 16:51:25 -- 72°49.0'	***UT (culm - transit) in seconds = (48 / π) * (tan Lat - tan Dec) * (μ Dec. – NS)***
6 - 16:56:20 -- 72°35.5'	

(2) - SOLUTIONS

All methods first attempt finding UT culm / H culm, and then derive UT / Height transit (aka *UT / Height LAN*) from some Correction formula to either UT culm first (2.1.a here-under) or to H culm first (2.1.b here-under).

2.1 - "Manually" finding UT culm can be done :

- **2.1.a - Through plotting heights vs times and hand drawing the curve.**
  - Looks like some kind of a "parabola". In a Navigation paper, many years ago, I found a very clever method of using semi-transparent paper, and then folding it to best manually surimpose both curve branches, so that the sheet folded line is a good determination of UT Culm. *Using this method, I find a culmination time very close to 16h38m00s.*
  - To use the First Order Formula here-above, we need to know the Observer's Latitude. We can get an excellent approximation for it through assuming that at Observation 4, the Sun is due South of the Observer. Hence with Sun Declination being equal to N20°28.5' get Approximate Latitude N 37°11.0' in order to derive UT (culm - transit) = + 26.3 s.
  - *Hence with this method I am getting : UT transit = 16h37m34s , at N37°11.0' / W070°11.0' , and : At UT = 17h00, Position at N37°09.5' / W070°10.2'*
- **2.1.b - Through the Wilson's Method**
  - i.e. the *hand drawing method just indicated by Tony Oz here* . Tony gets a Culmination time at 16h37m53s (Mean Values on Rising and Setting lines intersection) and computes the height difference (2.4') between UT culm and UT transit, to derive UT transit = UT LAN= 16h37m29s.
  - *Hence with this method Tony publishes his results as : LAN UT == 16:37:29; the fix for the LAN is Lat == 37°11,2'N; Lon == 70°11,7W. And the DR 17:00 37°09,7'N / 70°10,9 W*

- **2.2 - Direct Computations Methods :**

2.2.1 - Peter Hakel's immediately Published his Results here :

UT of LAN (from both "noon_motion" and "transit"): 16:37:29 , Lat: N 37° 10' , Lon: W 70° 11'
"many-body fix"): at 16:37:29 (LAN) Lat: N 37° 11' Lon: W 70° 12'
at 17:00:00 ("fix17h") Lat: N 37° 10' Lon: W 70° 12'

2.2.2 - Own results :

***6th Order LAN Method** : LAN 16h37m30.7s at N37°11.3' / W070°12.2' UT (culm-transit) =+ 26.15 s*
Standard deviation 0.2 NM (0.8' on Lon) with Method Validity time span (16h11m - 17h04m : OK).
***Many Body Fix Method** : Exactly the same results. 17h Fix N37°09.8' W070°11.4'*
***Last note** : Through reverse engineering with **1984 US Nautical Almanac** , find Height of Eye = 7 ft .*
No significant change (i.e. less than 0.06 NM) to results if computing individual height corrections.

1er Septembre 2021 - Antoine M. "Kermit" Couëtte