12 Feb 2011 Unorthodox Jupiter Lunar from a moving platform

Make a table of the vessel's movement:

WT	Time interval	Course	Speed	Distance	dLat	dep
$00^h08^m55^s$	Sun altitude					
	3^m	255°	12,0	0,60	-0,16	-0,58
00^h12^m	Course change					
	75^m	184°	16,2	20,25	-20,20	-1,41
$01^h26^m58^s$	Moon altitude					
	15^m	184°	16,2	4,05	-4,04	-0,28
$01^h42^m02^s$	Jupiter altitude					
	5^m	184°	16,2	1,35	-1,35	-0,09
01^h47^m	Course change					
	$3,4^m$	135°	22,0	1,25	-0,88	+0,88
$01^h50^m21^s$	Lunar distance					
	Total				-26,6	-1,5

In above table dLat and dep are given in miles and a negative sign indicates S and W, respectively.

To have a starting point for the calculations, we assume the averaged sun altitude observation took place at 47°N, 3°W. From NA we find Sun's declination S 13°39'. The ho was 7°51,7'. (Here I have used height of eye 6,40 m that gives a dip of 4,5'. If we instead use 21 feet, we get a dip of 4,4'. The heights are equal within 0,8 mm but gives a 0,1' difference in dip! Rounding off in tables …). Anyway, this gives LHA 62°10' and GHA 65°10'. From the NA we now find an approximate GMT of $16^h34^m52^s$. Sun's azimuth is 240°. The watch is thus approx $16^h25^m57^s$ slow on GMT.

78^m later, at approx GMT $17^h52^m55^s$, the Moon was shot. From the almanac we get GHA 342°15' and declination N 23°49'. Using the same assumed position as above we find hc 61°30' and azimuth 137°. With ho 61°41' we get intercept 11' towards. This LOP must however be moved 20 miles north and 2 miles east according to the table above, to get a fix at the time of the sun observation. The resulting fix gives a latitude of around 47°02' N and a longitude of 3°02' W. Applying the total dLat of -27' gives latitude 46°35' N at the time of the lunar distance observation. This latitude is accurate to within a few minutes of arc, even if the time is in (reasonable) error. Applying the total departure, converted to a dLong of -2', gives longitude at the time of lunar observation as 3°04' W, if the timing is correct. But it will do as a first approximation, making it possible to calculate the Jupiter and Moon altitudes at the lunar distance observation at approx GMT $18^h16^m18^s$.

For Jupiter we get GHA 52°15,5' and declination N 0°36,4'; for Moon GHA 347°53,2' and declination N 23°49,8. With latitude 46°35' N and longitude 3°04' W, we get Jupiter hc 27°11,0' and Moon hc 64°11,4'. Converting to sextant altitudes we have Jupiter hs 27°17,4' and Moon hs 63°35,8', as input to the lunar reduction. The cleared lunar becomes 66°24,2' and we find the GMT $18^h14^m15^s$. And the watch $16^h23^m54^s$ slow on GMT.

Now, knowing the GMT with higher certainty, we can rework the sun altitude. It was shot at GMT $16^h32^m49^s$ and we find the declination from NA as S 13°39,0', no change from the initial assumption. With latitude 47°02' N and ho 7°51,7', we get LHA 62°08,7' corresponding to LAT $4^h08^m35^s$ pm. EoT is 14^m13^s so we find LMT $16^h22^m49^s$. The difference between GMT and LMT is exactly 10 minutes of time, thus the longitude 2°30' W. The dLong of -2' between sun altitude and lunar distance observations gives the longitude at the time of the lunar distance observation 2°32'W.

Finally, a check on the Jupiter altitude observation. This was shot at GMT $18^h05^m56^s$ giving GHA 49°39,3' and declination N 0°36,4'. With latitude 46°37' N and longitude 2°33' W we get hc 28°22,3'. With ho 28°22,5' the intercept is negligible.

Summary: The averaged lunar distance observation was made at GMT $18^h14^m15^s$ at latitude 46°35' N, longitude 2°32' W. The watch was $16^h23^m54^s$ slow on GMT.

Further iterations, easily done on a computer, would probably result in a slightly different result. However, using printed NA data with its limited accuracy sets a lower bound for achievable accuracy. And the lunar distance observation itself, even if correct to ±0,05', gives a longitude uncertainty of ±1,5' alone. So, working with paper NA and 5-figure logs, I don't think it is worth the effort. But being nearly 2' off in latitude is a little annoying …