In section 2.1 (ii) Hagiwara and Spaans present a 'new' construction of isochrones or time fronts. A point of a sublane, attainable from the preceding time front, i.e. the time front for time,

\[ t_{k-1} = t_0 + (k-1)t \]

is selected as a point of the time front for time \( t_k \) on the criterion, that the great circle distance to the destination point \( X \) is minimal.

I have three severe objections to this — completely unexplained — construction. First, it produces different 'timefronts' for different destinations. Secondly, it seems inappropriate to use great circle distances as a time measure, while the ship's speed is far from constant in this problem. Finally, the above mentioned construction does not come anywhere near the observance of Pontryagin's Maximum Principle, which is an absolutely necessary condition for optimal control. In the least time problem this principle comes down to maximizing the projection of the ship's velocity vector onto the local direction of the time front gradient. This gradient is directed to the outside of the attainable region, perpendicular to the time front, which is the boundary of that attainable region. The following figure is intended to explain this.

A complete explanation and proof of the time front properties mentioned above can be found in a 1970 Netherlands Ship Research Centre report.²

REFERENCES