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Advanced Studies on Ambiguity Function Method and Implementation in the RTKLIB

Referee

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Key Words

GNSS, RTKLIB, GPSLAB, Ambiguity Function Method (AFM), LAMBDA, Relative Positioning,Double Difference

Summary

The key to GNSS positioning is ambiguity resolution (AR). Frequent interruption from Losses of Lock necessitate a new approach particularly in real-time kinematic and rapid static surveying. In order to address the above issues, the research focused on Ambiguity Function Method (AFM) which can absorb the cycle-slip effects. The primary objective of the study is to analyse the behaviour of AFM and thereby understand the applicability of AFM in real-time GNSS surveying. The investigation carried out by implementing AFM algorithm in RTKLIB for static relative positioning and Moreover, GPSLAB (Zebhasuer 2000) MATLAB based algorithm is used to compare the results. The results of LABDA method is used to verify implemented algorithm and the results.

AFM algorithm in GPSLAB employs Double Difference dual frequency observations with tropospheric correction. In contrast to GPSLAB, the implemented algorithm considers both single and dual frequencies, broadcast ionospheric correction.

The methodology used is to analyse the behaviour of AFM over length of baseline by introducing three major case studies; zero baseline, short baseline (< 2km) and long baseline. (>8 km). Moreover, AFM is evaluated for single and dual frequencies in each case study to understand the applicability of single frequency receivers for AFM. The influence of the number of epochs and the number of satellites were investigated.

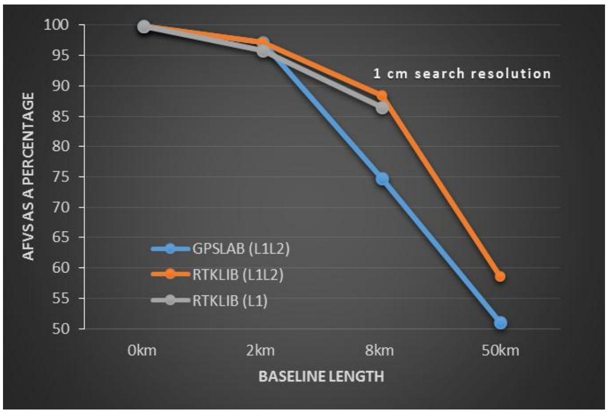

Fig 1: Maximum AFV over baseline length

The Fig: 1 shows the maximum ambiguity function value (AFV) over baseline length. The AFM seems to be highly reliable for short baseline lengths (< 2km). GPSLAB and RTKLIB shows close results for short baseline lengths and it convinces that Double Difference observations are promising for short baseline lengths.

The solution from single frequency observations is promising for short baseline (up to 8 km). And for longer baseline lengths, observations must be treated with sophisticated error models.

As shown in the Fig:2 The AFM is successful even with single epoch (4 to 8 satellites) for short baseline which implies a positive sign for applicability of AFM in real-time kinematic surveying. When the number of epochs increases the capability of isolating the true position is higher.

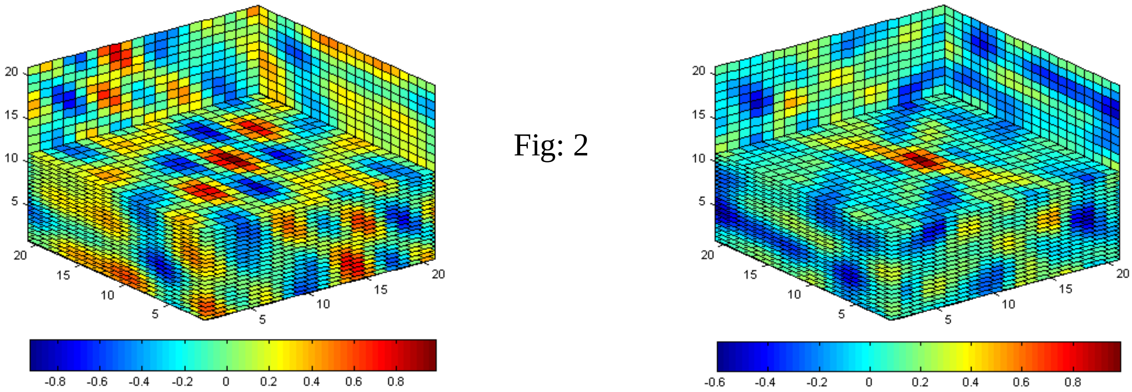

Fig: 2

(A) (B)

Fig (2-A): AFVs for 4 satellites and single epoch, Fig (2-B): AFVs for 8 satellites and single epoch. The baseline length is about 1.4km.

Fig. 3 shows the AFVs of observations of 7 -8 satellites from 1 epoch and 32 epoch in 8 km baseline lengths. This shows that when the baseline length increases AFM needs long time to isolate the true candidate.

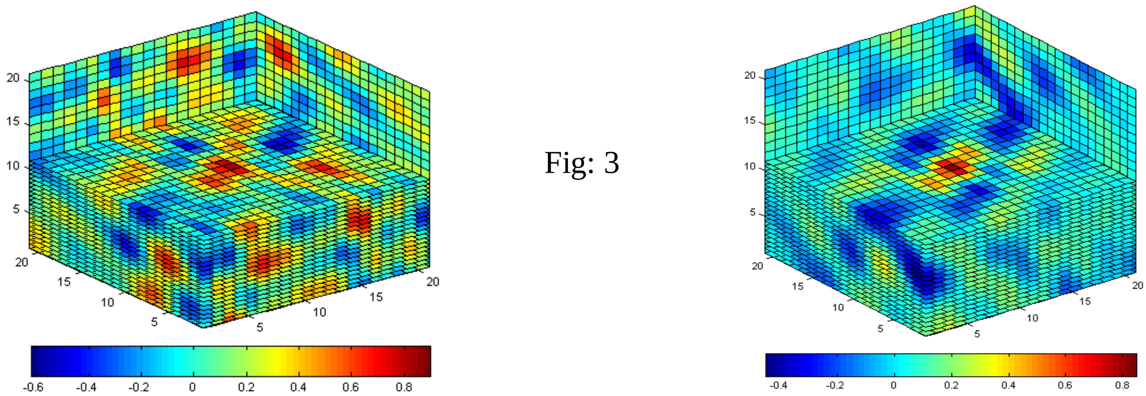

Fig: 3

(A) (B)

Fig (3-A): AFVs for single epochs and observations are from 8 satellites, Fig (3-B): AFVs for 32 epochs and observations are from 8 satellites

The one of the challenges in AFM in practice is finding reliable initial position and it plays an ample role to limit the searching space thus the speed up the complete process. The average Single Point Positioning (SPP) and the approximate header position are not precise enough as an initial position of rover. Therefore, solution from relative positioning will be a good approach for initial position of rover.

To apply the AFM in kinematic applications, fast searching methods and algorithms, initial position from relative positioning and statistical parameter for interpretation of errors in solutions should be introduced. Otherwise it is difficult to fully exploit the advantage of AFM in terms of insensitiveness to cycle-slip effects over LAMBDA method which is much faster in ambiguity fixing and widely being applied.