Carrier Phase Cycle-Slip Detection

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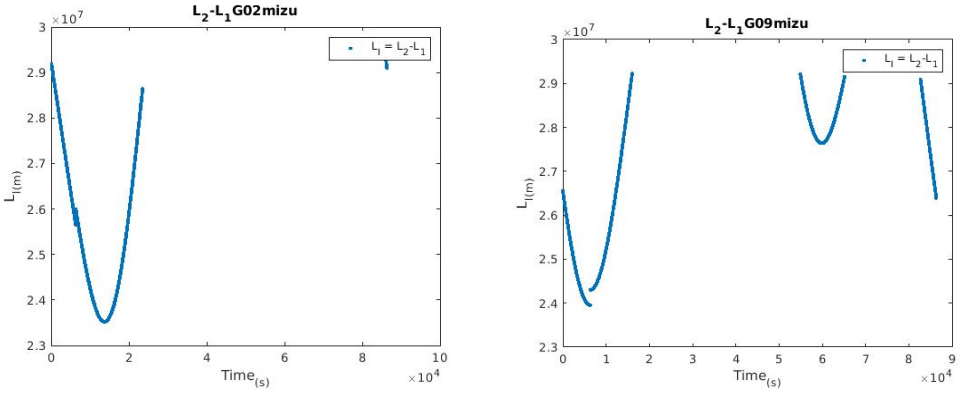
Cycle-Slips are seen as jumps of integer numbers of wavelengths λ .
Several methods are used for detecting cycle-slip , utilizeing single and multi-differenced observations.

In this project two kind of detectors-based methods will be done . these are given as follows :

1 Detector based on carrier phase measurements only : Geometry-free combination

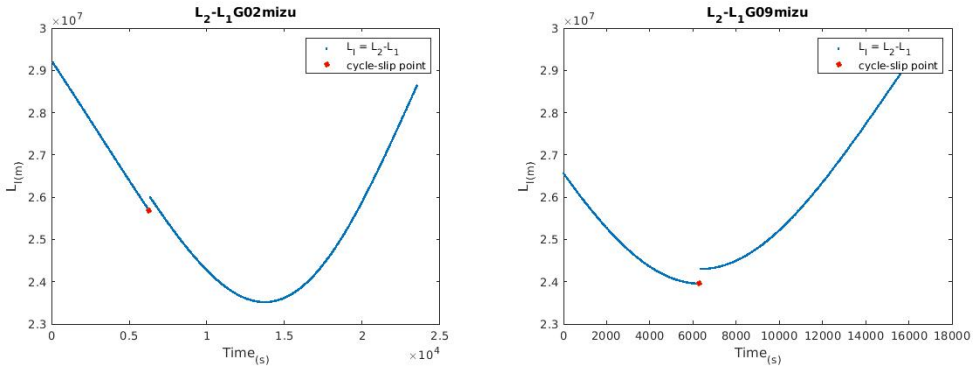
Geometry free combinations provide some benefits like removing geometry effect, and in non-disturbed conditions can provide non-dispersive effects in the signal.the jump that happend in this combination is smaller than the original signals, consequently it will provide more reliable detection.
Description of Algorithm :
Input data: Geometry-free combination of carrier phase measurements
$\Phi_I(s;k) = \Phi_1(s;k) - \Phi_2(s;k)$
For specific arcline interp gap data.
For each epoch (k)
For each tracked satellite (s)
Divide all time data to $tol_{\Delta t}$
Fit a sec-order polynomial P(s;x) to the next values $W = [\Phi_I(s;k), ..., \Phi_I(s;k + N_I)]$
if $|\Phi_I(s;k + N_I + 1) - P(s;k + N_I + 1)| > 4 * std(W)$
Reset algorithm after cycle-slip.

Geometry-free combination resualt :



(a) PRN = G02. (b) PRN = G09.

Figure 1: MIZU 2016.



(a) PRN = G02. (b) PRN = G09.

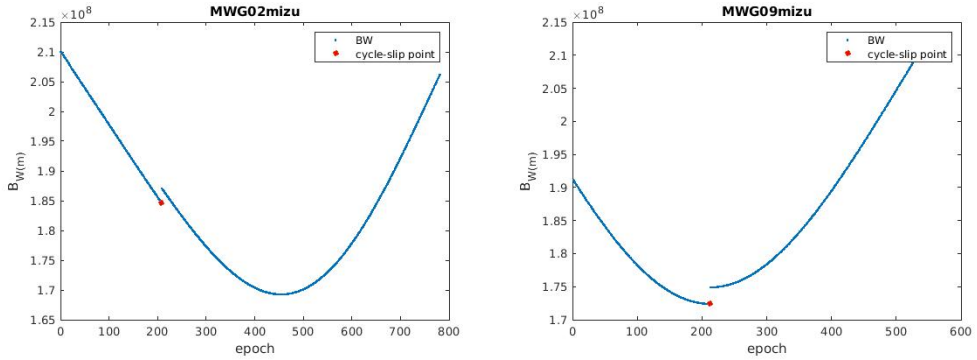
Figure 2: MIZU 2016 Sec-order Polynomial.

2 Detector based on carrier phase measurements only : Blewitt

By differing narrow-lane code from wide-lane phase combination the MW combination is resulted which has a double benefit. First the combination has a larger wavelength which leads to an enlargement of the ambiguity spacing. Second the narrow-lane combination reduce the noise and make acceptable bais around mean of data.

Description of Algorithm :
Input data: The MW combination
$B_W = \Phi_W - R_N = \lambda_W N_W + b_W + \epsilon$
For specific arcline For each epoch (k)
For each tracked satellite (s)
Evaluate $m_{BW} = mean[B_W(s;k), ..., B_W(s;k+N_I)]$,$s_{BW} = std[B_W(s;k), ..., B_W(s;k+N_I)]$
if $|B_W(s;k+N_I+1) - m_{BW}| > 4 * s_{BW}$
Reset algorithm after cycle-slip.

Blewitt resualt :



(a) PRN = G02. (b) PRN = G09.

Figure 3: MIZU 2016 Blewitt.