2. VTL-based NLOS Detection and Correction
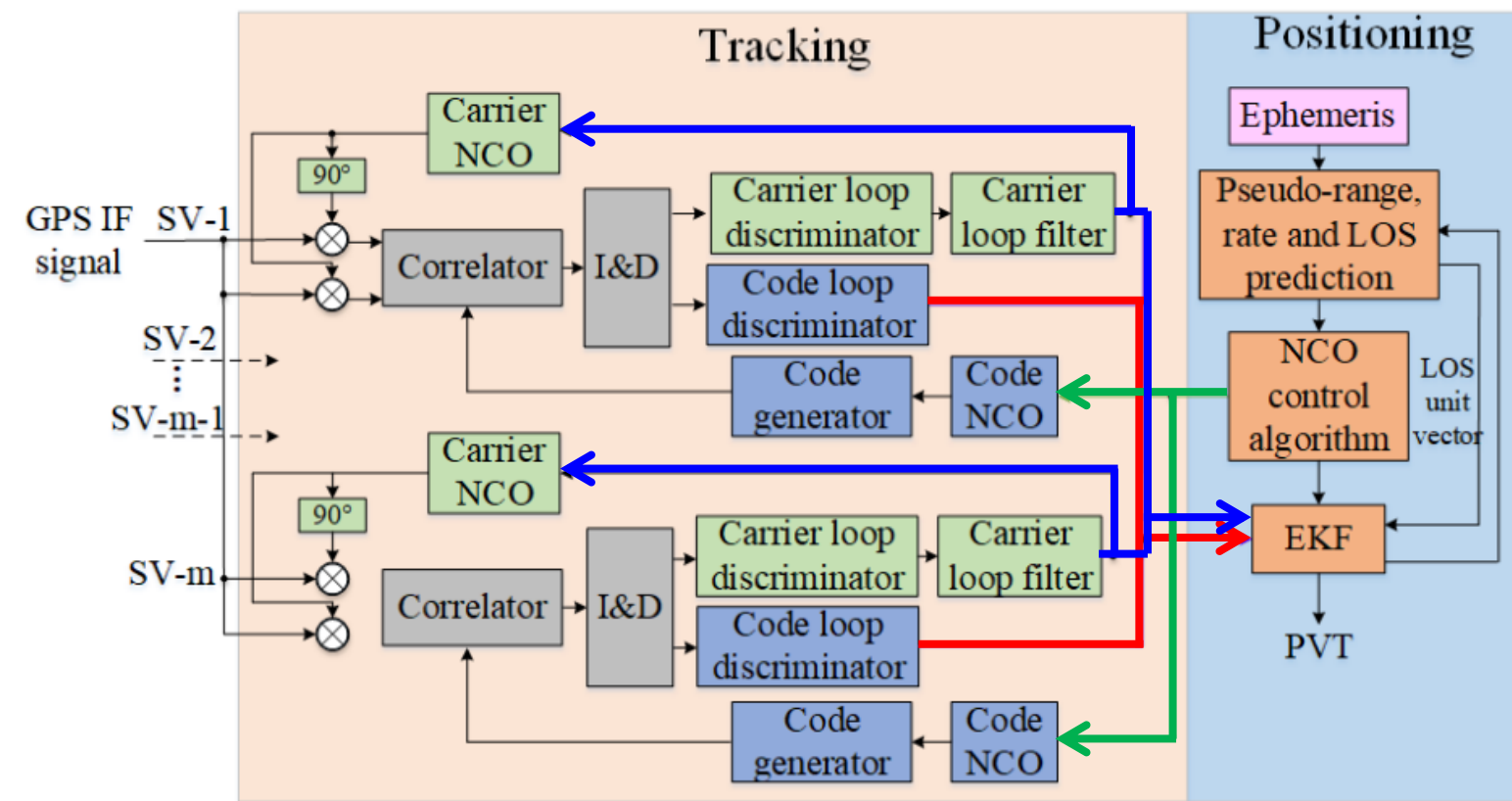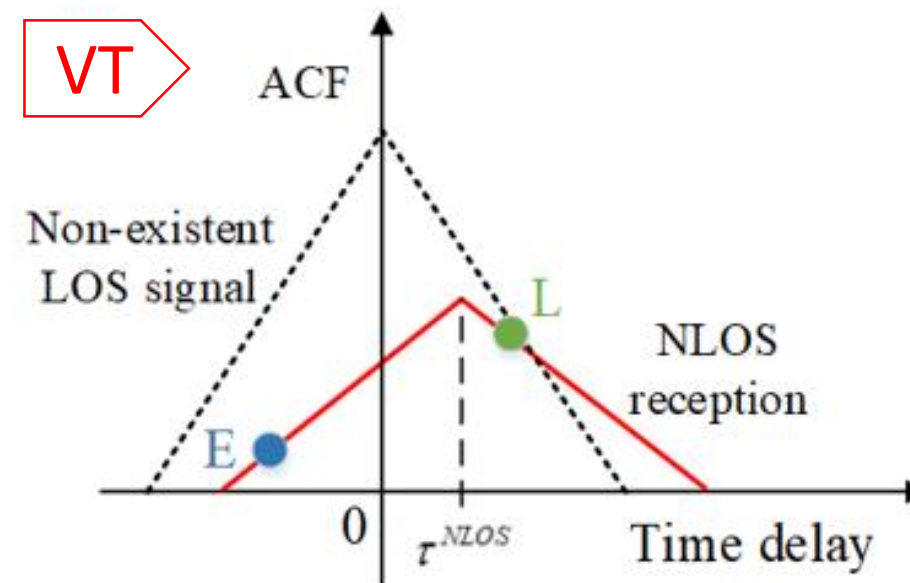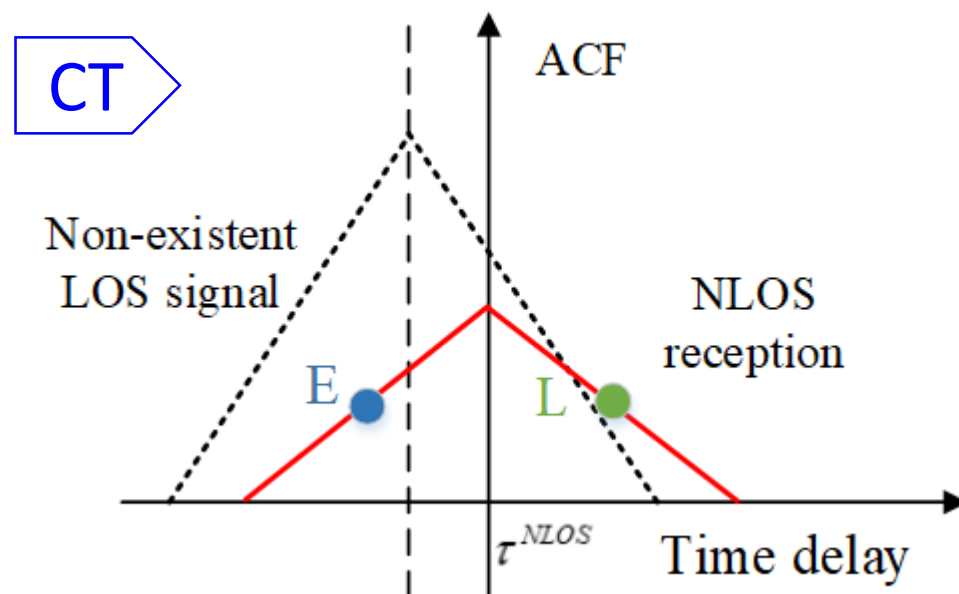

☐ VDLL + 2ⁿᵈ-order PLL

☐ Code NCO

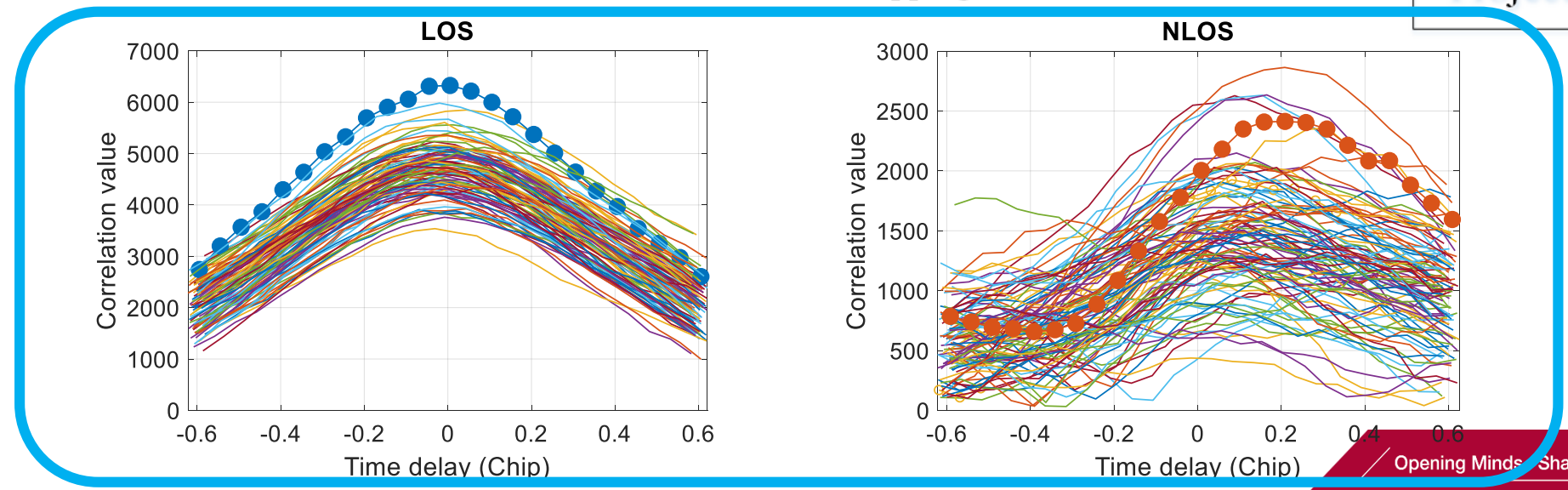$$f_{code,k}^m = f_{CA}\left(1 - \frac{\hat{\rho}_k^m - \hat{\rho}_{k-1}^m}{c \cdot T_0}\right)$$

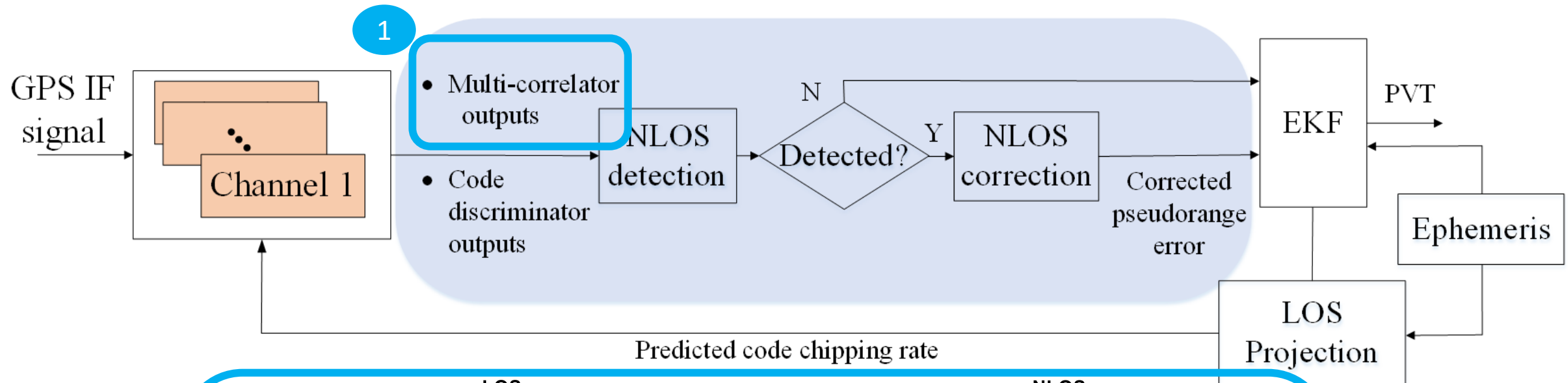$$\hat{\rho}_k^m = \left\|\mathbf{p}_k - \mathbf{p}_k^m\right\| + \delta\hat{\rho}_{sv,c}^m$$
$$+ \delta\hat{\rho}_I^m + \delta\hat{\rho}_T^m - \delta b_k$$

Xu B., Jia Q. and Hsu L.-T. (2019), Vector Tracking Loop-based GNSS NLOS Detection and Correction: Algorithm Design and Performance Analysis, IEEE Transactions on Instrumentation and Measurement, (accepted)

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2. VTL-based NLOS Detection and Correction

Why is VTL capable of detecting and correcting the NLOS reception?

Xu B., Jia Q. and Hsu L.-T. (2019), Vector Tracking Loop-based GNSS NLOS Detection and Correction: Algorithm Design and Performance Analysis, IEEE Transactions on Instrumentation and Measurement, (accepted)

2. VTL-based NLOS Detection and Correction
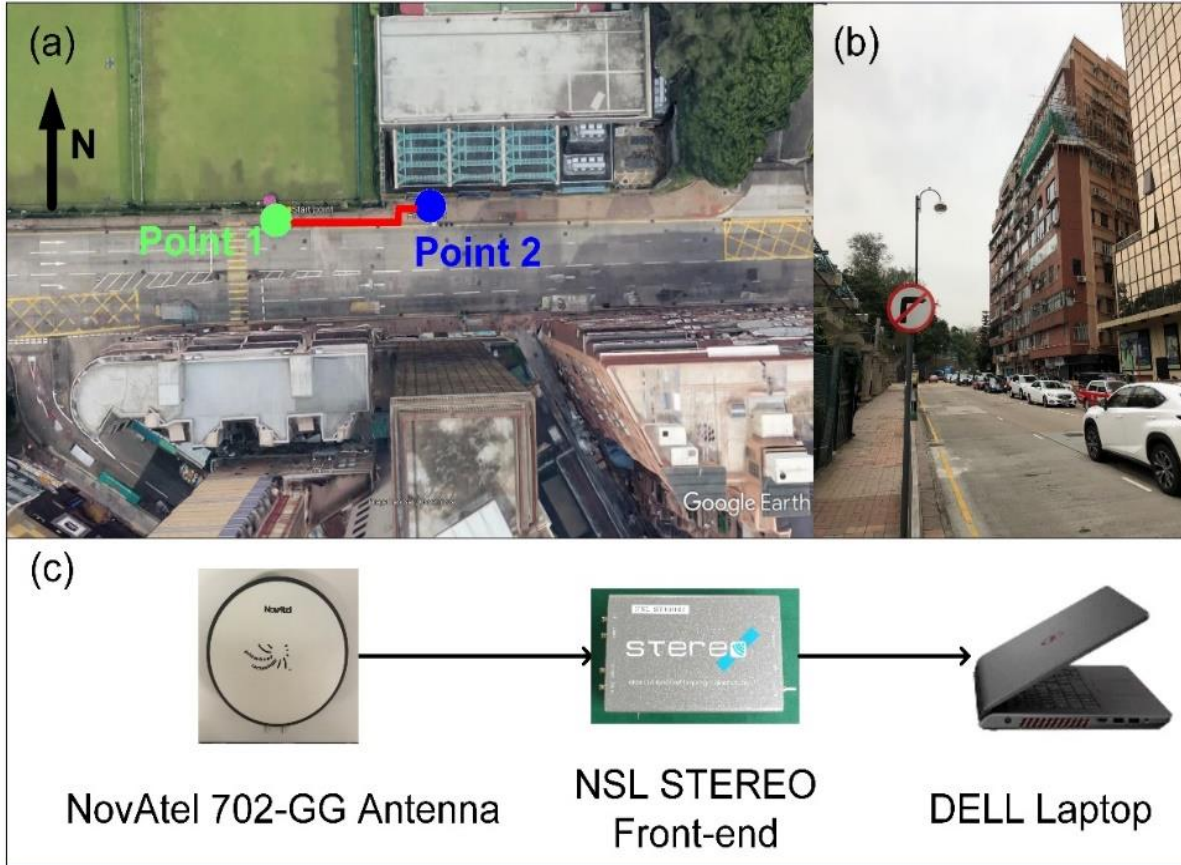
2. VTL-based NLOS Detection and Correction
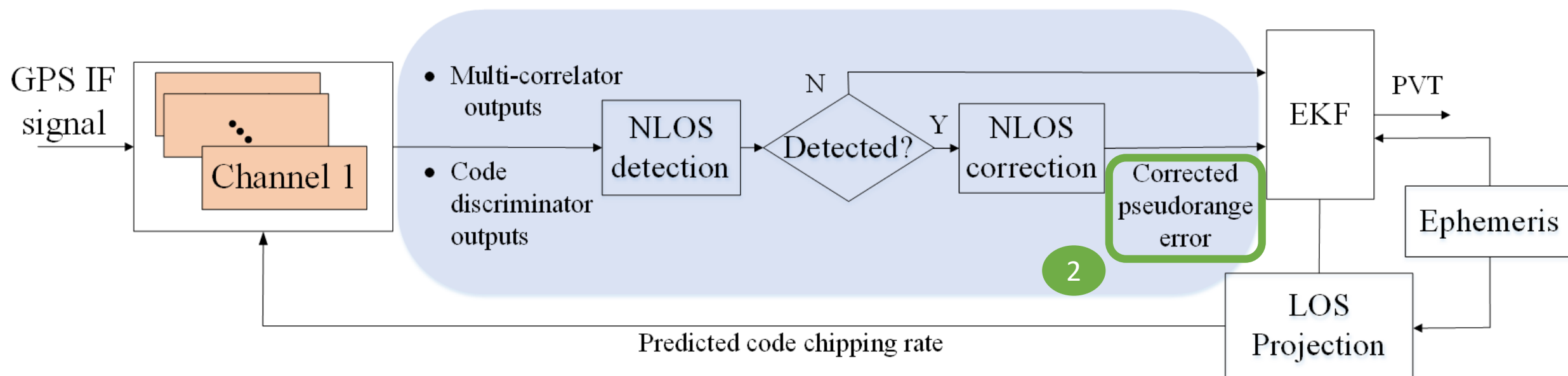
$$\Delta \rho_c^j = \left(\Delta \tau^j + \tau_{corr} \right) \cdot \frac{c}{f_{CA}}$$

Code discriminator outputs

Code discriminator outputs averaged over 50 consecutive values
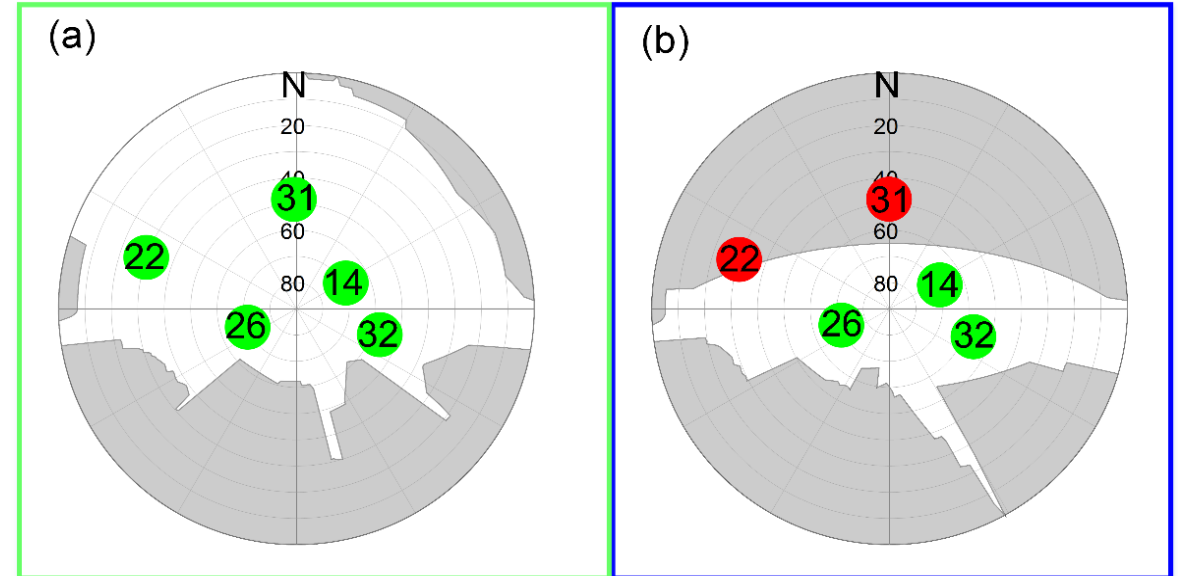
3. Experimental Results and Analysis

Front-end	Model	NSL Stereo
	Constellation	GPS L1
	Sampling rate & IF	26 MHz, 6.5 MHz
	Bandwidth	2 MHz (Double sided)
SDR [1]	Correlator numbers and spacing (chip)	Normal mode: 3, 0.5 NLOS detection mode: 25, 0.05
	Pre-detection integration (PDI)	1 ms
	Measurement update interval	20 ms
	PLL bandwidth	20 Hz

[1] B. Xu and L.-T. Hsu, "Open-source MATLAB code for GPS vector tracking on a software-defined receiver," GPS Solutions, vol. 23, no. 2, 2019.

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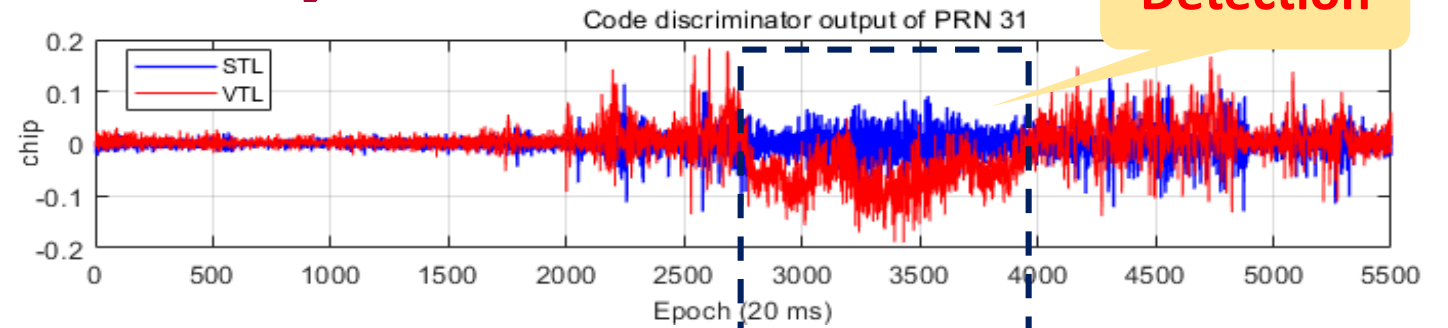# 3. Experimental Results and Analysis
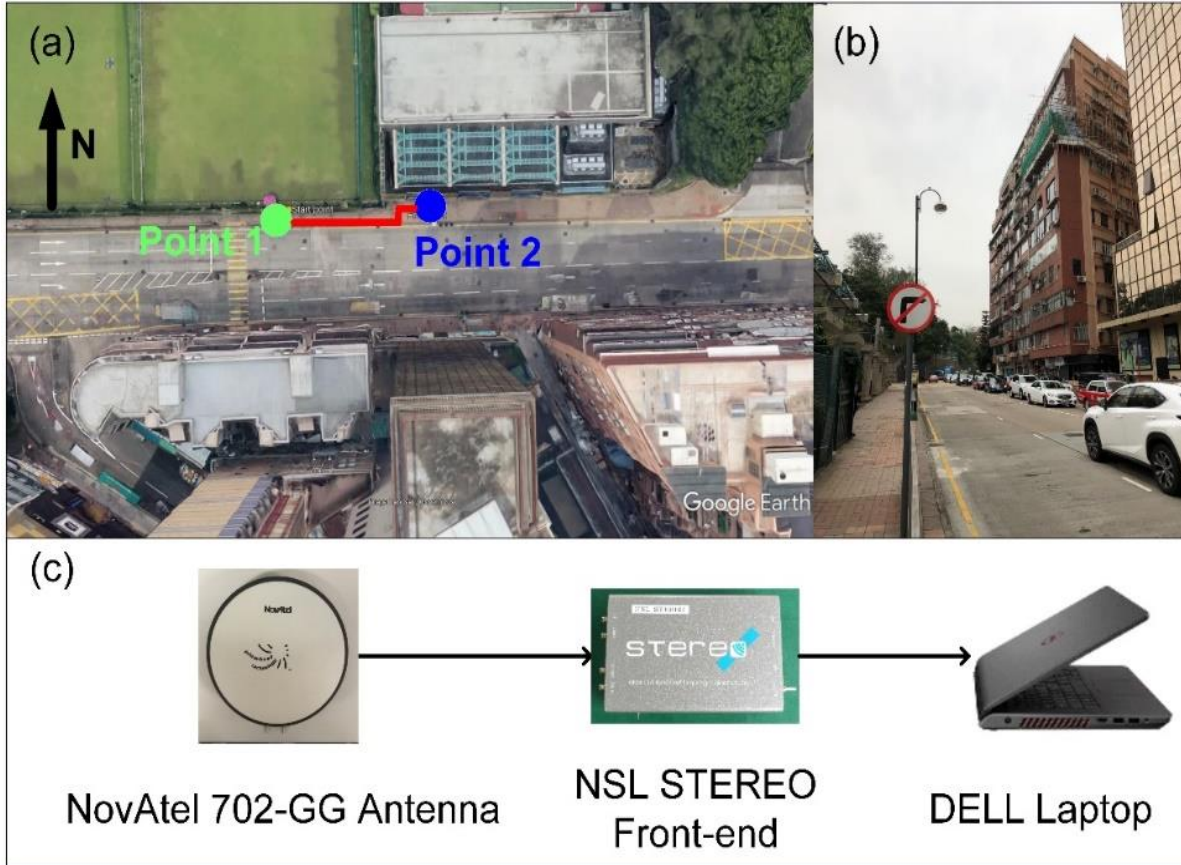
Experimental environment and set-up

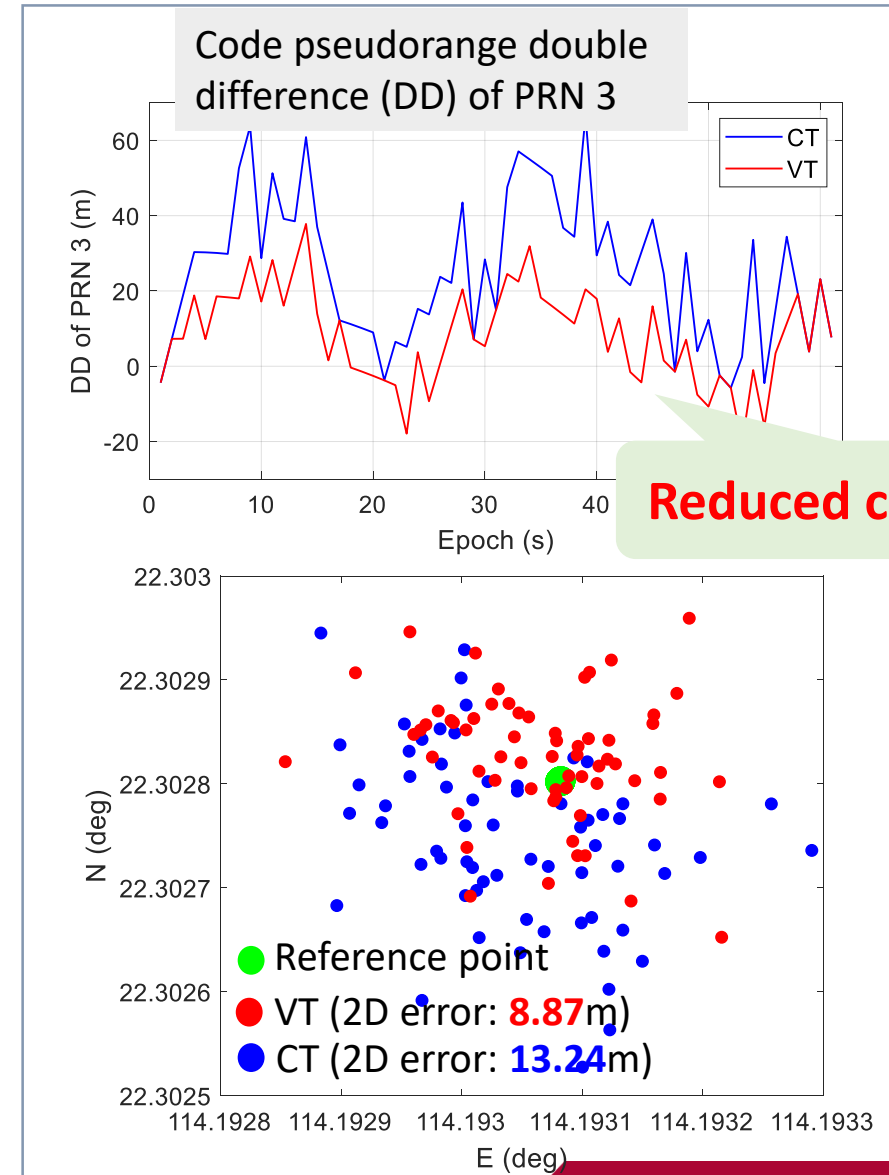

Point 1   Point 2

Sky-plot with building boundary information

3. Experimental Results and Analysis

Point 1

Point 2

Detection

Code discriminator output of PRN 31

Correction

Horizontal Positioning Error
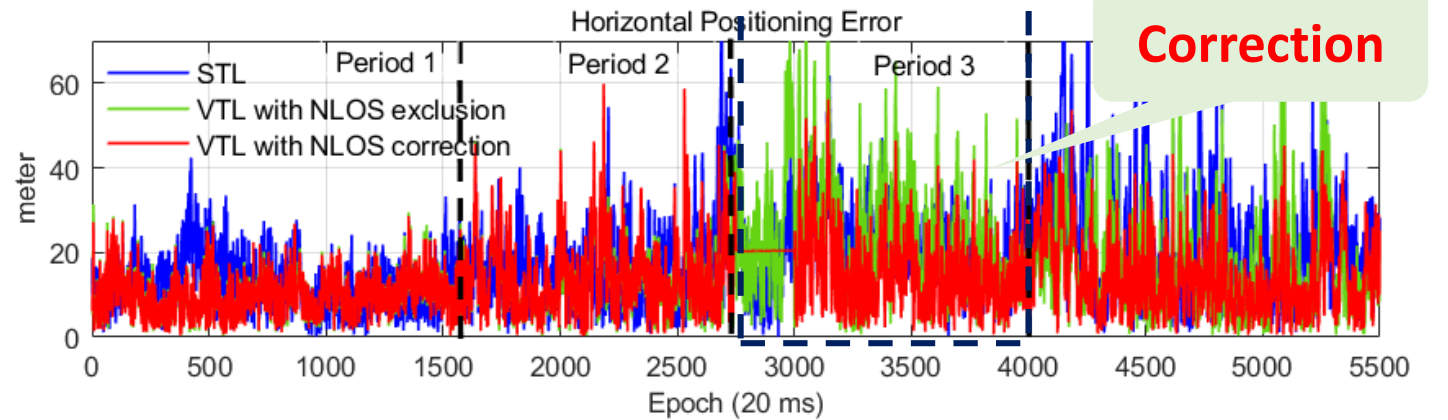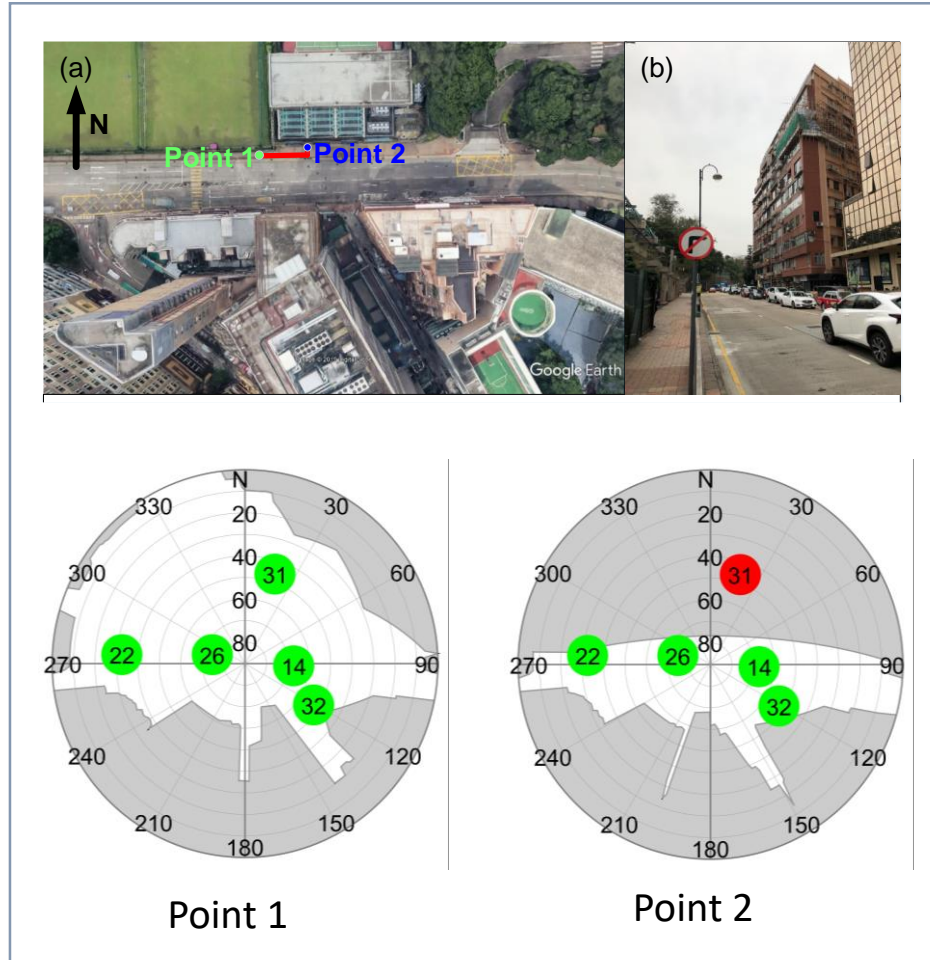
Period	STL		VTL WITH NLOS EXCLUSION		VTL WITH NLOS CORRECTION	
	MEAN	STD	MEAN	STD	MEAN	STD
1	12.70	6.49	10.06	4.94	9.91	4.81
2	17.24	10.23	14.26	9.15	14.42	9.23
3	22.07	8.35	23.20	13.75	17.54	10.10
4	22.83	15.03	17.54	11.64	16.00	9.79

Xu B., Jia Q. and Hsu L.-T. (2019), Vector Tracking Loop-based GNSS NLOS Detection and Correction: Algorithm Design and Performance Analysis, IEEE Transactions on Instrumentation and Measurement, (accepted)

3. Experimental Results and Analysis

Code pseudorange double difference (DD) of PRN 3

Reduced code noise

Reference point
VT (2D error: **8.87**m)
CT (2D error: **13.24**m)

Xu B., Jia Q. and Hsu L.-T. (2019), Vector Tracking Loop-based GNSS NLOS Detection and Correction: Algorithm Design and Performance Analysis, IEEE Transactions on Instrumentation and Measurement, (accepted)

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