ASSESSING PPP AMBIGUITY RESOLUTION WITHIN ONTARIO

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Introduction

Precise Point Positioning (PPP) data processing technique has been developed over the past 15 years to become a standard method for a growing number of positioning and navigation applications.

Standard Positioning Service (SPS)

m-level real-time broadcast orbit and clock information + Receiver tracking information + Error modelling = m-level user position estimate

Precise Point Positioning (PPP)

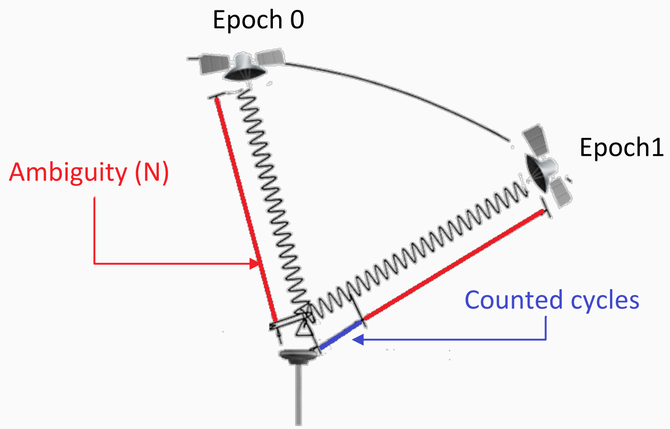
cm-level precise GPS orbit and clock information + Receiver tracking information + Additional error modelling + Filtering = dm to mm level user position estimate

Research objectives

To examine the challenges of ambiguity resolution (AR) in PPP. Quantify data collection periods necessary to meet implemented integrated cadastral surveys in Ontario and geodetic surveys accuracy specifications from National Standard for Spatial Data Accuracy, Virgina.

What is the ambiguity term?

Unknown integer number of cycles between satellite and receiver during initialization. After initialization receiver can precisely count number of cycles.

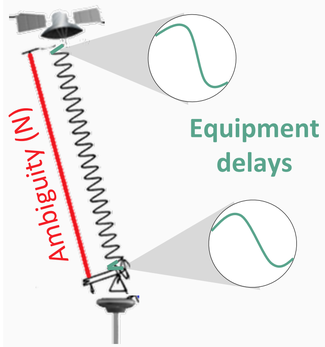


Benefits of ambiguity resolution:

- Significantly reduce convergence period
- Higher positional accuracy
- More consistent solutions

} More powerful technique

Challenges of PPP-AR



In PPP processing, the ambiguity parameters are not integers because they are corrupted by initial fractional equipment delays present in the GPS satellites and receivers.

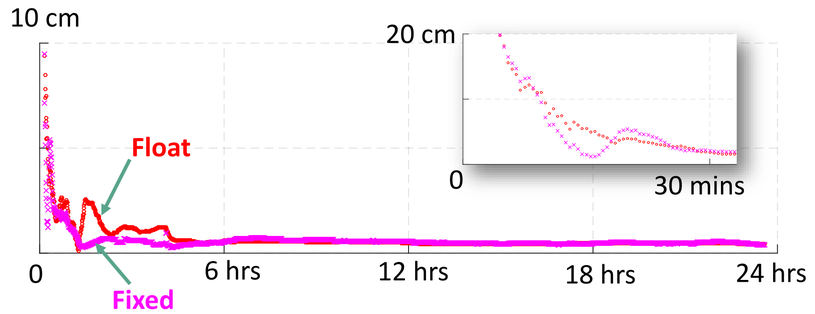
Satellite equipment delay corrections are provided by government agencies, e.g., NRCan, CNES (from France) and GFZ (from Germany). Receiver equipment delays are eliminated by single differencing.

Methodology

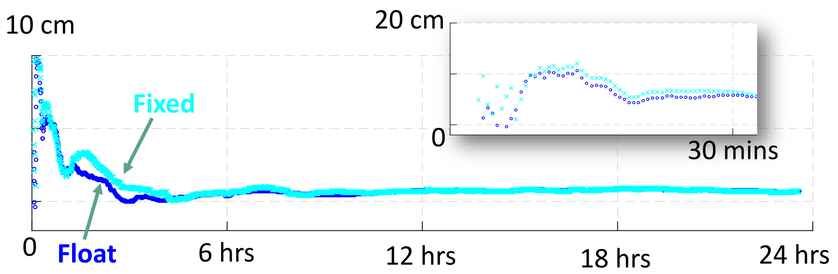
GPS data DOY 32-38 of 2015 from Canadian Active Control System (CACS) network was processed using satellite products provided by Natural Resources Canada (NRCan). PPP solutions were computed using YorkU-PPP software developed at York University originally based on NRCan online PPP-CSRS software. PPP solutions were compared to mm-level accuracy solutions (i.e., IGS weekly SINEX solutions.

Performance

Horizontal Position Error



Vertical Position Error



PPP-AR application to integrated survey specifications

Application	Horizontal accuracy classification	95% confidence [cm]	Convergence period
Cadastral	Remote areas	100	1 min
	Rural areas	20	10 min
	Urban areas	5	1 hours
Geodetic	Control survey	2	4 hours
	Control survey	1	13 hours
	Control survey	0.5	21 hours

Conclusions and future work

Conclusions:

- Quantified data collection periods necessary to meet integrated cadastral surveys and geodetic surveys accuracy specifications. It must be noted that these results are from good CACS sites.
- Performance in the horizontal component was improved by applying ambiguity resolution.
- Mismodelling that was present in horizontal component is now mapped into vertical component.

Future Work:

- Introduction of a more advanced ambiguity resolution and validation technique.
- Multi-constellation float with GPS AR.

References

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