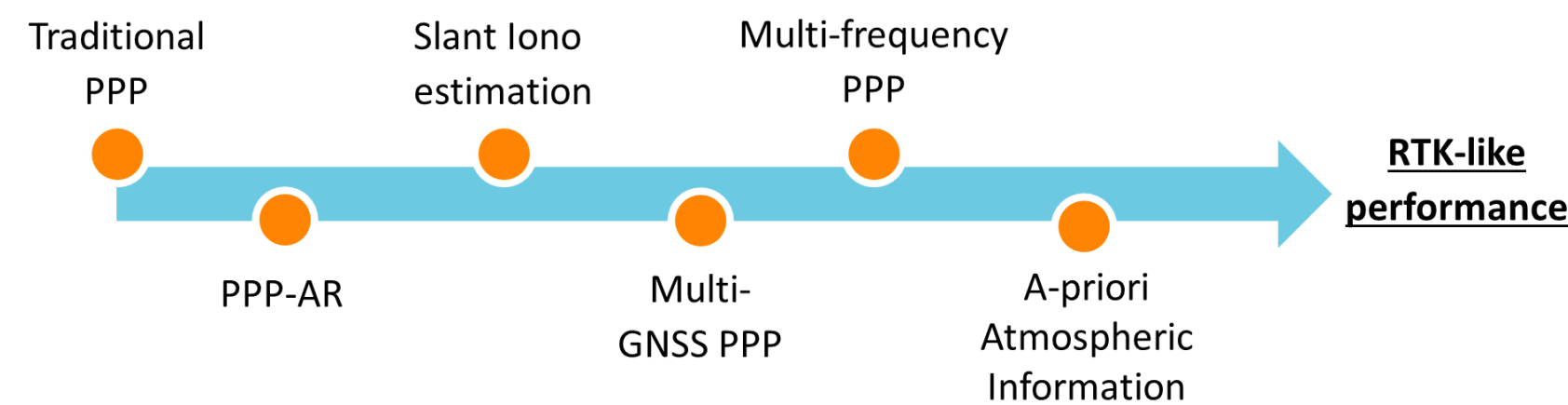




Evolution of PPP Model

Over the past two decades, the PPP user model has been constantly evolving. Each iteration, added improvements in terms of accuracy and most notably convergence.

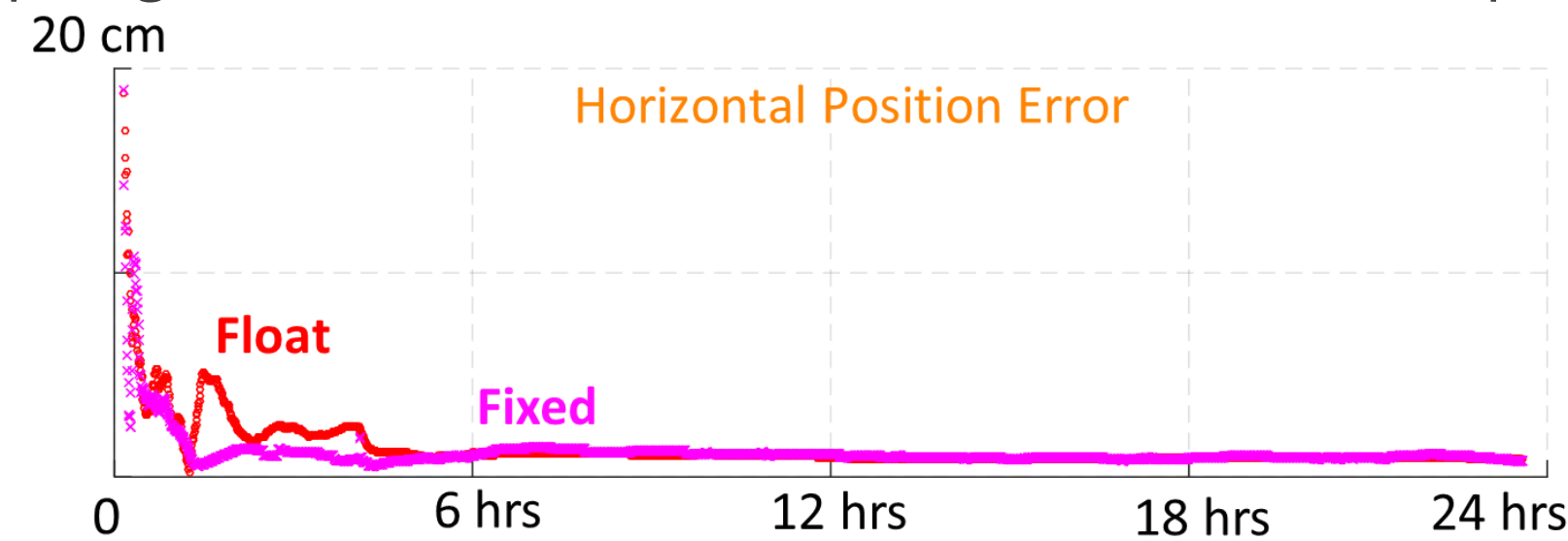


Research objectives

To examine the different performance indicators of PPP and PPP-AR. Determine if Cadastral Surveyors in rural areas need AR for accuracy or for integrity.

Ambiguity Resolution

AR is critical for cm-level positioning but for Cadastral Surveyors, requiring 20cm in rural areas at 95% confidence level, is it required?



Importance of integrity monitoring

Integrity is the measure of trust that can be placed in the information supplied by a navigation system. Integrity is important in PPP because

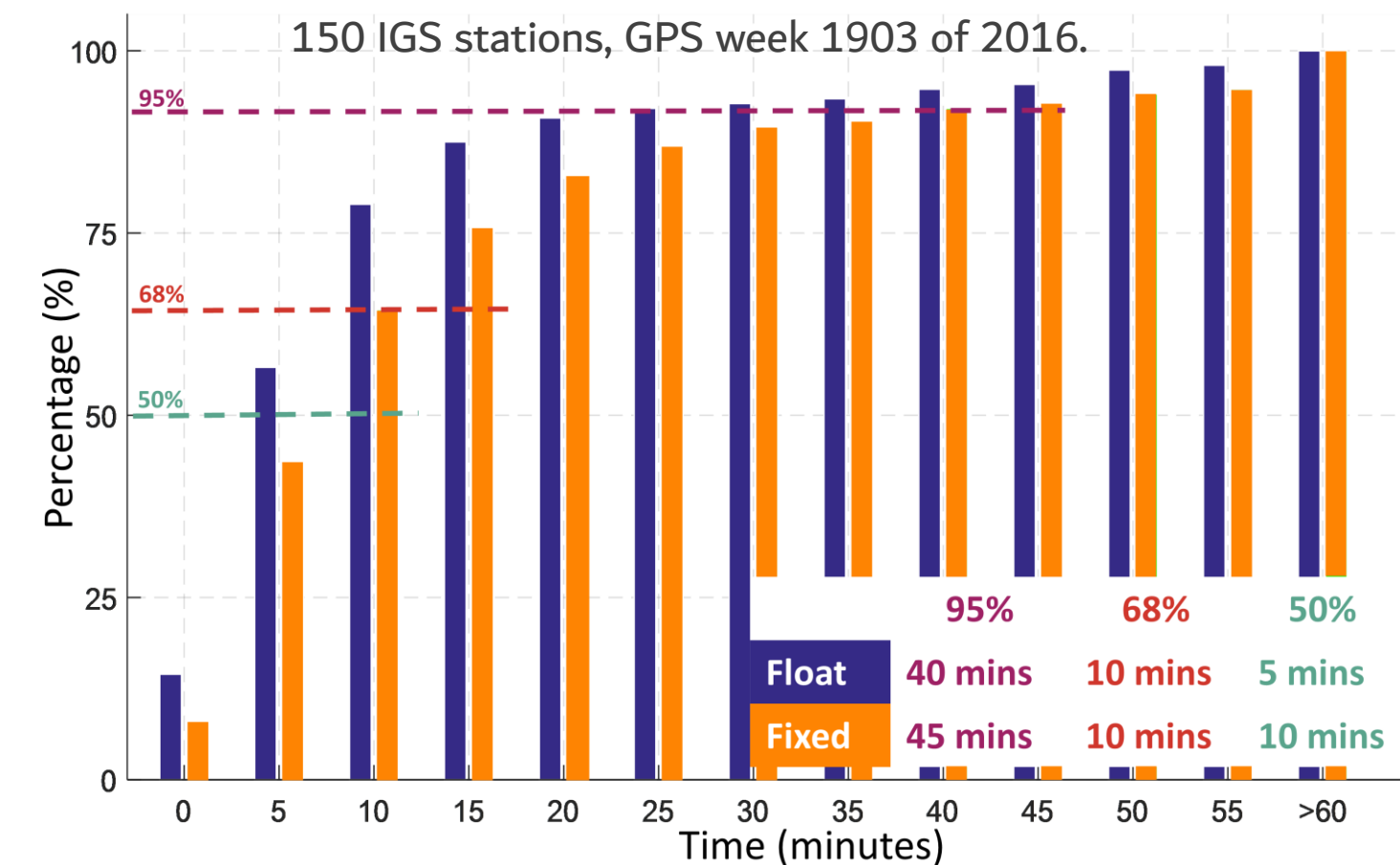
- No reference to local receivers
- All parameters have to be directly accounted for through estimation, elimination or modelling.

PPP Integrity Indicators

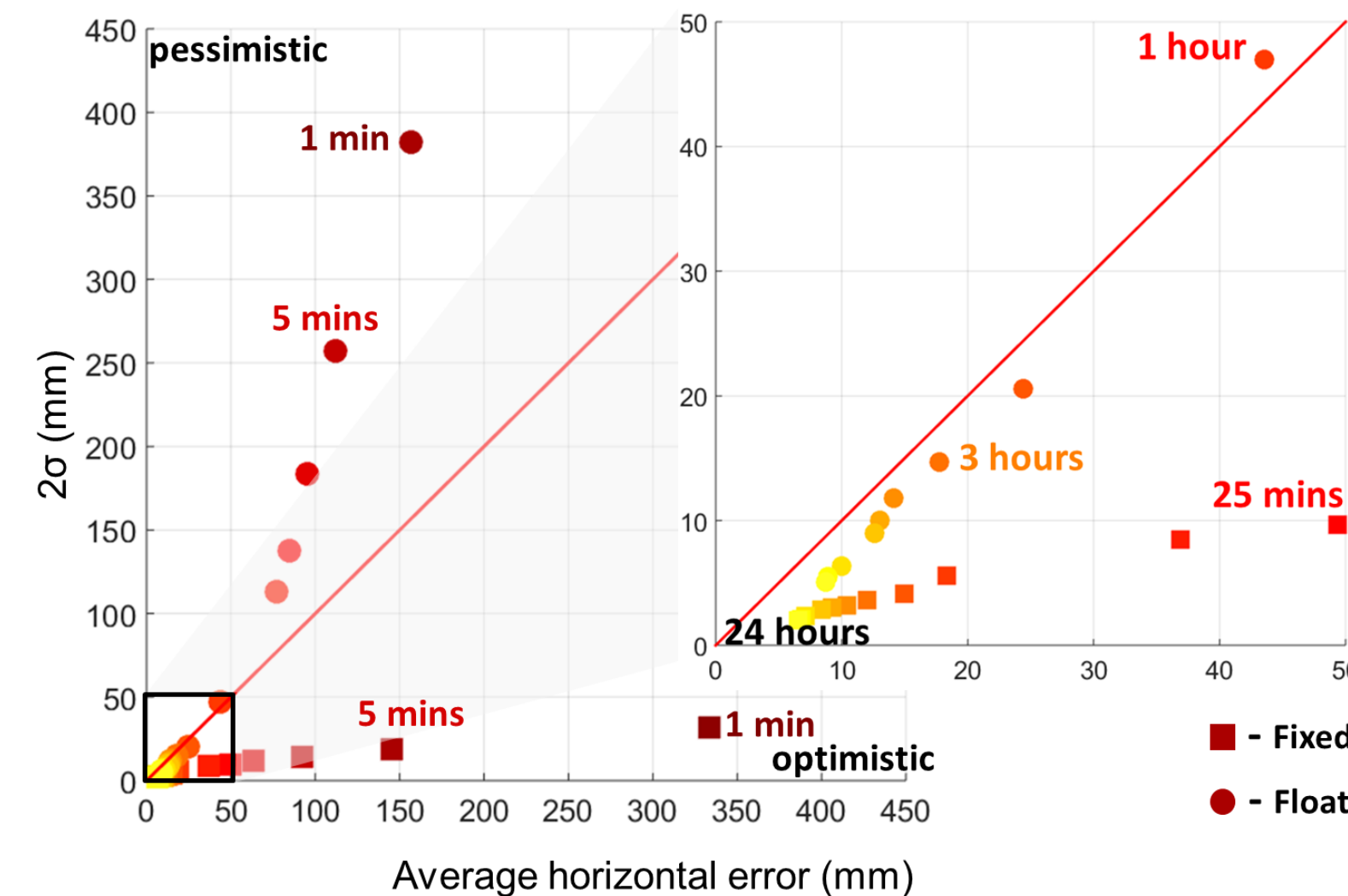
Primary integrity indicators examined:

1. Convergence
2. Position Uncertainty
3. Ambiguity Validation (Residual Testing)

1) Convergence: Time needed to achieve 20 cm horizontal



2) Position uncertainty: How realistic is your covariance?



3) Ambiguity validation: Can you trust the solution?

Ambiguity resolution and validation is critical for enabling cm-level accuracy. Ambiguity validation can be utilized as an integrity indicator of solution quality.

Ratio testing was selected because it is reliable, simple and straightforward for validation testing.

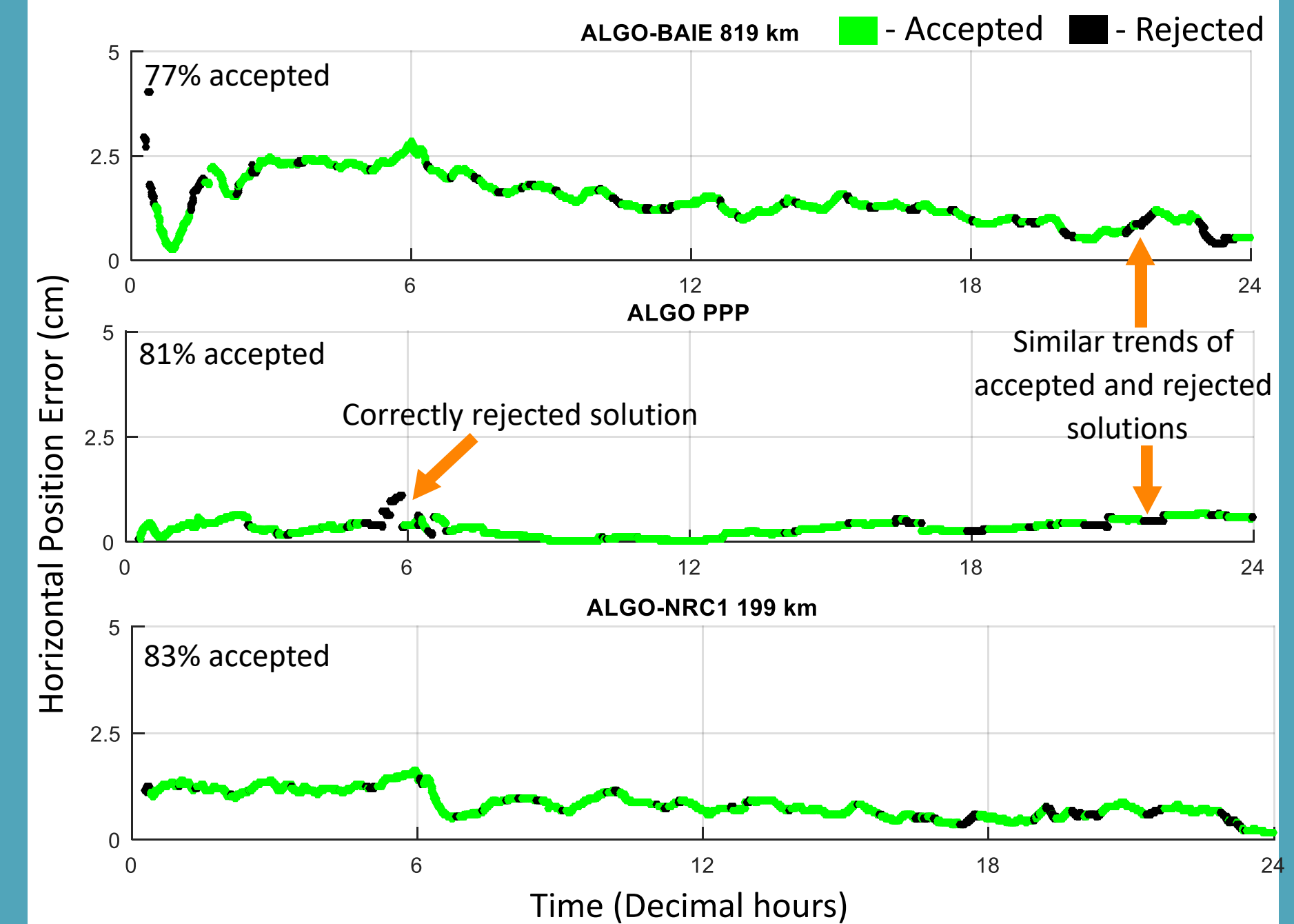
Second best set of ambiguity candidates

$$\frac{(\hat{x}_2 - \check{x}_2)V_{\hat{x}_2}(\hat{x}_2 - \check{x}_2)}{(\hat{x}_1 - \check{x}_1)V_{\hat{x}_1}(\hat{x}_1 - \check{x}_1)} \geq 1.5 \text{ Threshold}$$

Best set of ambiguity candidates

Comparison of long single baseline RTK and PPP

Long baselines were selected to ensure atmospheric errors were not correlated. Examined the position error of ALGO (DOY 179, 2016).



Conclusion

The role of ambiguity resolution in PPP depends on the accuracy specifications.

Specifications	Accuracy	Integrity
cm - level	✓	✓
dm - level		✓

Future work

Improve stochastic de-weighting scheme and position uncertainty

References

Seepersad G, Aggrey J, Bisnath S, "Do We Need Ambiguity Resolution in Multi-GNSS PPP for Accuracy or Integrity?," Proc. of 30th ITM of The Satellite Division of ION, Portland, OR, Sept 2017, pp. 2204-2218.

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