SAND2019-14018C

Fine-Grained Analysis of Communication Similarity between Real and Proxy Applications

PRESENTED BY

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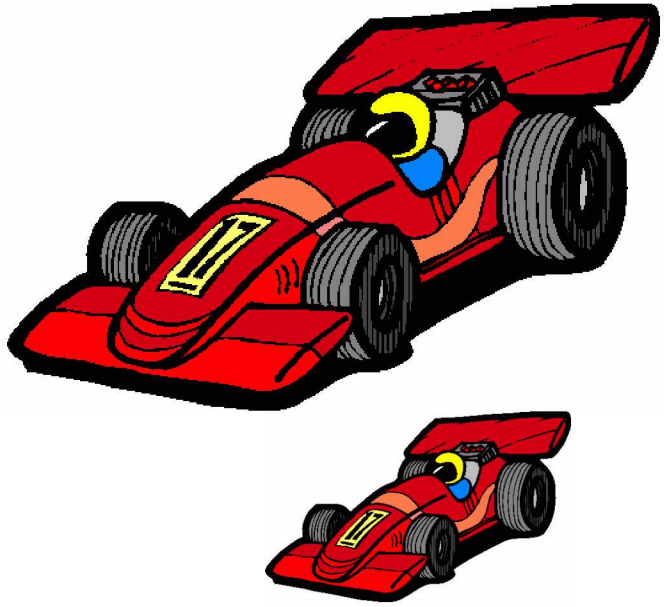
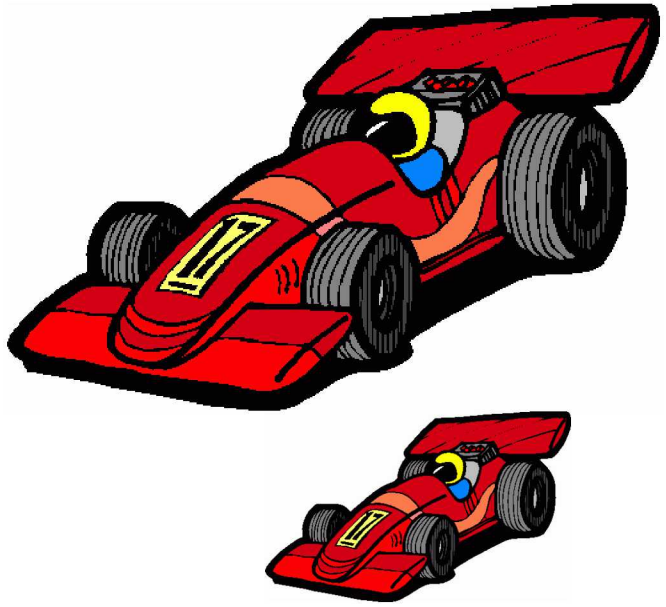
Proxy Apps are Wonderful!



Easy to Build!

Proxy Apps are Wonderful!



Easy to Modify!

Easy to Build!

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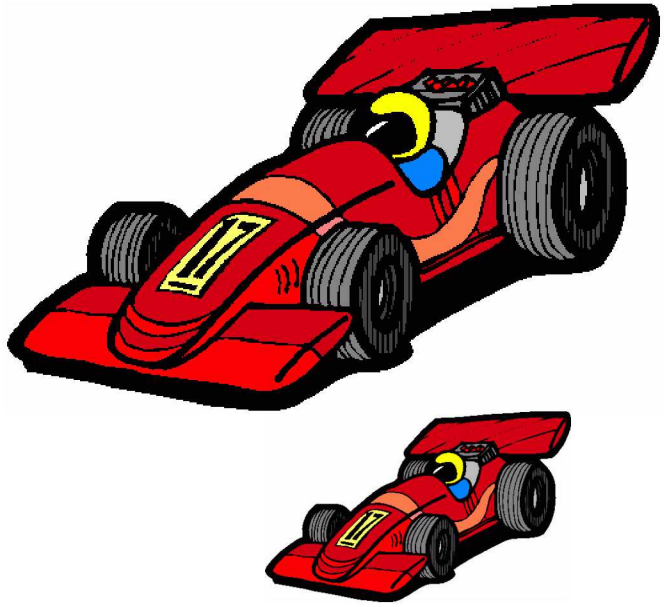


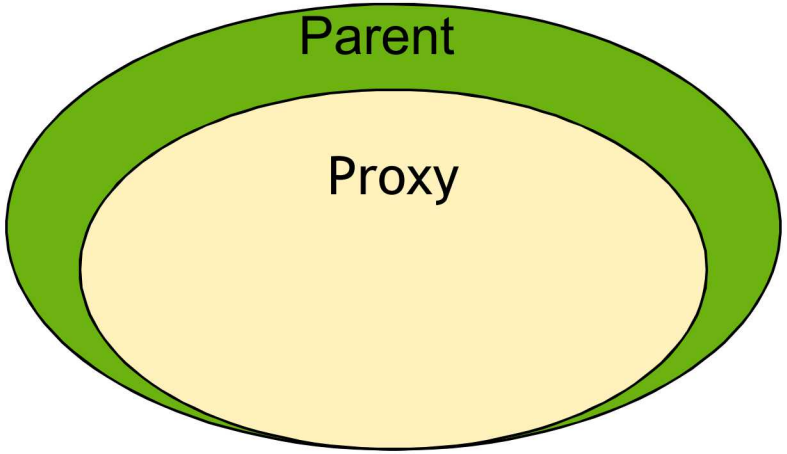
Easy to Modify!

Easy to Build!

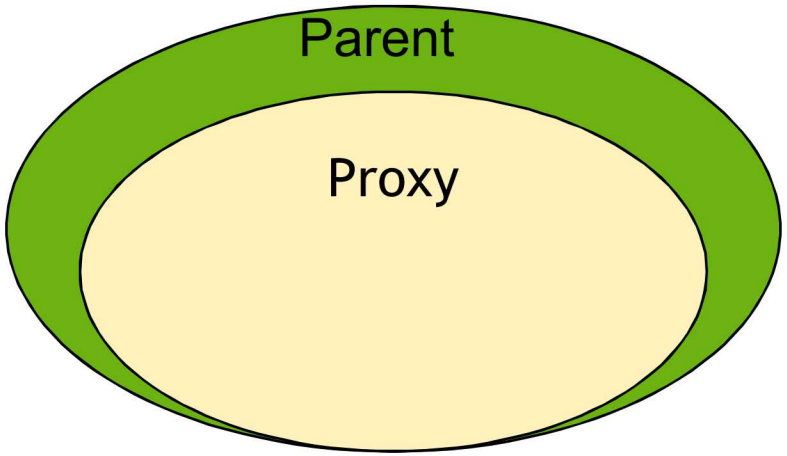
Easy to Run!

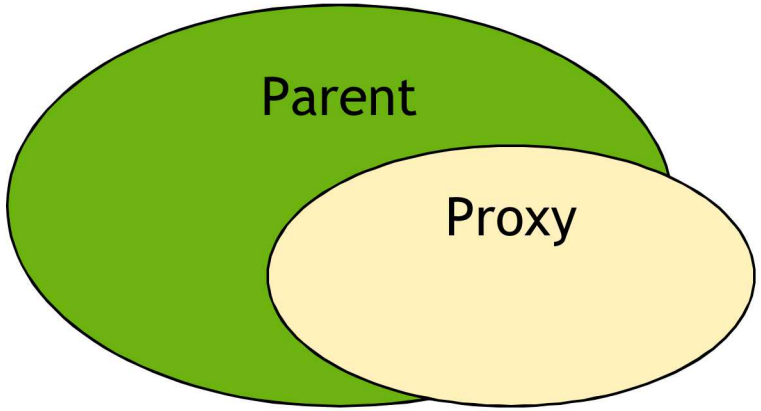
Explore Ideas!

Do Proxies Match the Real Thing?



Do Proxies Match the Real Thing?





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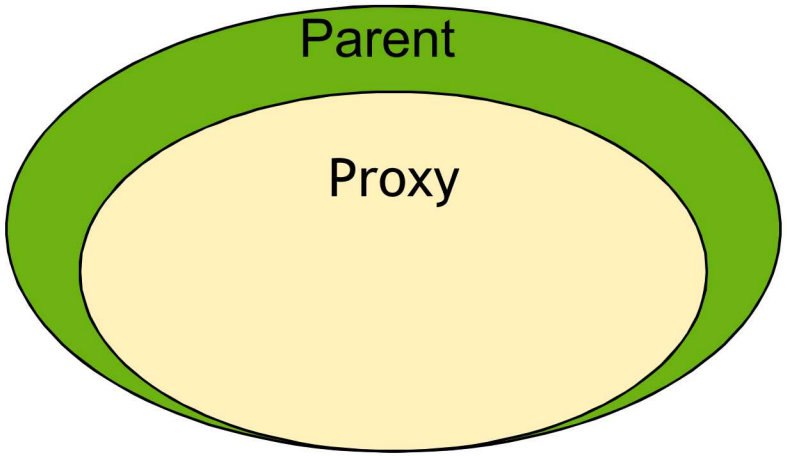

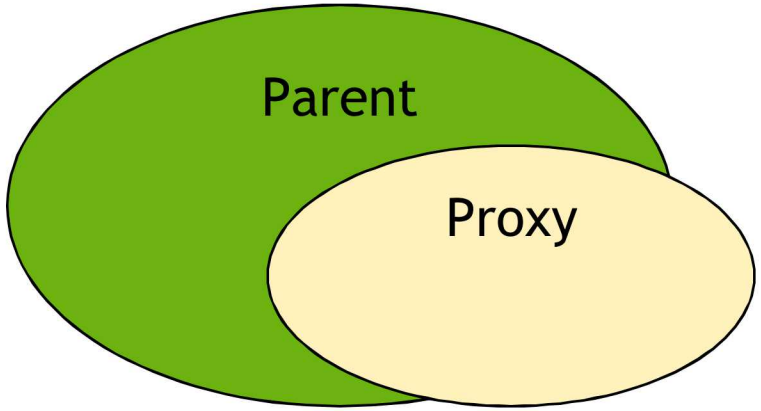

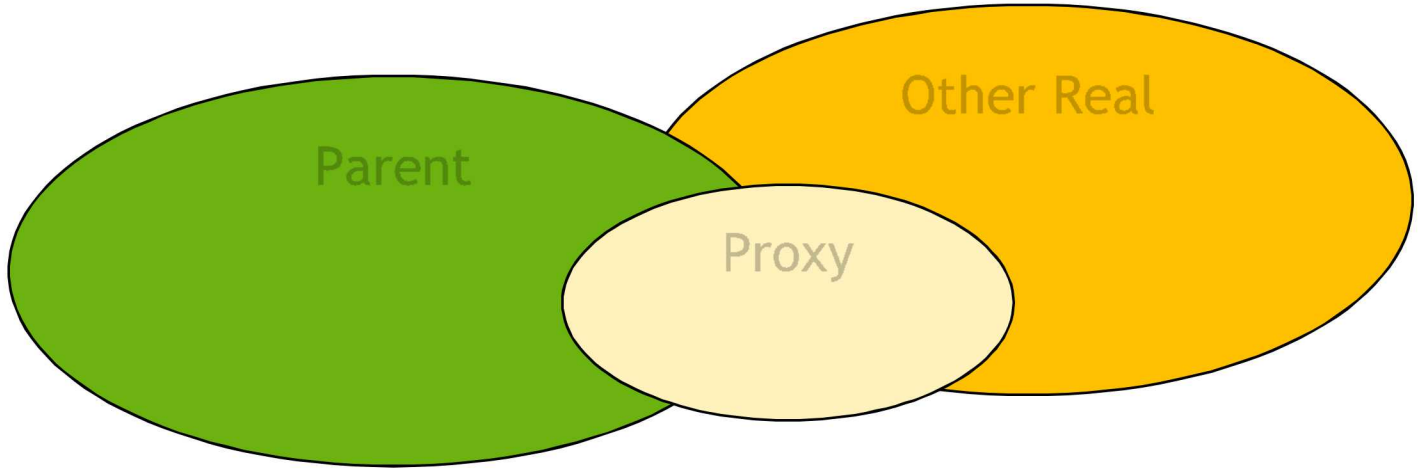

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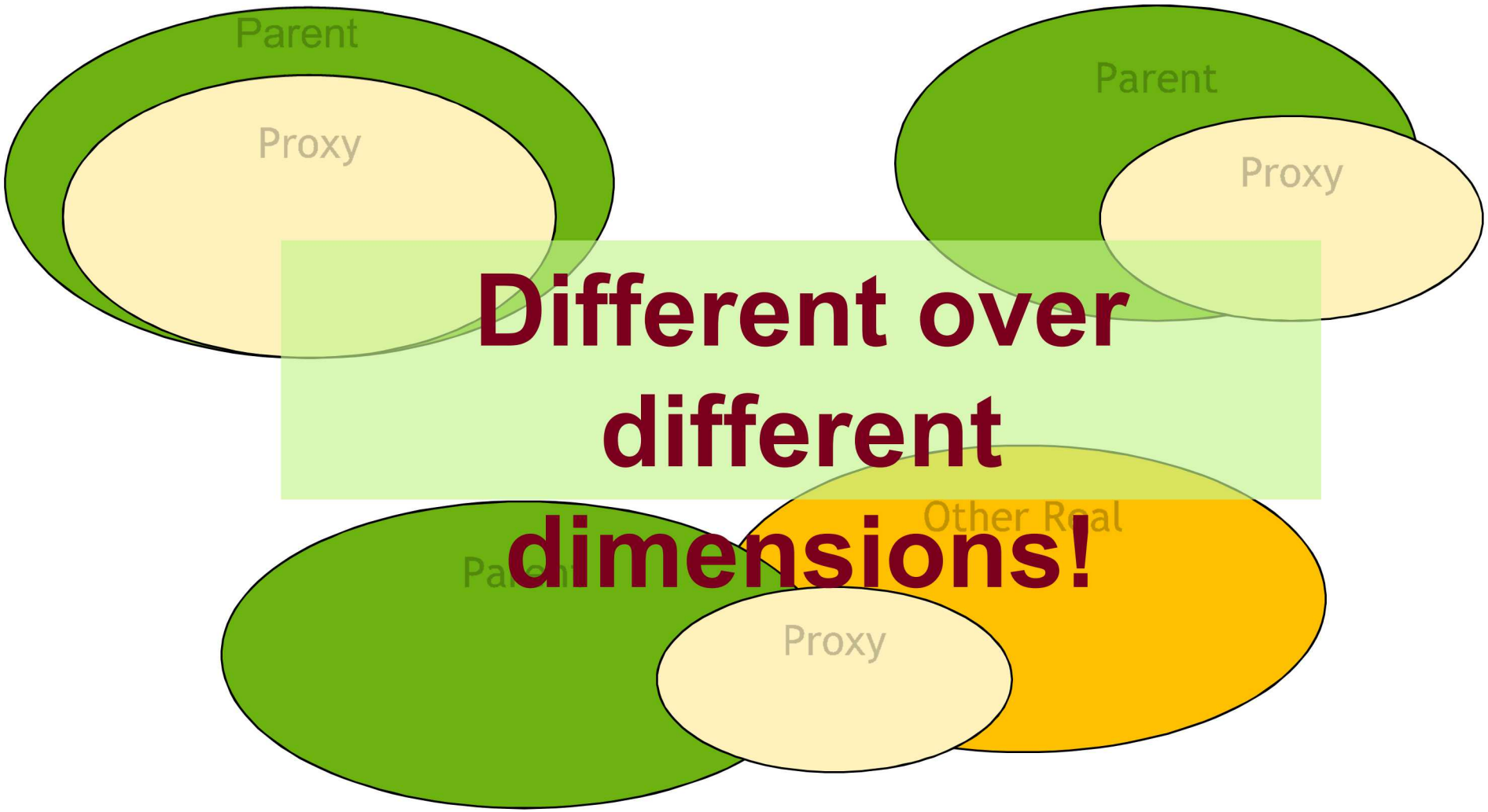
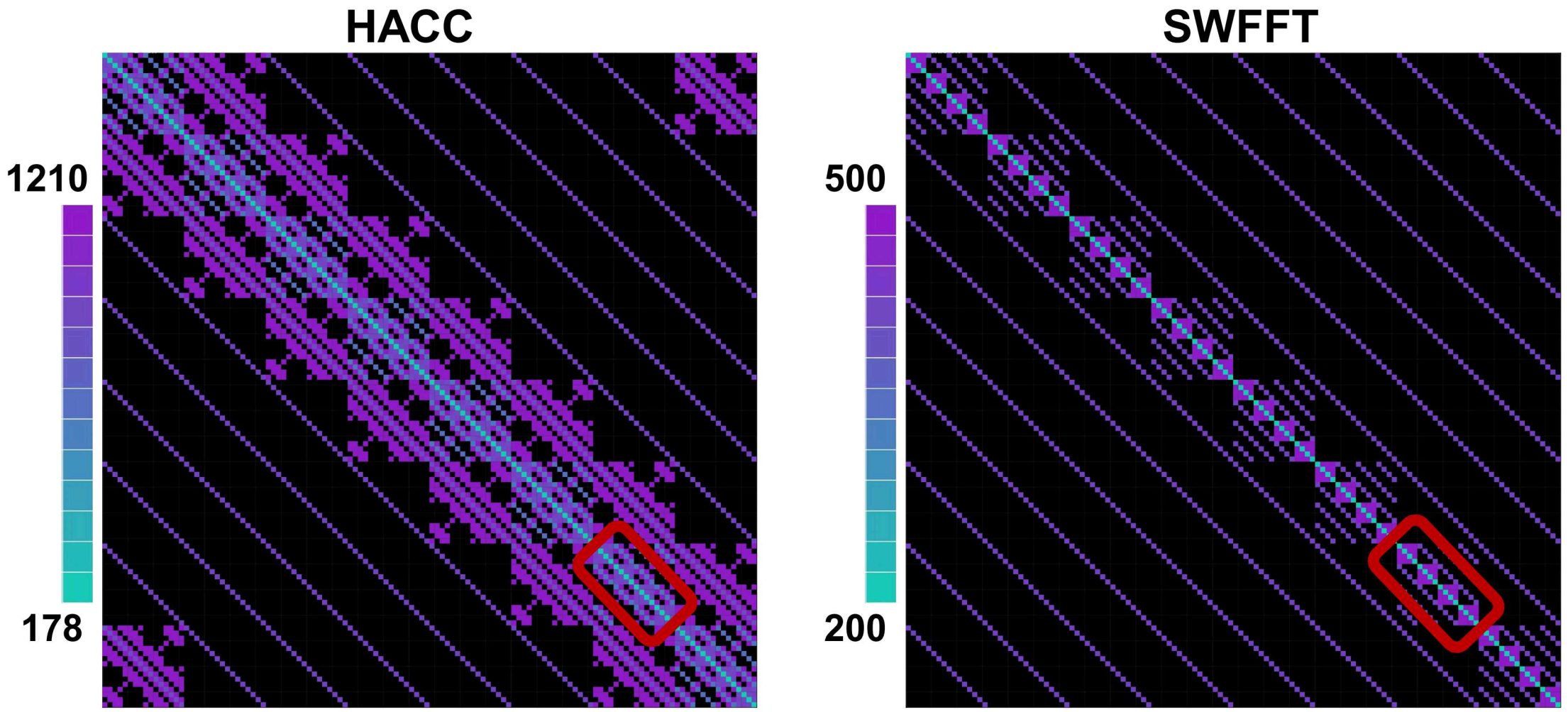


Different over different dimensions!

Previous work, Communication



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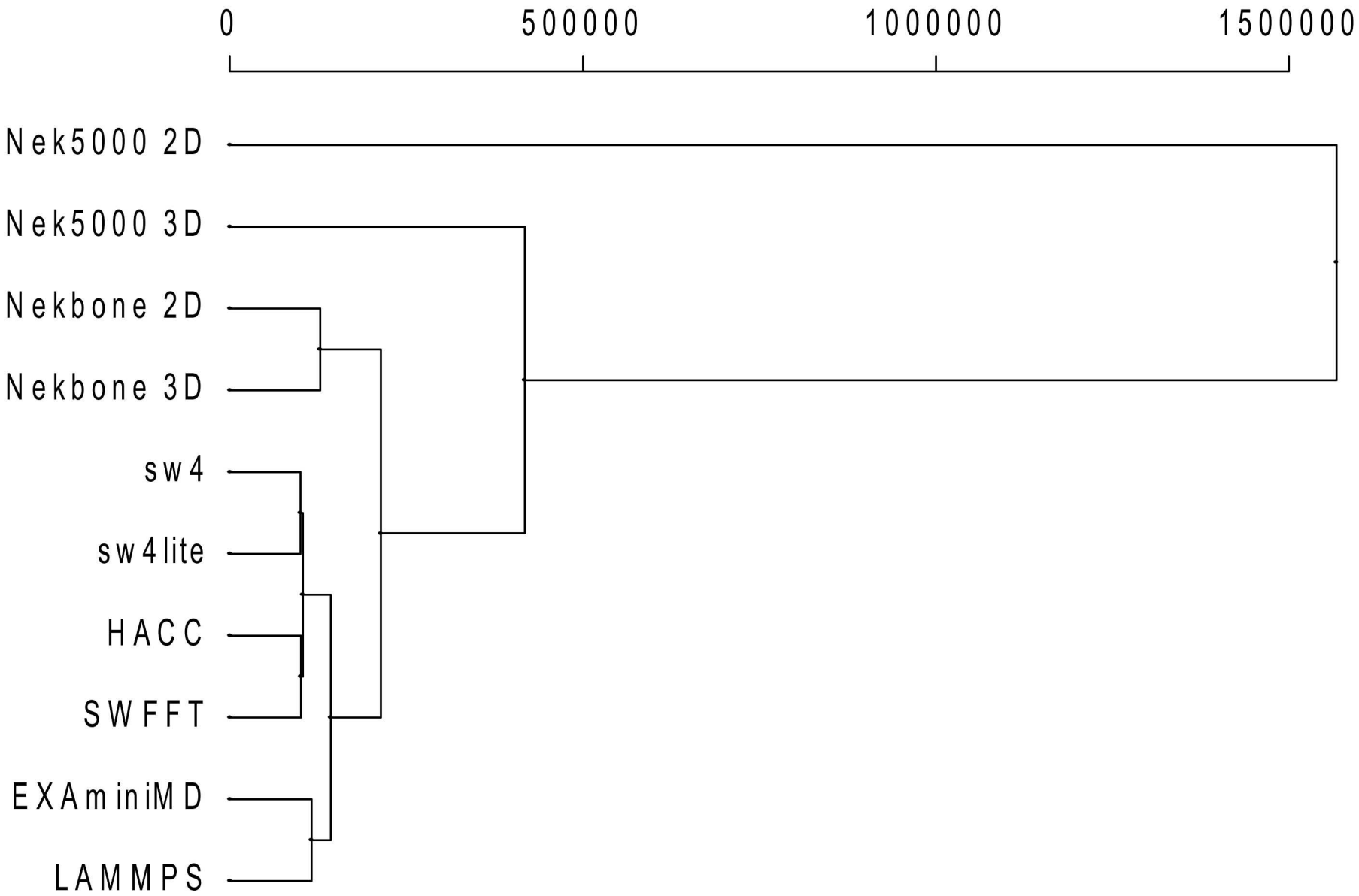


What about this work?

Motivation

Explored the dynamic communication behavior

Evaluated time-varying communication behavior

Improvement to miniAMR that makes it more closely match its parent CTH

Methodology

Define a reusable approach to evaluating parent/proxy correspondences

Preference towards simplicity

- But still effective

Cumulative vs time-varying communication behavior

Experiment with different statistical analysis methods

- Cosine similarity
- Person
- Spearman

Target: Time-varying Dynamic Communication Behavior

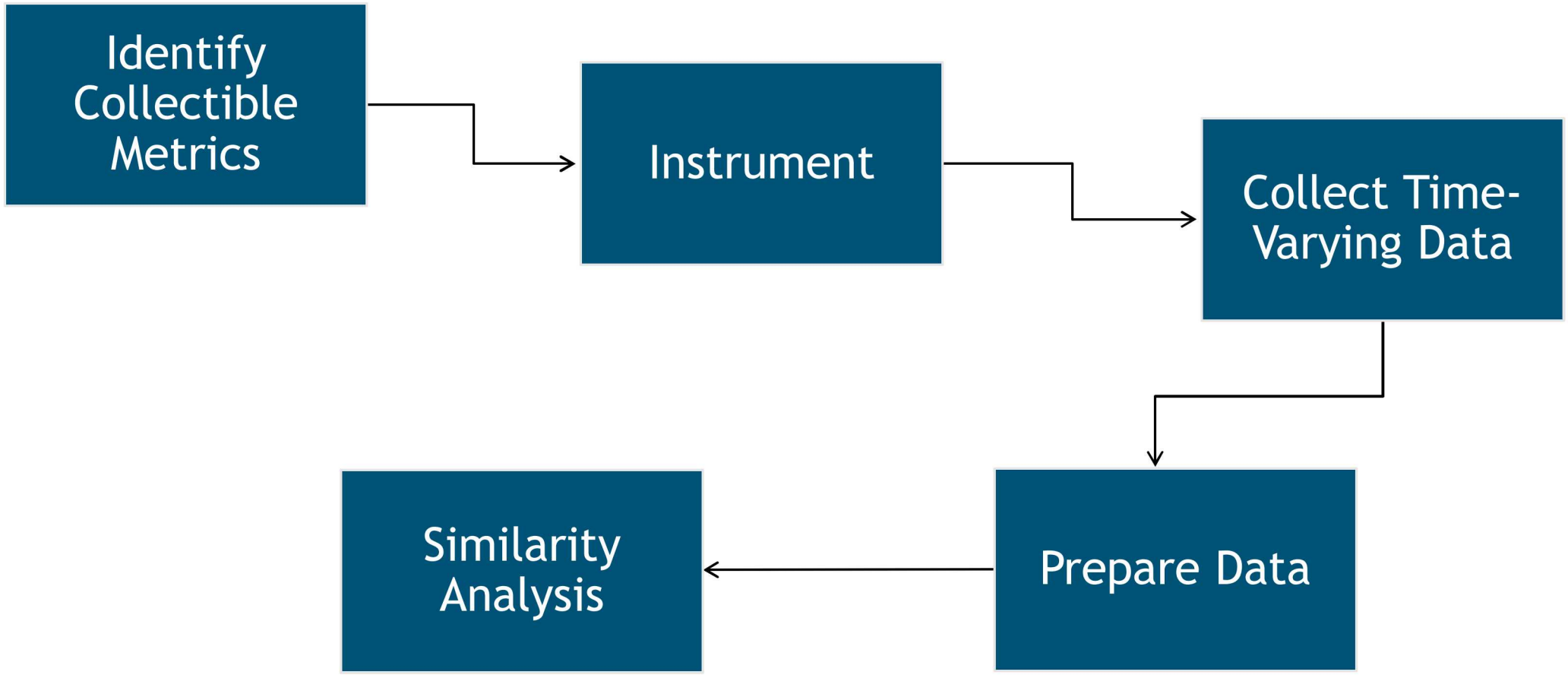
Goal is to evaluate if proxy exercises the communication similar to the parent

Measurements of target time-varying dynamic behavior

Currently: assume that parent and proxy configurations are similar

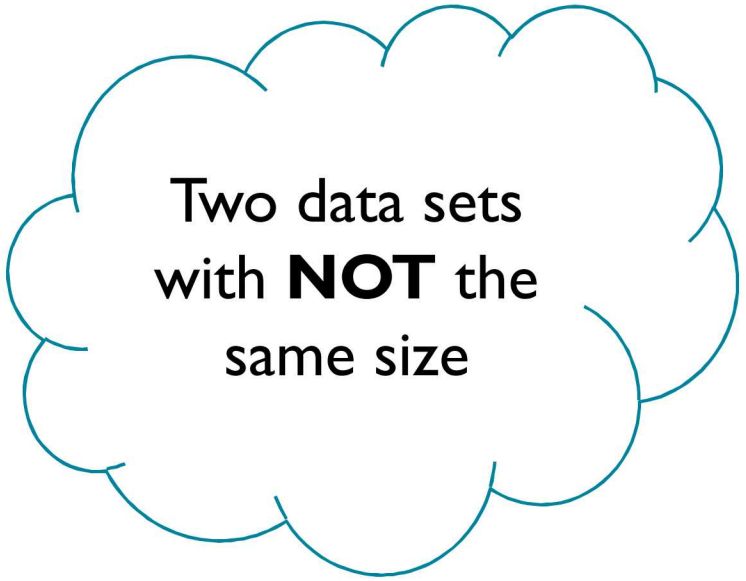
- Build configuration
- Run configuration

Methodology Flow



Pairwise Communication Data

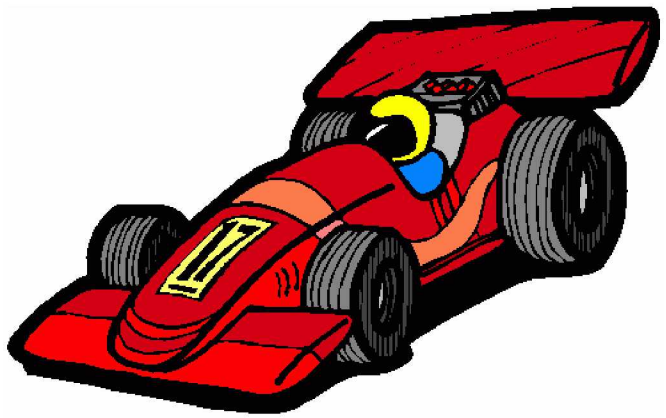
How to compare the Parent/Proxy patterns?



Parent		
Src	Dst	#Msg
0	1	35046
68	64	86
68	67	62
68	69	5887
68	70	24
68	71	29090
68	75	34984
68	91	5916

Proxy		
Src	Dst	#Msg
0	1	152120
0	10	153422
0	100	1302
68	64	13020
68	65	13020
68	67	153422
68	69	1302

Full View



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Src	Dst	#Msg
0	1	35046
0	10	0
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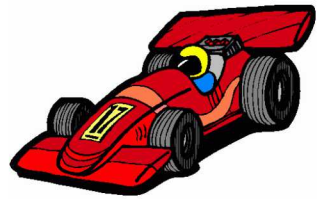
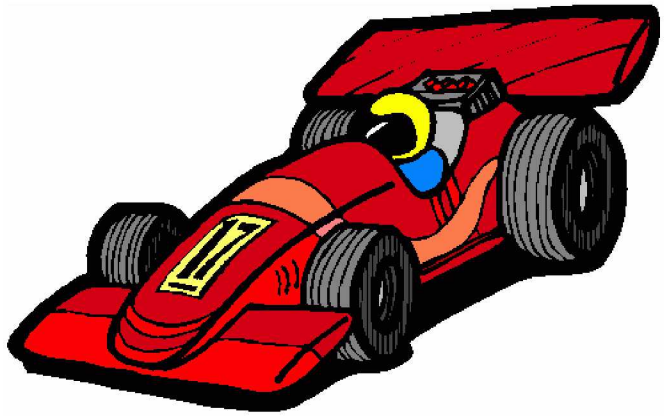


Parent View



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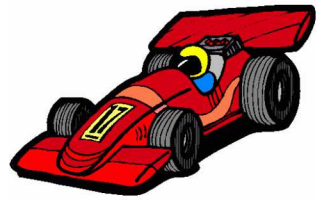
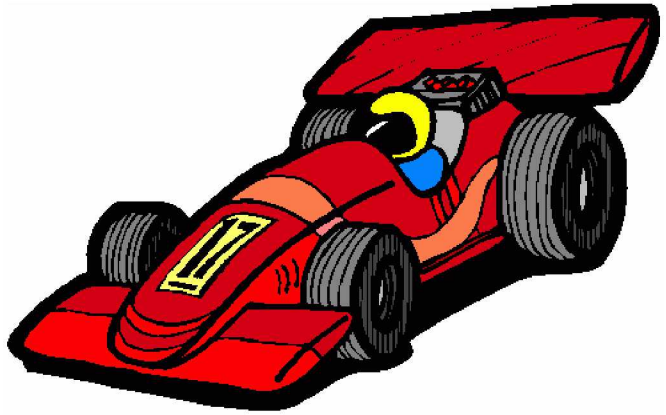


Proxy View



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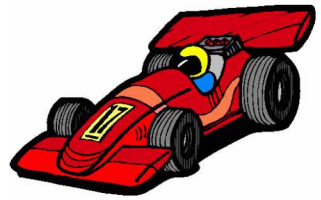
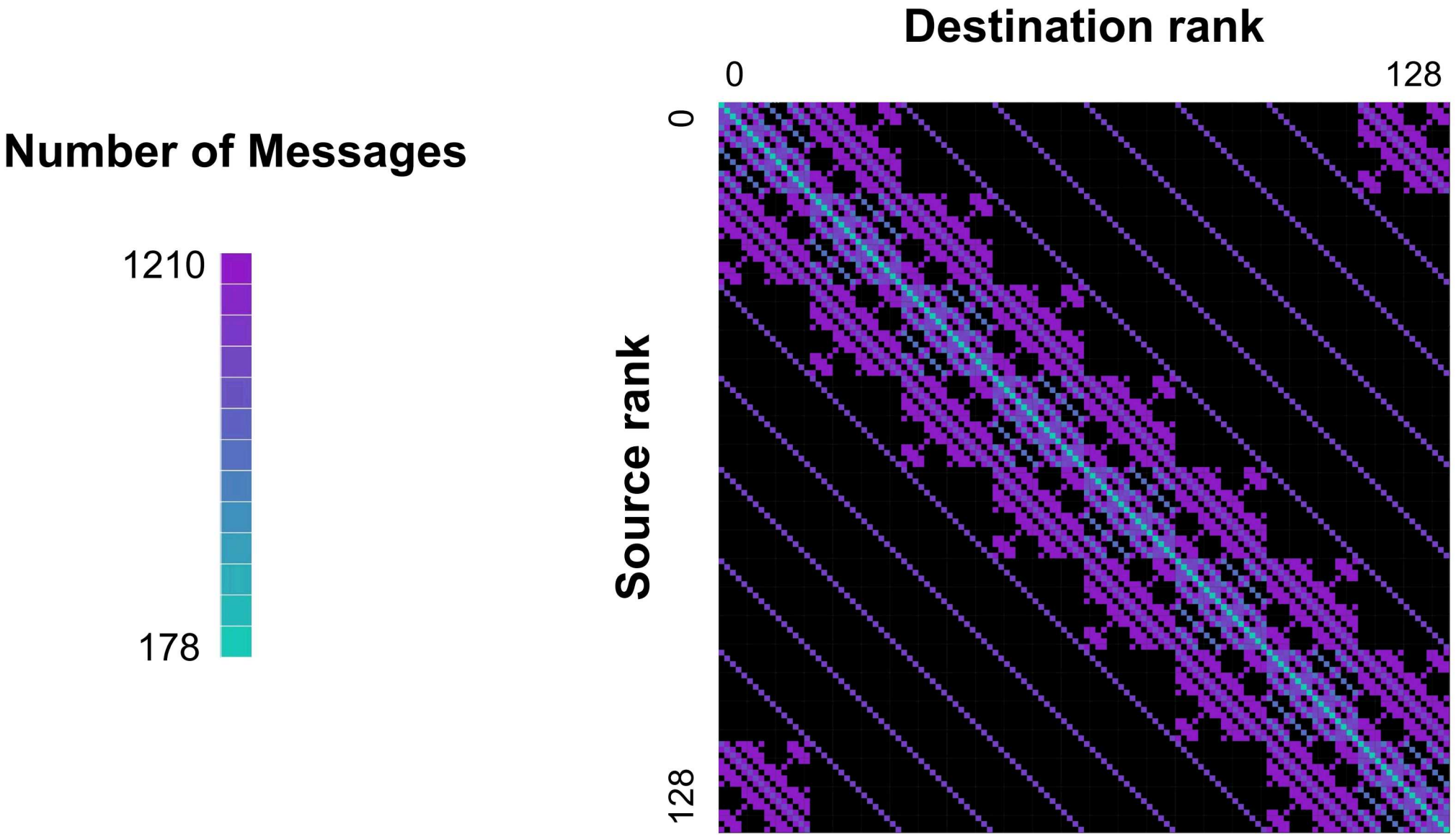


Communication Pairs



Parent/Proxy Pairs

List of the Proxy and real applications used in this work:

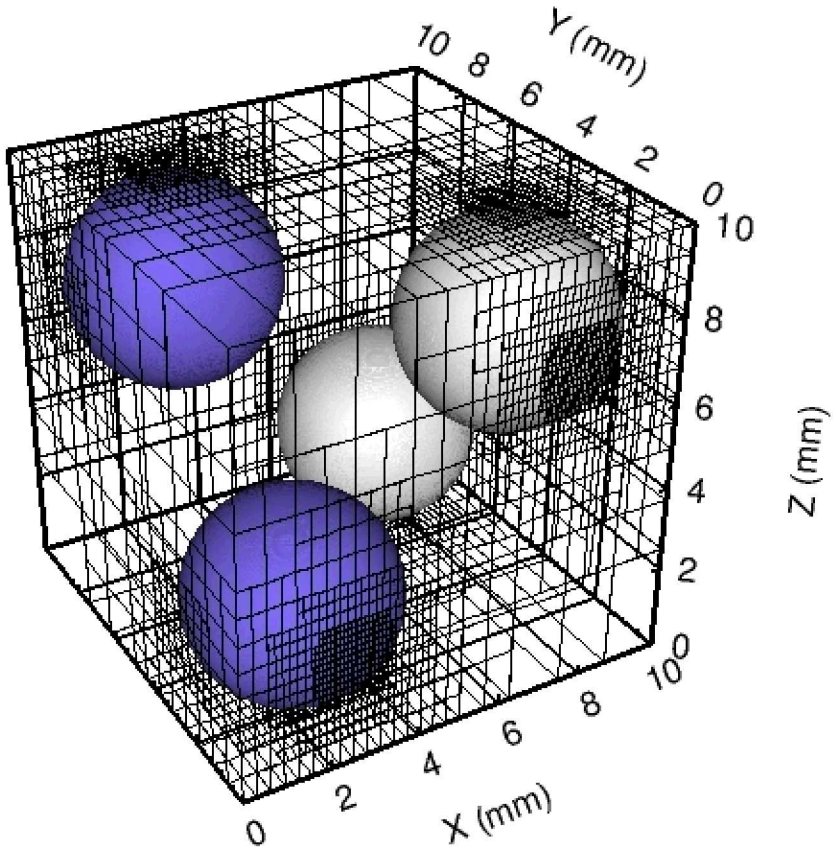
Proxy	Version	Parent	Version	
miniAMR	1.4.4	CTH	12.0	Shock Hydrodynamics
NEW miniAMR**Z**	TBD!	CTH	12.0	Shock Hydrodynamics
SWFFT	1.0	HACC	1.0	Cosmology/FFT
ExaMiniMD	1.0	LAMMPS	17 Aug 2017	Molecular dynamics

miniAMR vs miniAMRZ

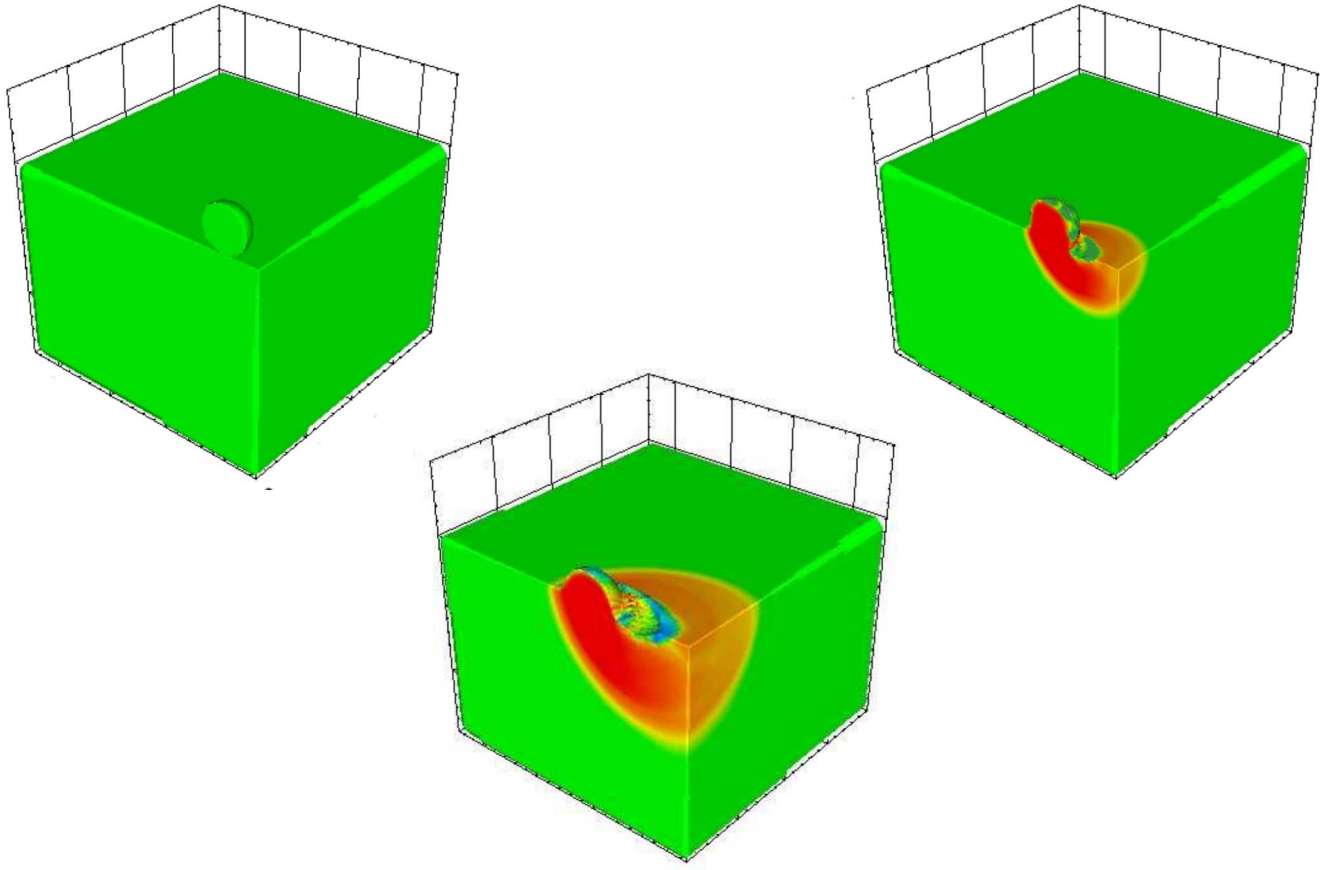
Need Courtenay help!

CTH/miniAMR(Z) problems

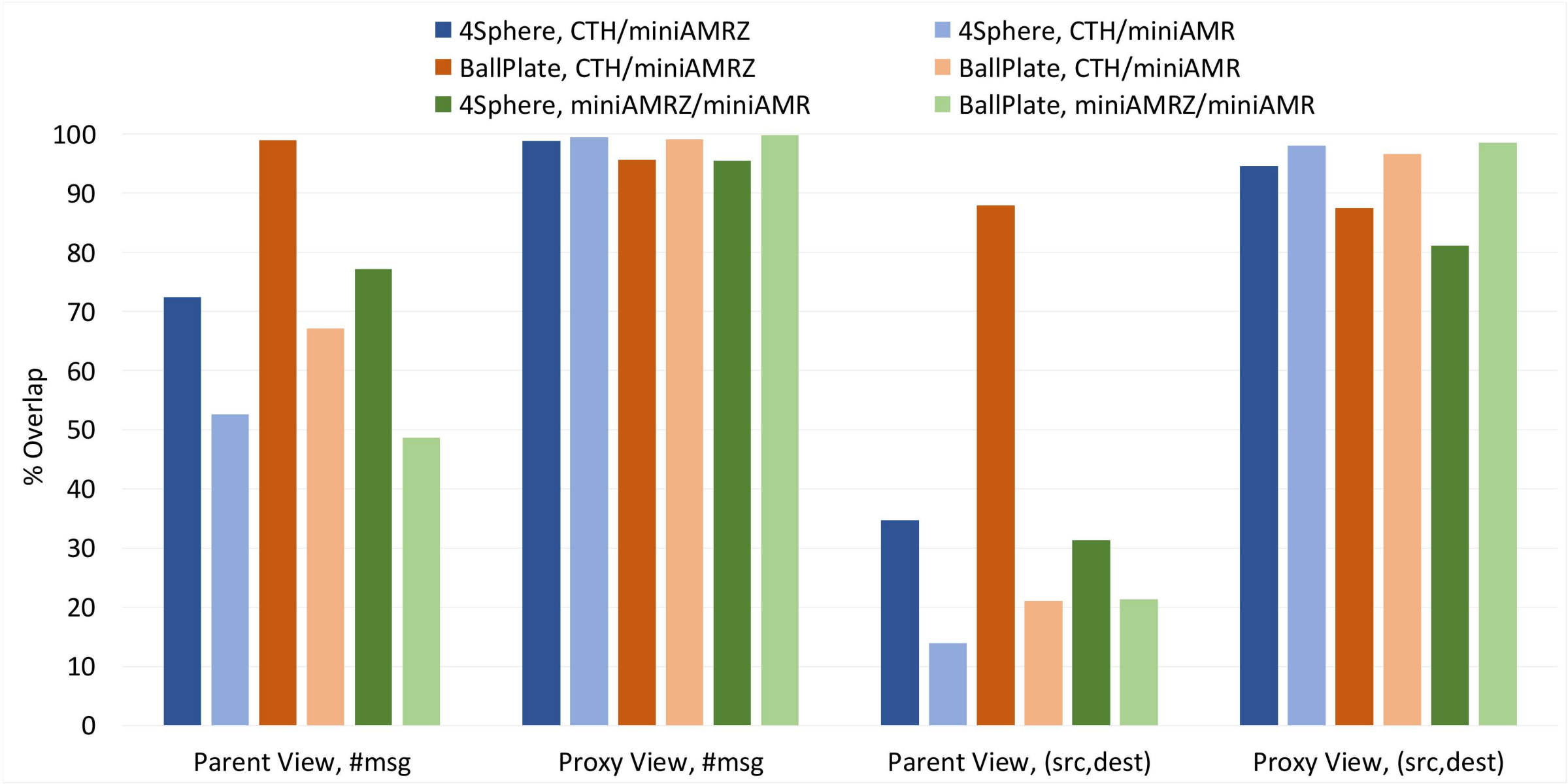
4 Sphere Problem



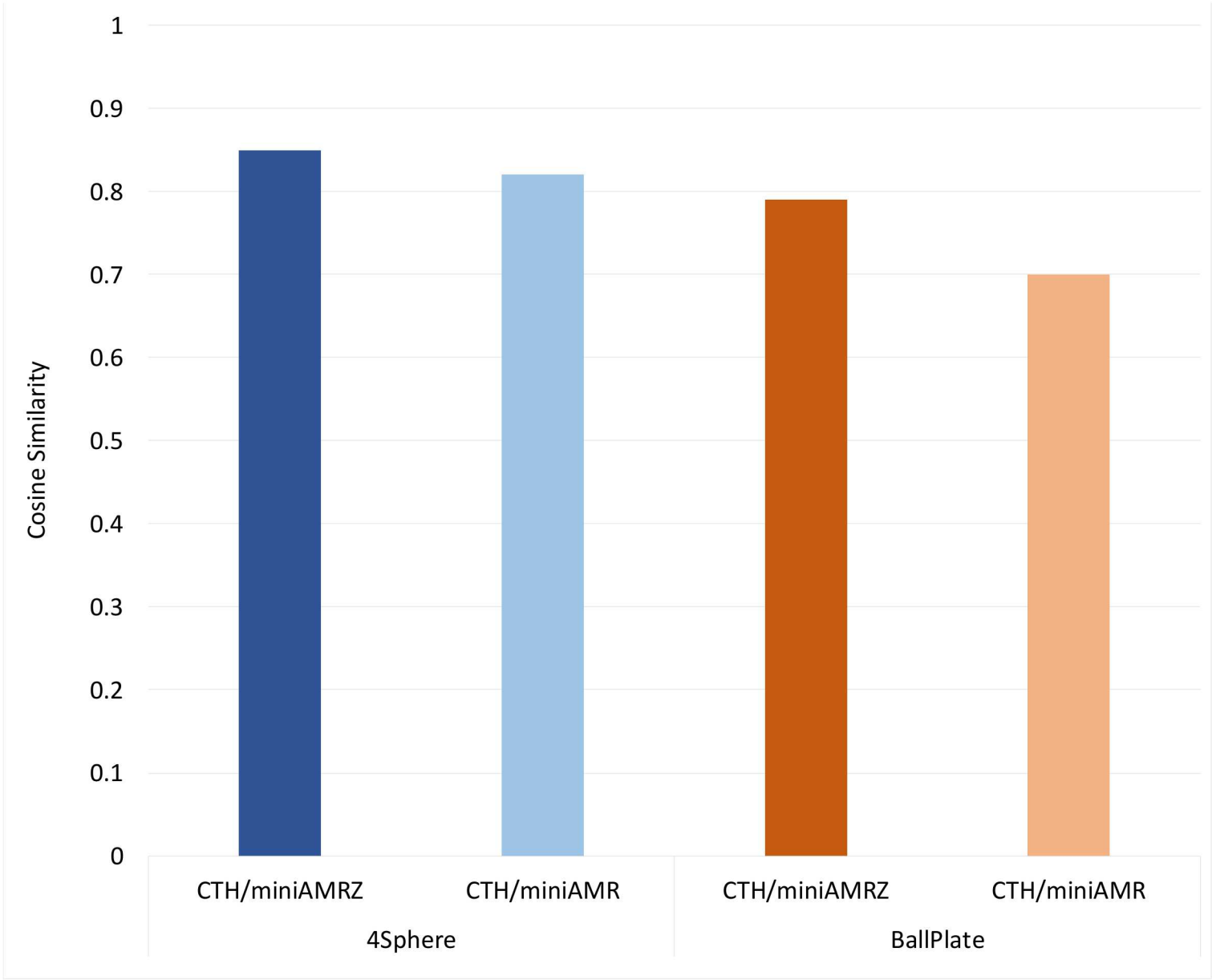
Ball & Plate Problem



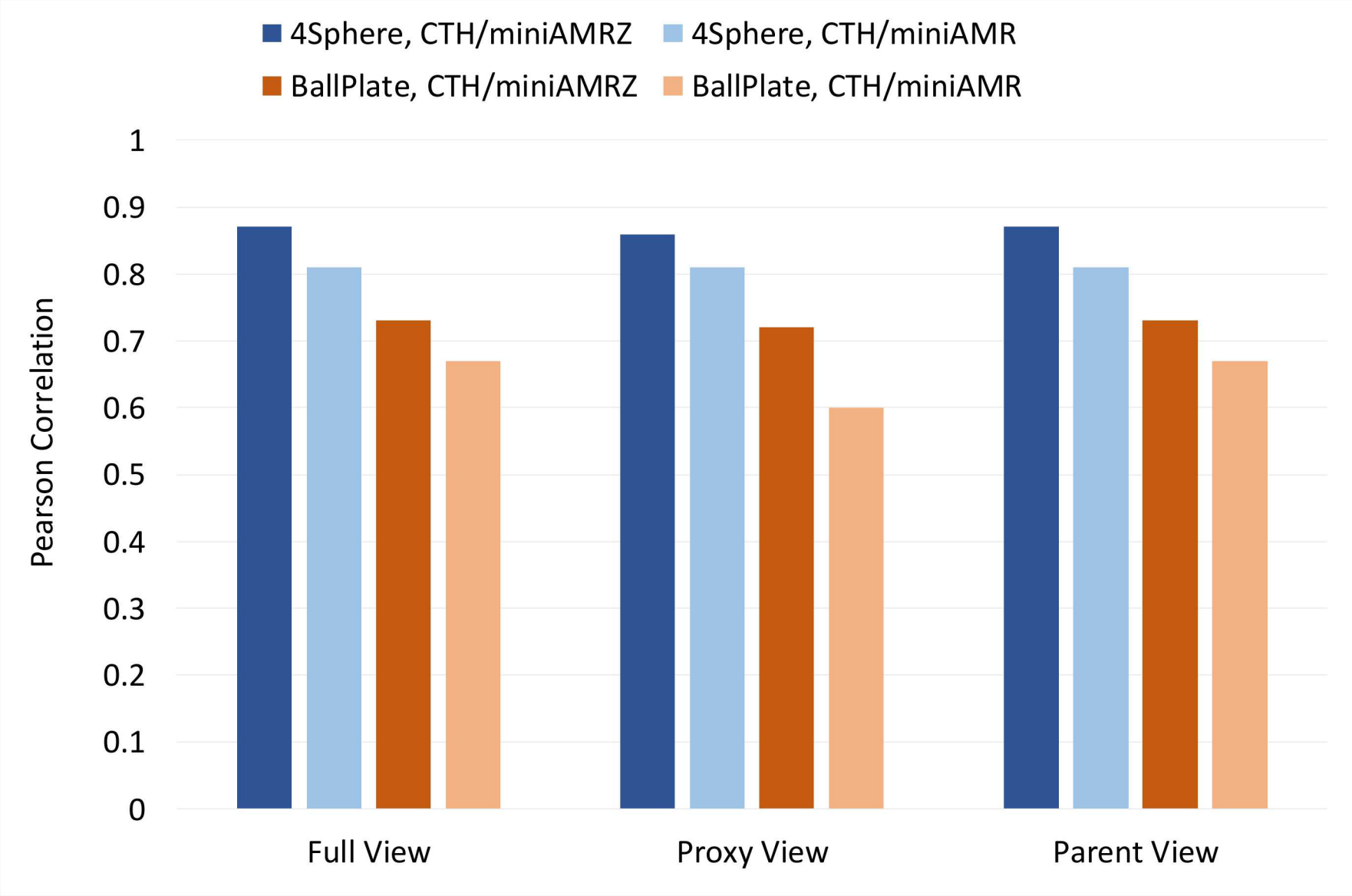
Result: Communication overlap relations



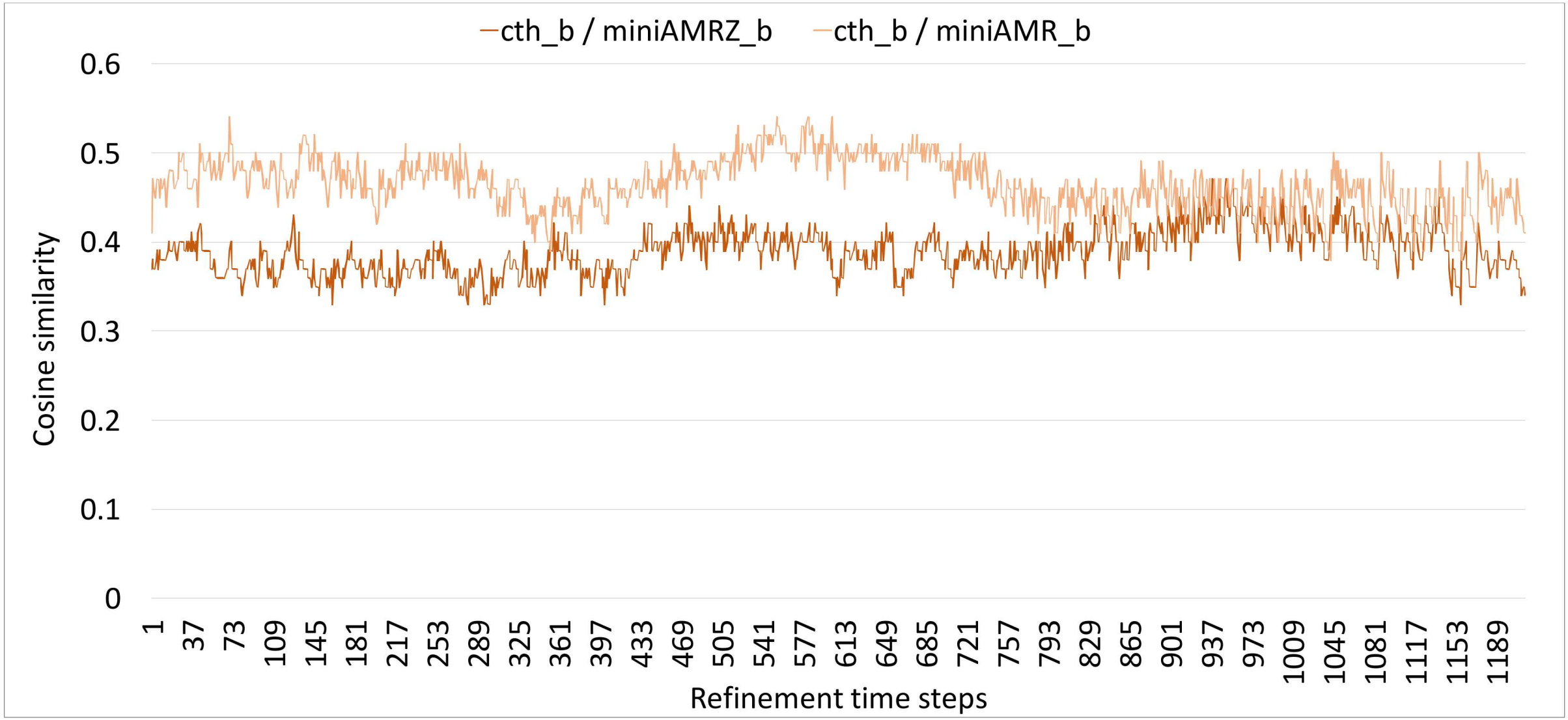
Result: Cosine Similarity



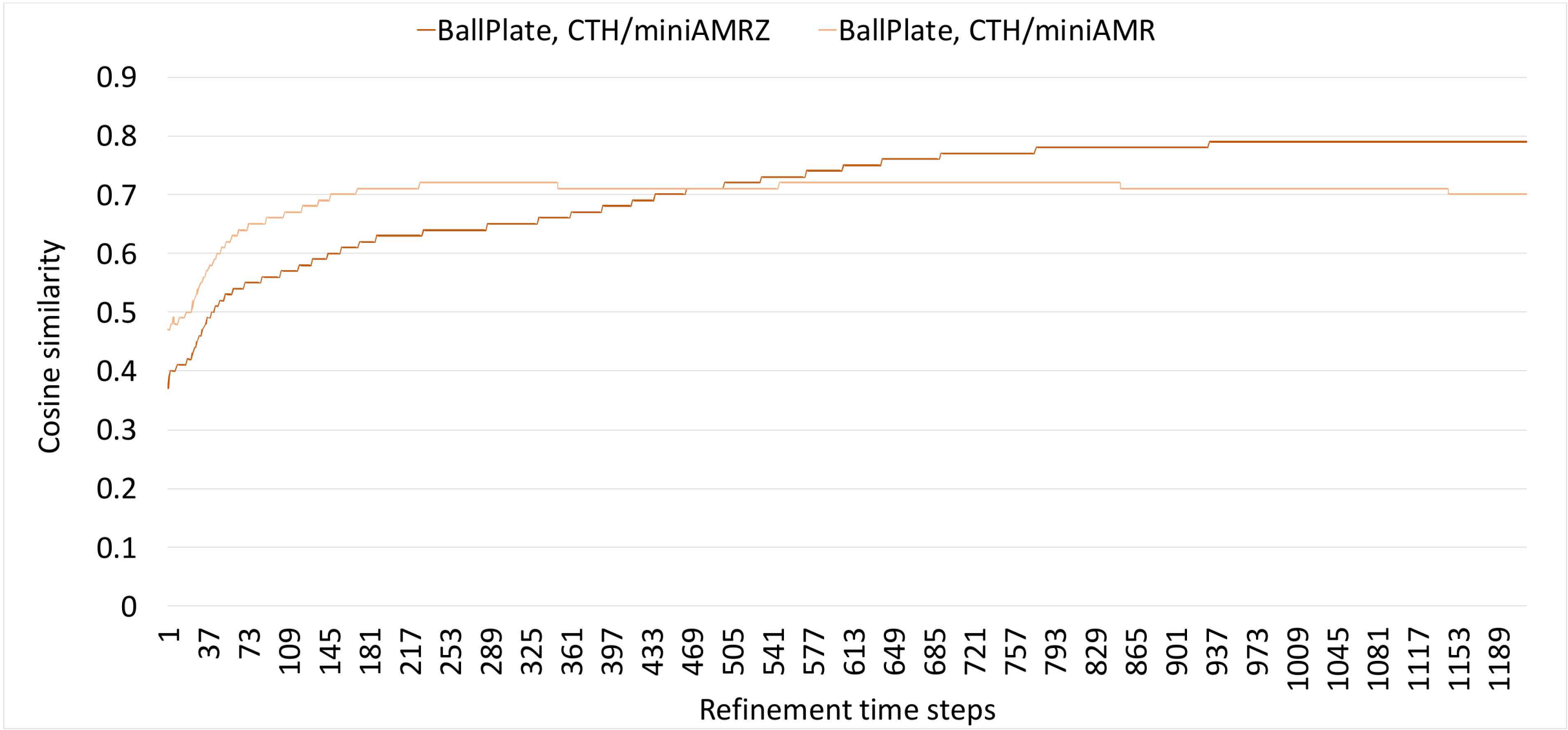
Result: Pearson Correlation



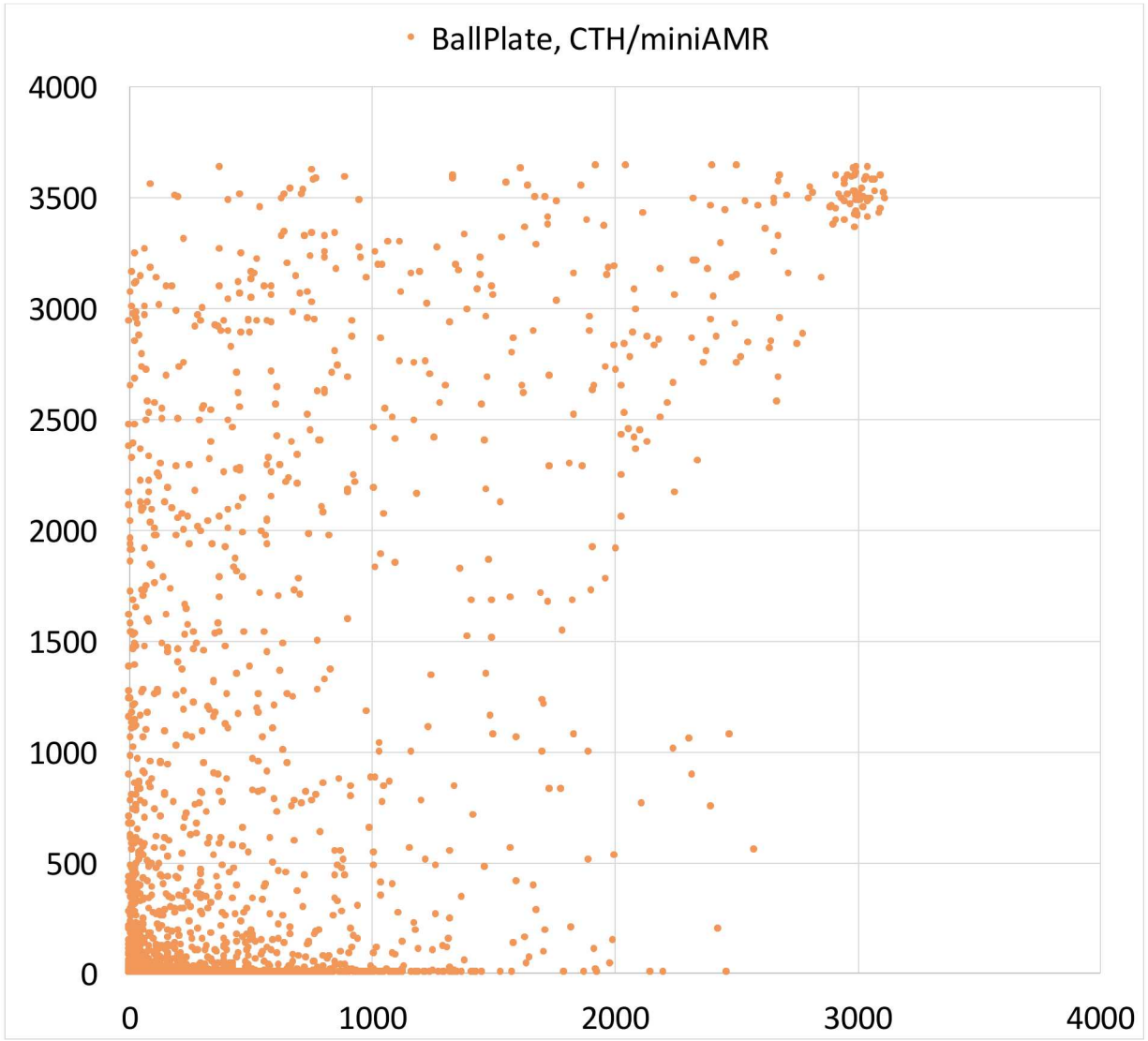
Similarity Metrics over Detailed Time Series Data, Ball & Plate

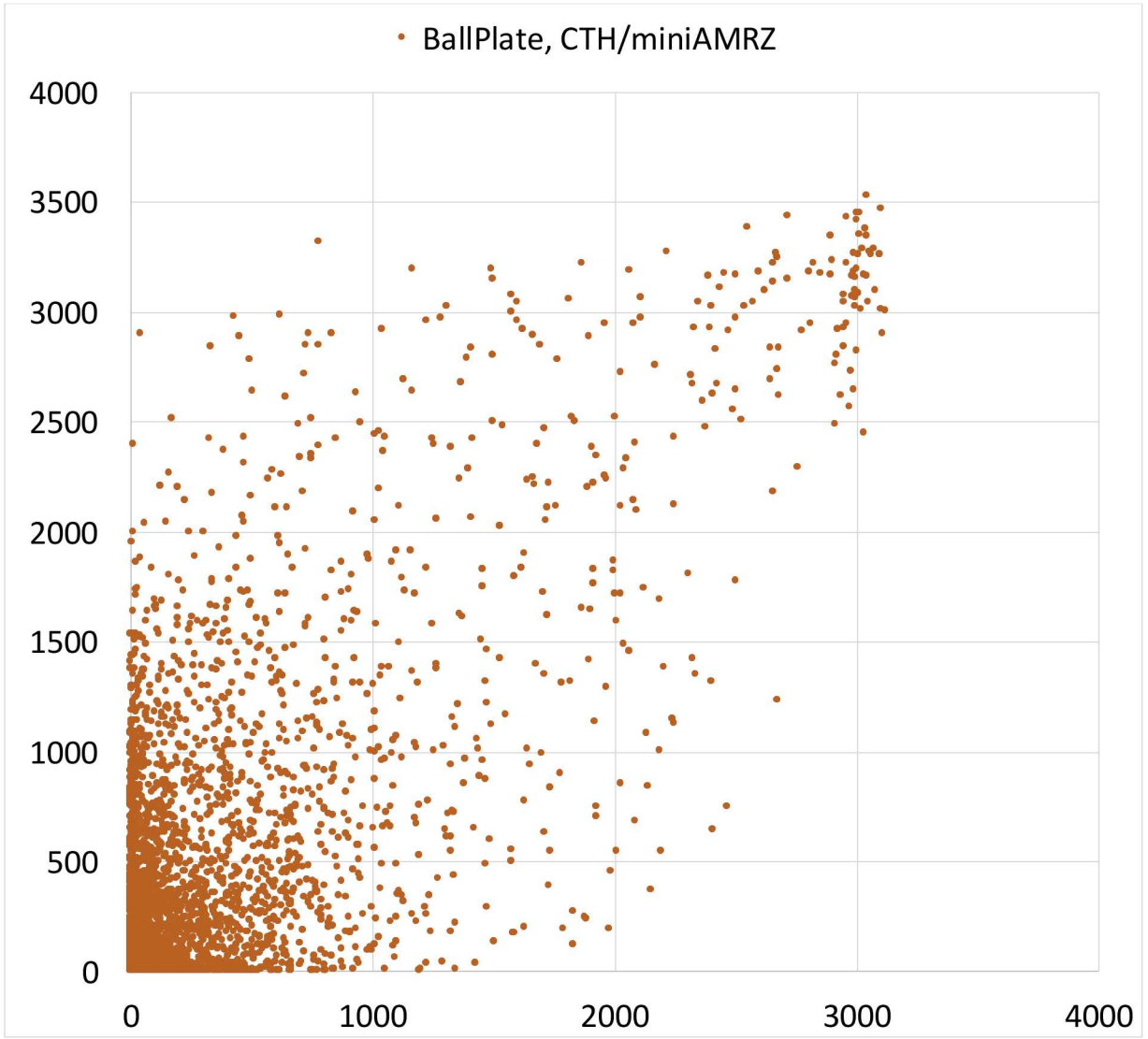


Cumulative Stepwise Cosine Similarity, Ball & Plate

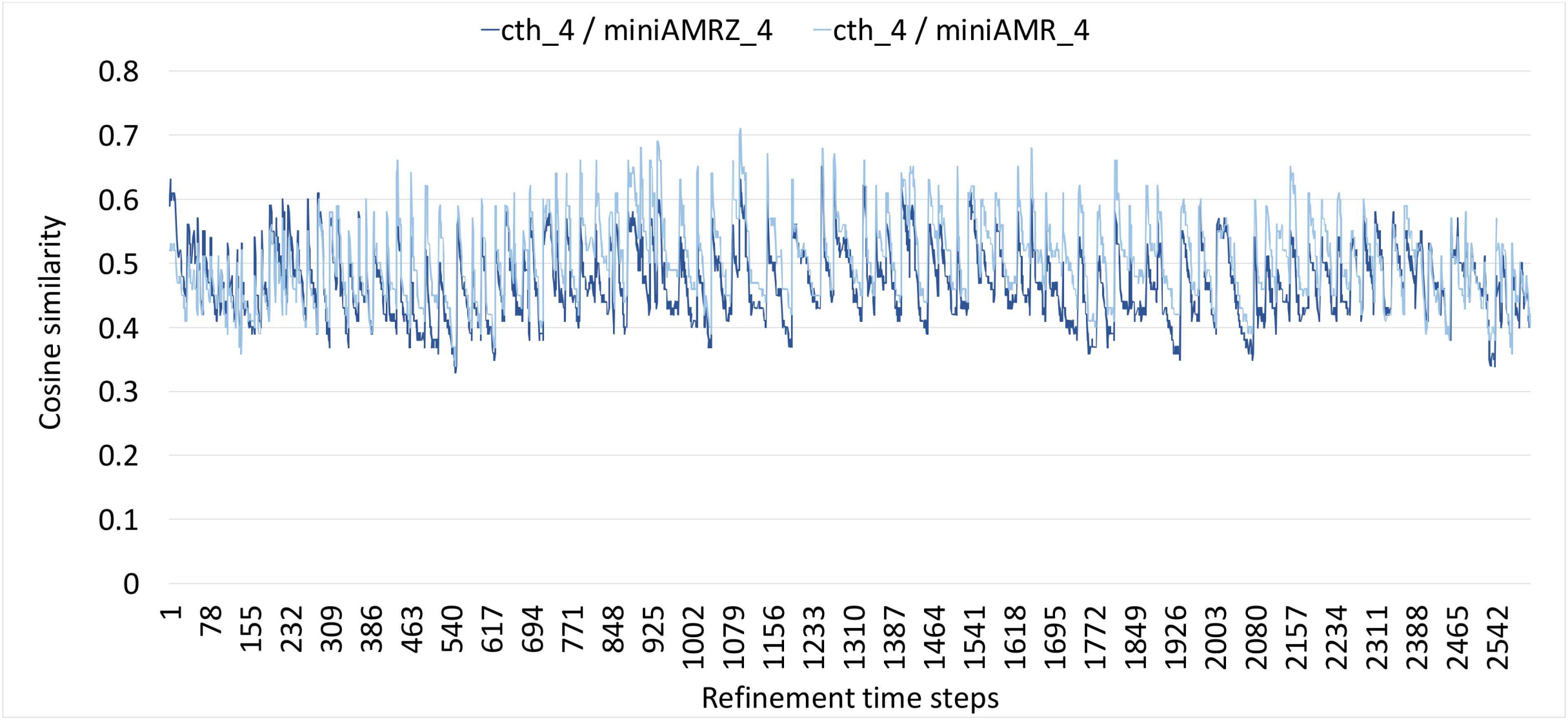


Messages Scatterplots, Ball & Plate

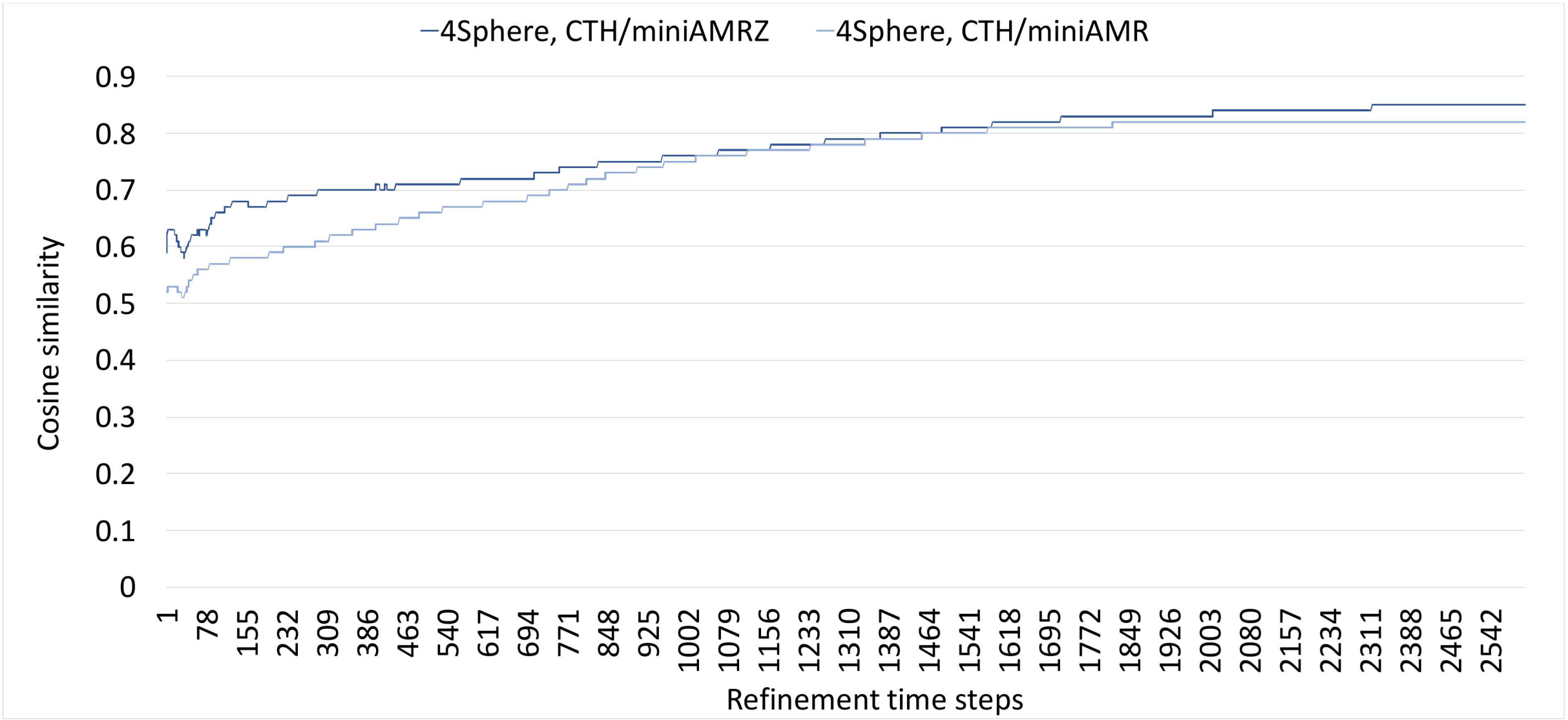




Similarity Metrics over Detailed Time Series Data, 4Sphere



Cumulative Stepwise Cosine Similarity, 4Sphere



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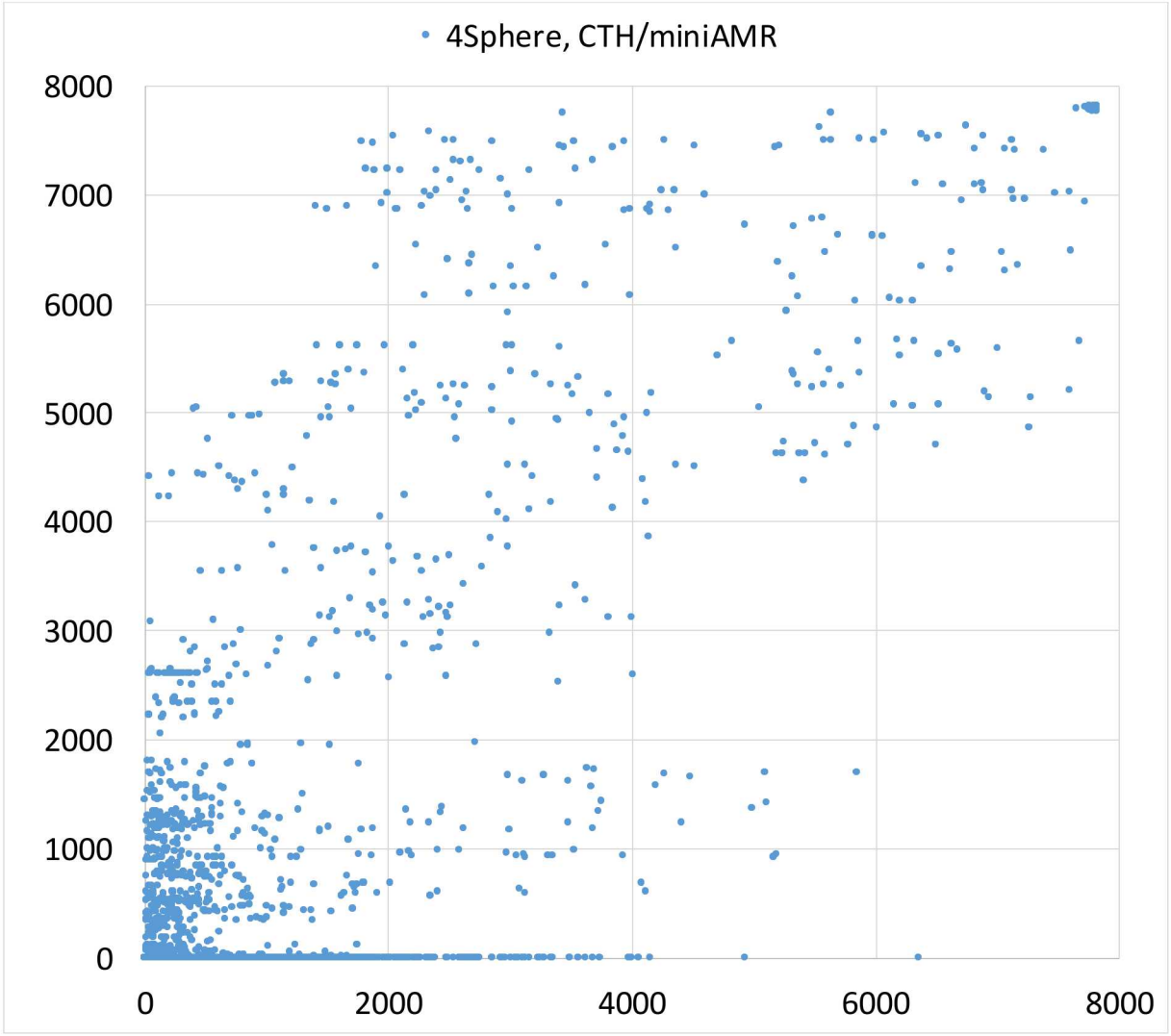

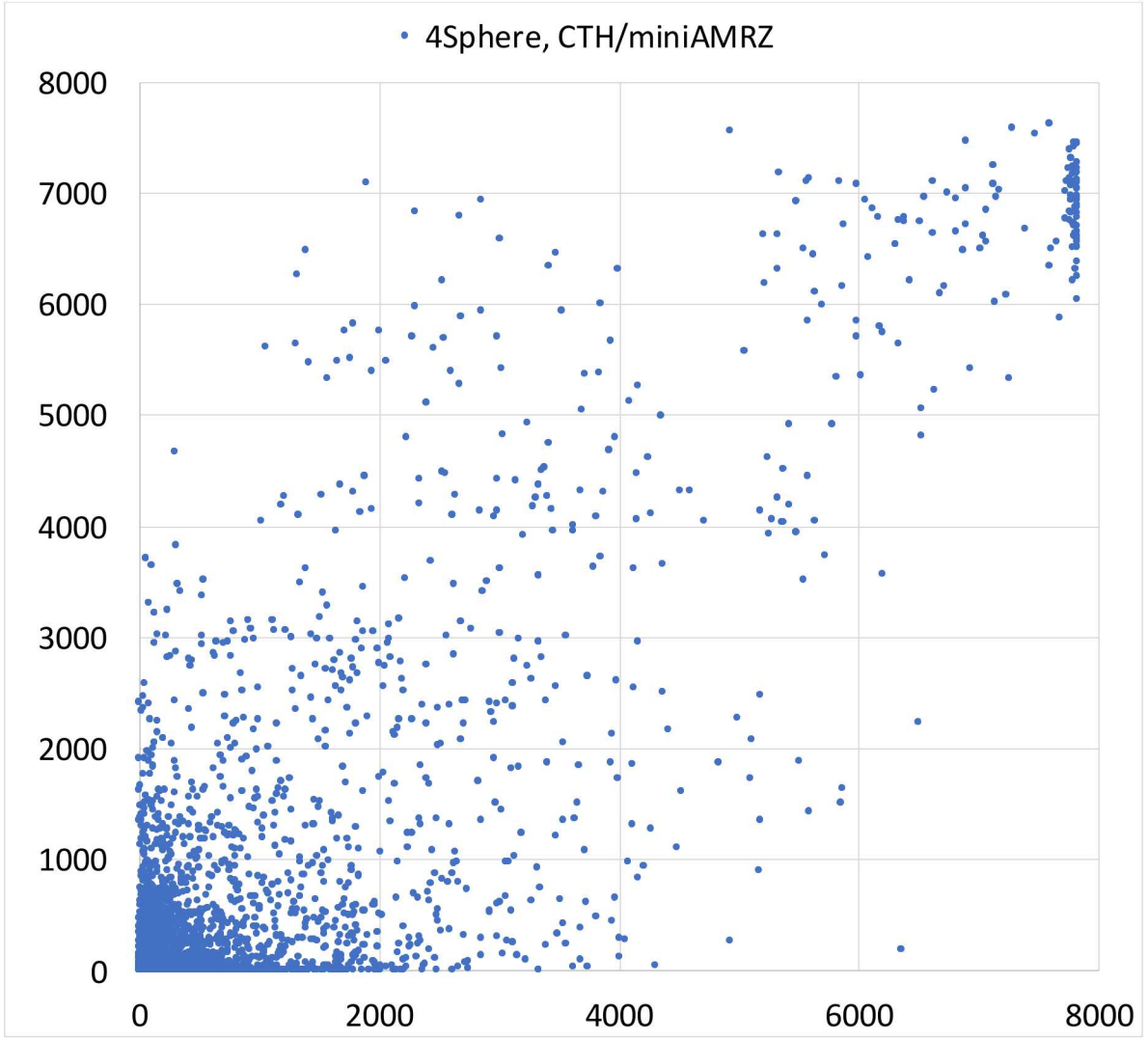

Conclusion

Explored how the communication of a proxy application relates to its parent application

Improved version of miniAMR – with Z!

Presented a time-varying quantification methods:

- A time-varying pairwise communication quantification method that captures how much of one application matches the other
- How we should look at data cumulative vs time-varying

Future Work

Examine alternative methods

Incorporate the work on the communication patterns by exploring pairs with communication implementation

Explore more parent/proxy pairs

Acknowledgment

This research was supported by the **Exascale Computing Project (ECP)**, Project Number 17-SC-20-SC, a collaborative effort of two DOE organizations, the Office of Science and the National Nuclear Security Administration, responsible for the planning and preparation of a capable exascale ecosystem including software, applications, hardware, advanced system engineering, and early testbed platforms, to support the nation's exascale computing imperative.

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Questions ?

What's new?

- Dynamic profiling
- Roofline modeling
- Qualitative comparison of quantitative metrics
- Intel’s Top-Down Microarchitecture Analysis (TMA)