Transient Thermal Simulator Using Machine Learning

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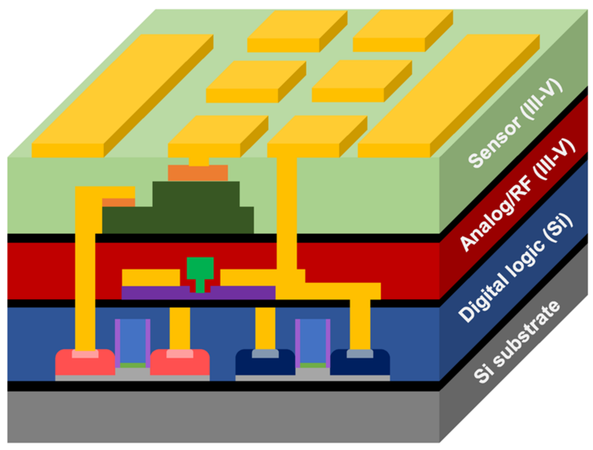
Introduction

Background:

- Increased temperature degrades performance of modern 3D chip



- PArallel Compact Thermal Simulator (PACT) developed by PEACLab can make accurate predictions based on numerical solvers [1]

Problems:

- Numerical solvers are time-consuming
- Neural Network solvers require ample training data

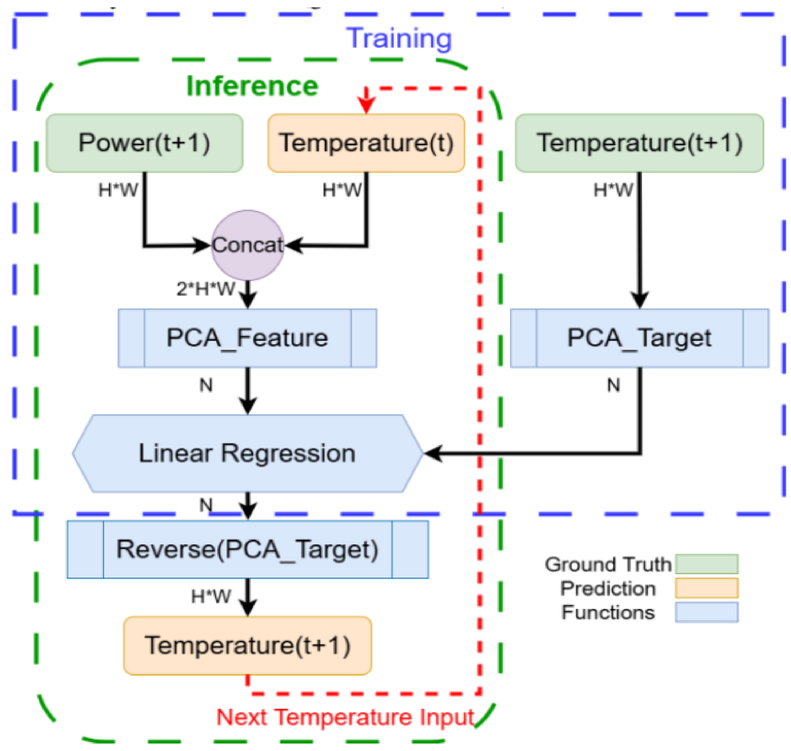
Methods

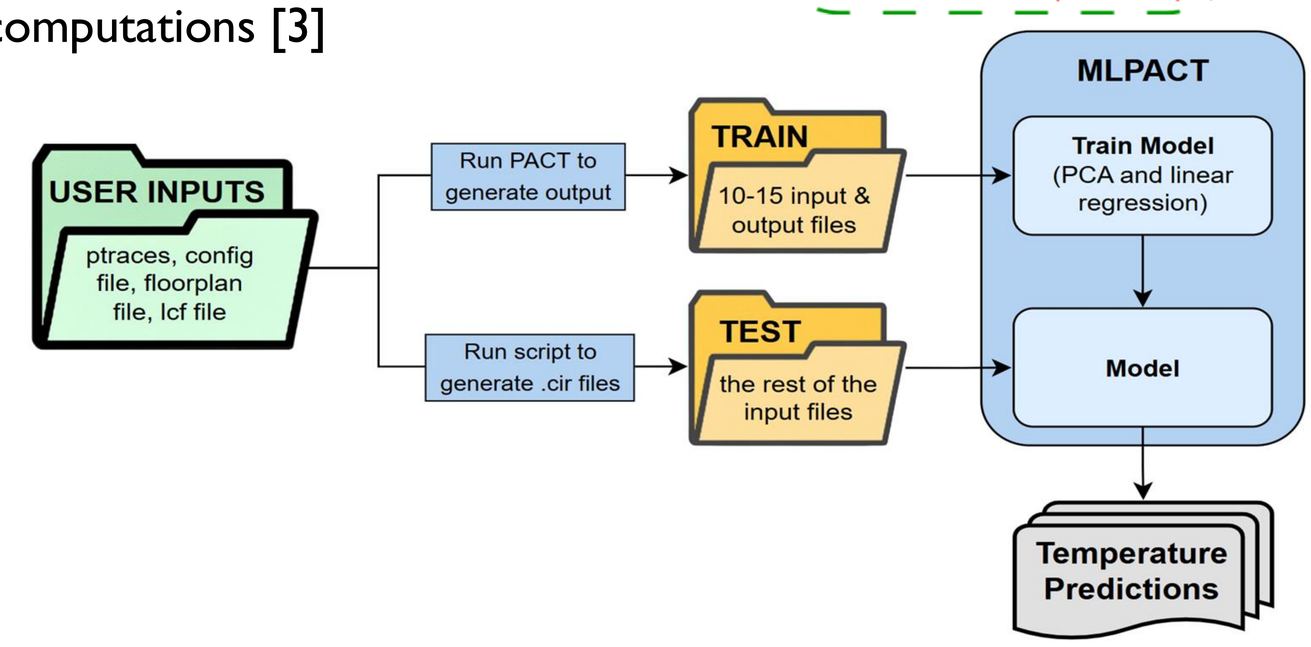
Dimensionality Reduction:

- Use principal component analysis (PCA) to compress high-dimensional thermal data into lower-dimensional components [2]

Fast Predictive Model:

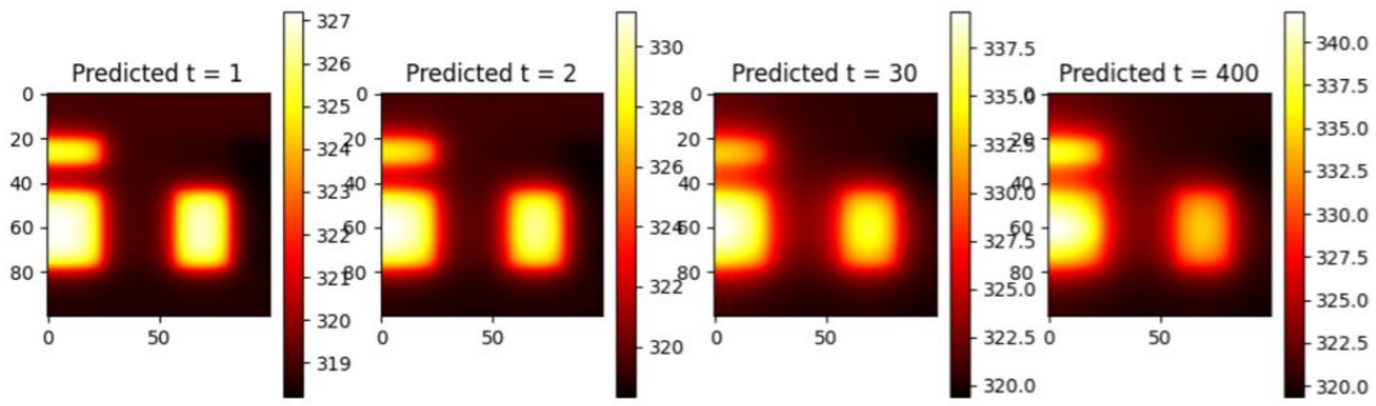
- Employ machine learning (ML) in PACT for faster and more accurate predictions of thermal distributions
- Utilize closed-form linear regression models for speedy computations [3]

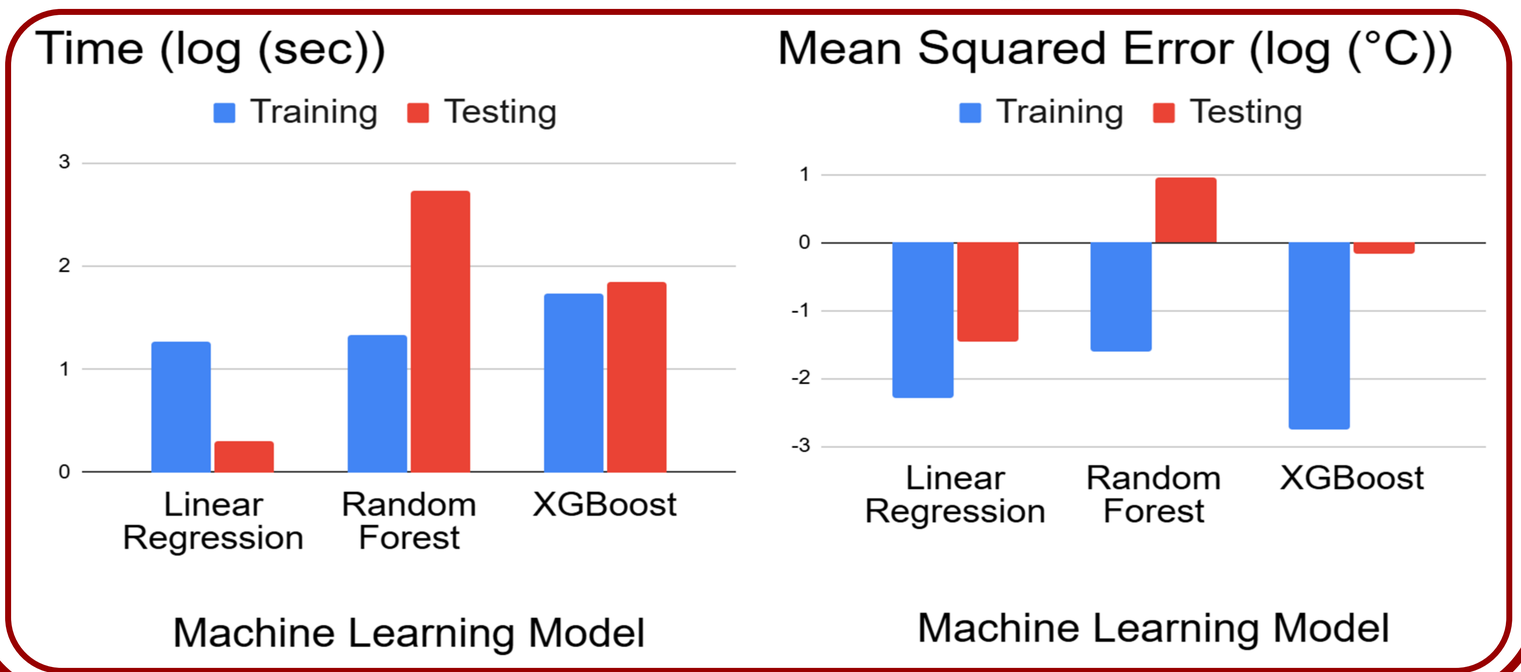




Results

- Linear regression achieves best performance in terms of **least computing time (<1 min)** and **least mean square error (<0.1 °C)**





Conclusion

Summary:

- MLPACT is turned into a pipeline with flexible parameterization and predictive model selection, requiring only 10–15 training samples

Future Work:

- Test on other chip architectures
- Systematically compare performance with other predictive models

References

http://bit.ly/4lZwOa7

Acknowledgements

I would like to thank Amin Khodaverdian and Professor Coskun providing me mentorship and guidance throughout this internship. I would also like to thank the rest of PEACLab for providing me with help along the way. Lastly, I would like to thank the RISE program and Boston University for giving me the opportunity to be here!