



## Overview

At the Synergy Lab, we conduct basic and applied research that explores a breadth of complementary intellectual activities that synergistically span all aspects of parallel and distributed computing – from systems software & middleware to tools & applications – in order to accelerate discovery and innovation.



## Highlights

### Microsoft Commercial, Featuring Wu Feng

Spring 2015, the commercial highlights Feng's collaboration with medical researchers at VT and other research centers with such programs as Computing in the Cloud.

### Best Paper Award at ACM/SPEC ICPE 2013

Subramaniam and Feng receive the *Best Paper Award* for their paper on energy-proportional computing at the *4th ACM/SPEC Int'l Conference on Performance Engineering*, 2013.

### The Green Computing Book

Feng publishes *The Green Computing Book*. This book discusses approaches to advance the state of the art in large-scale green computing.



### Best Poster Award at ACM CODASPY 2015

Zhang and Feng, in collaboration with Shu and Yao, receive the Best Poster Award for "Rapid Screening of Transformed Data Leaks with Efficient Algorithms and Parallel Computing" at the *5th ACM Conference on Data and Application Security and Privacy* in March 2015.

### Paper Selected Among Best in 20 Years of ACM HPDC IEEE/ACM HPDC (1992 – 2012)

Lin, Ma, Archuleta, Feng, Gardner, Zhang, "MOON: MapReduce On Opportunistic eNvironments," *19th ACM Int'l Symposium on High-Performance Distributed Computing*, 2012.

### Green500 Pioneer to Accelerate Mini-Drone Project

The Synergy Lab, along with collaborators at VT and NCSU, use GPUs to accelerate the CFD simulation of micro-air vehicles.

## Research Areas

### Systems



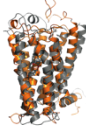
Systems software and tools; adaptive run-time systems, parallel computing, monitoring and measurement, emerging platforms in all forms and scales.

### Networking



Architecture, performance measurement and evaluation, modeling, protocols, routing & fundamentals and network security.

### Renaissance



Accelerating BIG DATA apps, rational drug design, large-scale genomic search, facilitating CS education, human computer interaction and for cancer research.



### Green Computing



Power modeling and prediction, hardware and software controlled power management and benchmarking on platforms ranging from mobile processors and DSPs to supercomputers.



### Research Publications

Visit the Pubs of the Synergy Lab <http://synergy.cs.vt.edu/publications.php>



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 WWTF NPR: <http://bit.ly/ZyXuTD>  
 Microsoft Commercial: <https://youtu.be/7Zw8gKJXgI4>



## Those who fund our research





SEEC, established July 2014, is an interdisciplinary and integrative center that spans 20 different departments and institutes across Virginia Tech. The vision of the center is to democratize parallel and distributed computing via the synergistic co-design of hardware, software, and algorithms to massively accelerate discovery and innovation.



The center "SEECs" to combine the strengths of research, education, and infrastructure at Virginia Tech, along with social, business, and research opportunities in society to leverage the power of computers for the good of mankind.

Look for future postings to see how using a synergistic co-design approach can accelerate applications in diverse areas such as cyber security, data mining, molecular dynamics, computational fluid dynamics, robotics, next-generation DNA sequencing, and neuroinformatics.

### Green500

The Green500 provides rankings of the most energy-efficient supercomputers in the world. We raise awareness about power consumption, promote alternative total cost of ownership performance metrics, and ensure that supercomputers only simulate climate change and not create it.



### PPP: Parallel Programming with Pictures

The PPP program teaches parallel programming concepts in a blocks-based language that caters to K-12 students, undergraduate students, or workforce professionals to re-train via easily understood abstractions.

The project extends a picture-based programming environments, i.e., Snap!, with blocks providing parallel execution functionality. A further goal is to generate appropriate back-end code for parallel execution on a wide range of platforms, e.g., from laptops to ORNL's Tiny Titan or even to the Titan supercomputer at ORNL.

### Heterogeneous Parallel Computing, e.g., CPUs+GPUs in HokieSpeed

Recent trends have exposed the CPU as a "jack of all (computing) trades, master of none." To address this, heterogeneous computing systems with multiple types of brains have emerged to herald a new age in supercomputing. Building on our expertise, we address a myriad of aspects in accelerator-based parallel computing from systems software to middleware and libraries to applications. (Much of this work grew out from the NSF Center for High-Performance Reconfigurable Computing or CHREC.)



### Contact Information

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### BIG DATA Analytics

Data is being generated at a rate that outstrips our ability to compute on that data. For example, DNA sequencers generate *10-fold* more data every 18 months while our compute capability only *doubles* every 18 months. This research aims to co-design across multiple layers (hardware, architecture, algorithms, and software) to bridge the above gap across disciplines.

### Cloud Computing

With the simultaneous need for high-performance computing (HPC) and its associated expense, cloud computing offers an alternative means to access HPC, one without its exorbitant cost but at the expense of less control and arguably less performance. This work seeks to create a new generation of scalable analysis & management software for "client+cloud" environments to deliver HPC for BIG DATA and scientific computing.

### Networking

Our aim is to develop models, architectures and protocols for next-generation networks. We have focused on performance evaluations of existing systems. In doing so we have implemented optimized systems and protocols as proof of concepts.



The NSF Center for High-Performance Reconfigurable Computing consists of more than 30 institutions from academia, industry, and government with synergistic interests and goals in reconfigurable and adaptive computing for a broad range of missions – from satellites to supercomputers. The Synergy Lab is one of the two labs that lead CHREC activities at the Virginia Tech site.

### Faculty & Staff



W. Feng



M. Gardner



H. Wang



H. Trease

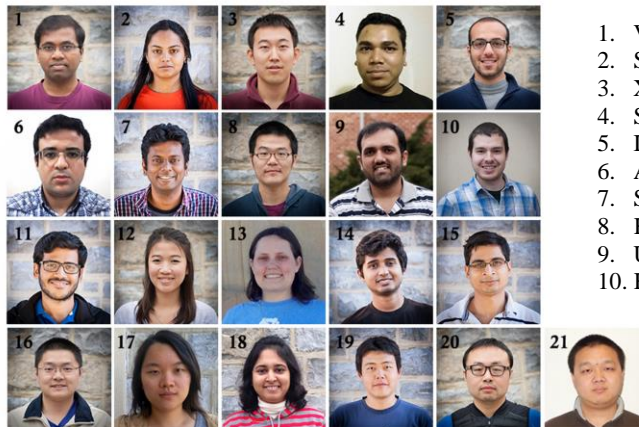


P. Sathre



M. Thomas

### Students



### Those who bring synergy to lab

- |                  |              |
|------------------|--------------|
| 1. Vignesh       | 11. Arnab    |
| 2. Sangeetha     | 12. Sarunya  |
| 3. Xuewen        | 13. Katy     |
| 4. Sajal         | 14. Varun    |
| 5. Islam         | 15. Anshuman |
| 6. Ahmed         | 16. Jing     |
| 7. Saravanan     | 17. Wenjie   |
| 8. Kaixi         | 18. Sharmi   |
| 9. Umar          | 19. Run      |
| 10. Konstantinos | 20. Xiaodong |
|                  | 21. Da       |