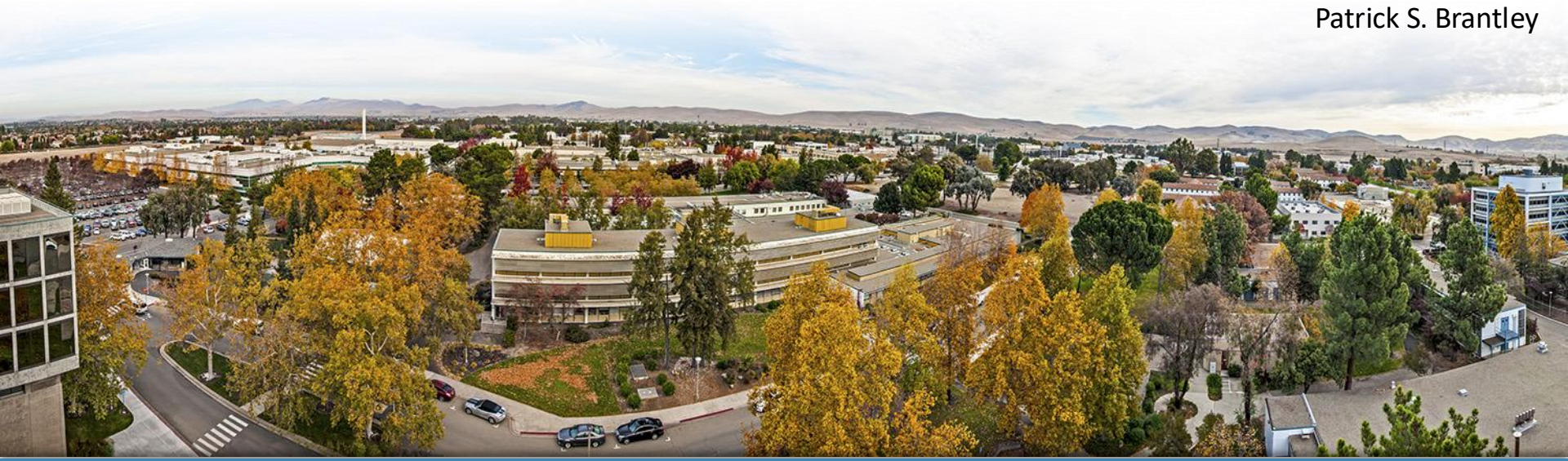
Introduction and Monte Carlo Transport Project Software Engineering Practices

University of Michigan Software Engineering Class Lecture

Patrick S. Brantley



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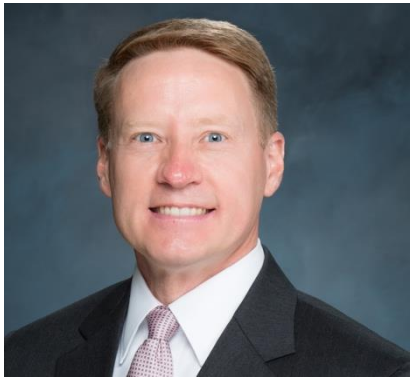
Lawrence Livermore National Laboratory

Patrick Brantley

- University of Tennessee B.S. in Nuclear Engineering
- University of Michigan NERS Ph.D. in Nuclear Engineering and Scientific Computing
  - Worked with Prof. Ed Larsen on “Spatial and Angular Moment Analysis of Continuous and Discretized Particle Transport Problems”
- Started working at LLNL in 1998
  - I’ve been doing Computational Transport/Physics at LLNL for almost 27 years, and I still love it!
- American Nuclear Society Mathematics and Computation Division
  - Chair 2016 – 2017
  - Technical Program Chair 2010 – 2012



I currently lead the Monte Carlo Transport Project

- Software Engineering:
  - Approx. 370k lines of C++ code with embedded Python interpreter
  - Parallelism: MPI, OpenMP, Cuda, HIP
  - Git version control, repositories hosted on GitLab, branch development with merge request reviews, pre-merge testing, automated nightly testing on multiple platforms with multiple configurations including use of sanitizer tools
  - Requirements gathering via ongoing customer interactions and annual program planning
  - Regular production releases and nightly development releases

- Staffing: 6 nuclear engineers/computational physicists and 5 computer scientists
  - LLNL software projects are typically multidisciplinary with computer scientists as an integral component
  - Computer scientists contribute to novel algorithm development including for GPU supercomputers, advance software engineering practices for multiple computing platforms, understand and improve code parallel scaling and performance, support code releases and process, etc.
  - Some computer scientists also contribute significantly to physics development
    - Multiple CS staff have obtained Ph.D. degrees
  - More broadly at LLNL computer scientists are involved in AI/ML, computational math & science, HPC systems and software, cybersecurity, etc.
  - Most recent project hire is a Michigan Nuclear Engineering Ph.D. graduate

LLNL hires staff and interns in Engineering, Computer Science, Physics, etc.

- LLNL is a recipient of the Glassdoor 2022 Best Places to Work award

- General LLNL jobs site:
  - https://www.llnl.gov/join-our-team/careers

- LLNL has various student internship programs
  - Defense Science & Technology Summer Student Internship applications due in January each year
  - https://sd.llnl.gov/careers/students