

# Preface

This volume contains the 14 papers that were presented at the 5th International Workshop on Performance Modeling, Benchmarking, and Simulation of High Performance Computing Systems (PMBS 2014), which was held as part of the 26th ACM/IEEE International Conference for High Performance Computing, Networking, Storage, and Analysis (SC 2014) at the Ernest N. Morial Convention Centre in New Orleans during November 16–21, 2014.

The SC conference series is the premier international forum for high-performance computing, networking, storage, and analysis. The conference is unique in that it hosts a wide range of international participants from academia, national laboratories, and industry; this year's conference attracted over 10,000 attendees and featured over 350 exhibitors in the industry's largest HPC technology fair.

This year's conference was themed *HPC Matters*, recognizing the immense impact that high-performance computing has on our lives. Specifically, SC 2014 was focused not only on the very visible way in which HPC is changing the world around us, but also on how HPC is improving every aspect of our lives in the most unexpected ways.

SC offers a vibrant technical program, which includes technical papers, tutorials in advanced areas, Birds of a Feather sessions (BoFs), panel debates, a doctoral showcase, and a number of technical workshops in specialist areas (of which PMBS is one).

The focus of the PMBS 2014 workshop was comparing high-performance computing systems through performance modeling, benchmarking, or the use of tools such as simulators. We were particularly interested in receiving research papers which reported the ability to measure and make tradeoffs in hardware/software co-design to improve sustained application performance. We were also keen to capture the assessment of future systems, for example, through work that ensured continued application scalability through peta- and exa-scale systems.

The aim of the PMBS 2014 workshop was to bring together researchers from industry, national laboratories, and academia, who were concerned with the qualitative and quantitative evaluation and modeling of high-performance computing systems. Authors were invited to submit novel research in all areas of performance modeling, benchmarking, and simulation, and we welcomed research that combined novel theory and practice. We also expressed an interest in submissions that included analysis of power consumption and reliability, and were receptive to performance modeling research that made use of analytical methods as well as those based on tracing tools and simulators.

Technical submissions were encouraged in areas including: performance modeling and analysis of applications and high-performance computing systems; novel techniques and tools for performance evaluation and prediction; advanced simulation techniques and tools; micro-benchmarking, application benchmarking, and tracing; performance-driven code optimization and scalability analysis; verification and

validation of performance models; benchmarking and performance analysis of novel hardware; performance concerns in software/hardware co-design; tuning and auto-tuning of HPC applications and algorithms; benchmark suites and proxy apps; performance visualization; real-world case studies; studies of novel hardware such as Intel Xeon Phi coprocessor technology, NVIDIA Kepler GPUs, and AMD Fusion APU.

## PMBS 2014

We received an excellent number of submissions for this year’s workshop. As a result of this we were able to be very selective in those papers that were chosen; 14 full papers were accepted from a total of 53 submissions (26%). The resulting papers show worldwide programs of research committed to understanding application and architecture performance to enable peta-scale computational science.

Contributors to the workshop included Argonne National Laboratory, the Barcelona Supercomputing Center, IBM, Inria, Jülich Supercomputing Centre, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, NVIDIA, Sandia National Laboratories, Technische Universität Dresden, the University of Illinois, the University of Oxford, and the University of Stuttgart, among many others.

Several of the papers are concerned with *Performance Benchmarking and Optimization*, see Section A. The paper by Hormozd Gahvari et al. explores the use of a Cray XC30 system using a Dragonfly interconnect topology for running an Algebraic Multigrid solver application. Andrew V. Adinets et al. present initial benchmarking results for IBM’s new POWER8 architecture. The paper by Guido Juckeland et al. outlines a new SPEC benchmark suite specifically designed for accelerator architectures. Everett Phillips and Massimiliano Fatica outline the development of a CUDA implementation of the HPCG benchmark – a benchmark that is growing in popularity due to LINPACK’s well-documented shortcomings. Gihan Mudalige et al. present the porting of the CloverLeaf hydrodynamics application, from Sandia National Laboratories’ Mantevo proxy app suite, to the OPS high-level abstraction framework being developed at the University of Oxford.

Section B of the proceedings collates papers concerned with *Performance Analysis and Prediction*. Waleed Alkohani and colleagues utilize dynamic binary instrumentation in order to identify characteristics that affect an applications performance. Yu Jung Lo et al. build upon previous work with the Roofline model to develop a toolkit for auto-generating Roofline models, including extending these models to accelerator architectures. Raúl de la Cruz et al. document the development of a performance model for Intel’s Xeon Phi coprocessor architecture with a particular focus on stencil computations. A performance model for the HPCG benchmark is presented by Vladimir Marjanović et al. showing a strong correlation between memory bandwidth and HPCG performance. Elmar Peise et al. build performance models for tensor contraction calculations. Their models allow the most efficient algorithm to be chosen ahead of runtime using the results from a set of micro-benchmarks to inform algorithm choice.

The final section of the proceedings, Section C, is concerned with *Power, Energy, and Checkpointing*. Anne Benoit et al. present a general-purpose model to handle both

fail-stop and silent errors, utilizing this model to determine the optimal checkpoint and verification period under a variety of different execution scenarios. The work by Shane Snyder et al. explores the use of an infection-style group membership protocol for managing faults in HPC storage systems. Prasanna Balaprakash et al. build upon work presented at the previous PMBS workshop showing the tradeoffs that exist between performance and energy consumption when using multilevel checkpointing libraries. The final paper by Balaji Subramaniam and Wu-chun Feng deals with the energy consumption for distributed NoSQL data stores under load. Specifically, they analyze the use of three resource provisioning techniques, demonstrating a significant power saving when both power and performance are considered as part of the provisioning algorithm.

## Acknowledgments

The PMBS 2014 workshop was extremely well attended and we thank the participants for the lively discussion and positive feedback received throughout the workshop. We hope to be able to repeat this success in future years.

The SC conference series is sponsored by the IEEE Computer Society and the ACM (Association for Computing Machinery). We are extremely grateful for the support we received from the SC 2014 Steering Committee, and in particular from Torsten Hoefler and Martin Swamy, the SC 2014 Workshop Chairs.

The PMBS 2014 workshop was only possible thanks to significant input from AWE in the UK, and from Sandia National Laboratories and the Lawrence Livermore National Laboratory in the USA. We acknowledge the support of the AWE Technical Outreach Programme (project CDK0724) and the Royal Society Industry Fellowship scheme (IF090020).

We are also grateful to LNCS for their support, and to Alfred Hofmann and Anna Kramer for assisting with the production of this issue.

November 2014

Stephen A. Jarvis  
Steven A. Wright  
Simon D. Hammond

High Performance Computing Systems. Performance  
Modeling, Benchmarking, and Simulation  
5th International Workshop, PMBS 2014, New Orleans,  
LA, USA, November 16, 2014. Revised Selected Papers  
Jarvis, S.A.; Wright, S.A.; Hammond, S.D. (Eds.)  
2015, XII, 276 p. 101 illus., Softcover  
ISBN: 978-3-319-17247-7