ReveR-SES: Reversible Computing for Exascale and beyond

Objectives

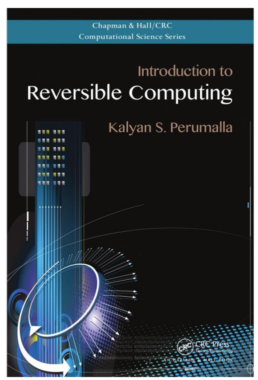
- Enable and optimize reversible computing to overcome the formidable challenges in exascale and beyond
  - Memory wall: Overcome reliance on memory that increases energy cost and reduces speed
  - Concurrency: Fundamentally eliminate blocked execution
  - Fault tolerance: Enable highly efficient and scalable resilient execution
  - Beyond Moore Era Computing: Target new, fundamentally reversible architectures, including adiabatic circuits and quantum computing

Approach

Developed prototypes for automation, runtime, theory, and experiments

- Reversible source-to-source compilation techniques
- Reversible physical models (reversible elastic collisions)
- Reversible random number generators (uniform, and non-uniform distributions, including non-invertible CDFs)
- Reversible dynamic memory allocation
- RBLAS – Reversible Basic Linear Algebra Subprograms operates on CPUs and GPUs
- Proposed reversible interface for integer arithmetic

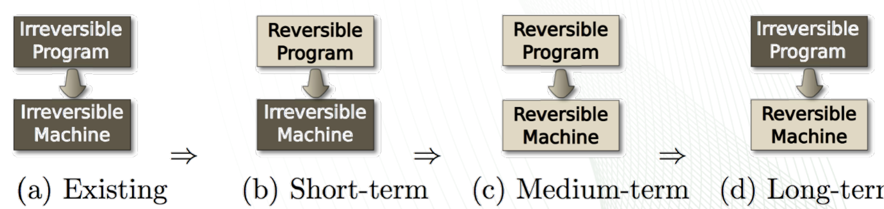
Selected Publications



- [**Book**] Perumalla, "Introduction to Reversible Computing," CRC Press, ISBN 1439873403, 2013
- Perumalla et al, "Towards reversible basic linear algebra subprograms…," Springer TCS, 24(1), 2014
- Perumalla et al, "Reverse computation for rollback-based fault tolerance…," Cluster Computing, 17(2), 2014
- Perumalla et al, "Reversible elastic collisions," ACM TOMACS, 23(2), 2013

Impact

- Addresses fundamental computational science questions with respect to (thermodynamic) limits of energy and computation time
- Provides new scientific understanding of the nature of computation of physics and physics of computation



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