Extreme Scale Resilience Home

The Argonne National Laboratory/MCS/Extreme Scale Resilience group covers fault tolerance and resilience for HPC simulations and data analytics at extreme scale

Lead: Franck Cappello, ANL

Topics and people

- **Multi-level Checkpoint / Restart**: Bogdan Nicolae, Leonardo Bautista Gomez (Postdoc now at BSC), Franck Cappello
  - Main project: VeloC (ECP)
- **Lossy compression**, Sheng Di, Franck Cappello.
  - Main projects: EZ (ECP), CODAR (ECP)
- **Silent soft errors/data corruptions detectors and compression**: Sheng Di, Franck Cappello
  - Main project: Aletheia (NSF)
- **Failure characterization and prediction**: Sheng Di, Rinku Gupta, Franck Cappello
  - Main project: Catalog (DOE ASCR)
- **Failure modeling and fault tolerance optimizations**: Sheng Di
- **Fault tolerance protocols**: F. Cappello

Main collaborators: Marc Snir (ANL and UIUC), Jon Calhoun (Clemson), Bill Kramer (UIUC), Bogdan Nicolae (IBM Dublin), Thomas Ropars (EPFL), Amina Guermouche (UVSQ), Frederic Vivien (Inria), Yves Robert (LIP), Satoshi Matsuoka (Titech), Mitsuhisa Sato (U. Tsukuba), Omer Subasi (BSC), Osman Unsal (BSC), Leonardo Bautista Gomez (BSC)

Tools and software

- **SZ (Error Bounded Lossy Compressor for floating point data sets)**
- **Z-checker (An lossy data compression assessment tool)**
- **AID (Adaptive Impact-Driven Detection)** library for SDC detection
- **FTI** (operational prototype): Fault Tolerance Interface for multi-level checkpoint/restart (in memory checkpointing, checkpointing on remote nodes, erasure encoding, etc.)
- **HELO/ELSA** (operational prototypes): System event clustering and Failure predictor
- **MPICH-HFT** (prototype under development): Fault tolerant MPI with hierarchical fault tolerant protocol

Main collaborative activities

- **Illinois-Inria-ANL-BSC-JSC-Riken-UTK Joint Laboratory on Petascale Computing**

Recent Publications (from 2013)

- W. He, H. Guo, T. Peterka, S. Di, F. Cappello, HW Shen, Parallel Partial Reduction for Large-Scale Data Analysis and Visualization, in The 8th IEEE Symposium on Large Data Analysis and Visualization (IEEE LDAV) in conjunction with IEEE VIS 2018, Berlin, Germany, October 21, 2018.
- C. Wang, N. Dryden, F. Cappello, and M. Snir, Neural Network Based Silent Error Detector, in IEEE CLUSTER 2018, 2018. [best paper award (in the programming and system softwaretrack)]


• D. Tao, S. Di, Z. Chen, and F. Cappello, Exploration of Pattern-Matching Techniques for Lossy Compression on Cosmology Simulation Data Sets, Proceedings of the 1st International Workshop on Data Reduction for Big Scientific Data (DRBSDDI) in Conjunction with ISC'17, Frankfurt, Germany, June 22, 2017.


• S. Di, F. Cappello, Fast Error-bounded Lossy HPC Data Compression with SZ, IEEE IPDPS 2016


• T. Martsinkevich, T. Ropars, F. Cappello, Addressing the last roadblock for message logging in HPC: alleviating the memory requirement using dedicated resources, Euro-Par 2015 workshop on Resilience - Resiliency in High Performance Computing with Clouds, Grids, and Clusters, to appear, 2015

• L. Bautista Gomez and F. Cappello, Detecting Silent Data Corruption for Extreme-Scale MPI Applications, EuroMPI 2015


• L. Bautista-Gomez and F. Cappello, Detecting and Correcting Data Corruption in Stencil Applications through Multivariate Interpolation, FTS 2015 workshop at IEEE Cluster 2015

• L. Bautista-Gomez and F. Cappello, Exploiting Spatial Smoothness in HPC Applications to Detect Silent Data Corruption, IEEE HPCC 2015


• S. Di, L. Bautista-Gomez, F. Cappello, Optimization of Multi-level Checkpoint Model with Uncertain Execution Scales, to appear in IEEE ACM SC14


• L. Bautista-Gomez, Franck Cappello, et al. GPGPUs: How to Combine High Computational Power with High Reliability (Embedded Tutorial), Design, Automation & Test in Europe, DATE'14

• S. Di, S. Bouguerra, L. Bautista Gomez, F. Cappello, Optimization of Multi-level Checkpoint Model for Large Scale HPC Applications, IEEE IPDPS 2014


• L. Bautista-Gomez, F. Cappello, Improving Floating Point Compression through Binary Masks, Proceedings of IEEE BigData 2013

• T. Ropars, T. Martsinkevich, A. Guermouche, A. Schiper, F. Cappello, SPBC: Leveraging the Characteristics of MPI HPC Applications for Scalable Checkpointing, Proceedings of IEEE/ACM SC14


• S. Di, D. Kondo, F. Cappello, Characterizing Cloud Applications on a Google Data Center, short paper, Proceedings to ICPP2013

• B. Nicolae, F. Cappello, AI-Ckpt: Leveraging Memory Access Patterns for Adaptive Asynchronous Incremental Checkpointing, Proceeding of ACM HPDC 2013
• M. S. Bouguerra, A. Gainaru, F. Cappello, L. Bautista Gomez, N. Maruyama and S. Matsuoka, Improving the computing efficiency of HPC systems using a combination of proactive and preventive checkpointing, Proceedings of IEEE IPDPS 2013
• M. El Mehdi Diouri, O. Gluck, L. Lefevre, F. Cappello, Towards an energy estimator of fault tolerance protocols, Poster, in Proceedins of ACM PPoPP 2013