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

**News**

**July. 2016** F. Cappello (and George Bosilca) Tutorial on Resilience for HPC at DSN 2016  
Mar. 2016 F. Cappello plenary session, CODA 2016, Santa Fe  
Jan 2016: SZ lossy compressor available here  
**May 2015** F. Cappello Keynote on Trust in results of numerical simulations and scientific data analytics at HIPEAC CSW & BR, Oslo *(cancelled)*  
April 2015 White paper on Trust in results of numerical simulations and scientific data analytics  
April 2015 AID (Adaptive Impact-Driven Detection) library for SDC detection  
Jan. 2015 Using Data Analytics to Detect Corruptions in Numerical Simulations, BDEC Barcelona, short presentation  
Nov. 2014 FTI 0.9.5 release  
Nov. 2014 2cd workshop of the Joint-Laboratory on Extreme Scale Computing  
Nov. 2014 FTI Demo on the DoE booth at SC14  
Nov. 2014 FTI presented at Journée thématique «Impact des nouveaux calculatrices pour l’océan et l’atmosphère » by Julien Bigot (CEA – Maison de la Simulation)  
July 2014 Our journal article “Towards exascale resilience: 2014 update” is presented in HPC wire  
April 2014 Inria-UIUC/NCSA-ANL-BSC Join-lab workshop, June 9-11  
March 2014 Presentation of the G8 ECS project results at Kobe  
**Feb. 2014** BDEC workshop at Fukuoka (Japan): The Need for Resilience Research in Workflows of Big Compute and Big Data Scientific Application  
Dec. 2013 Data compression algorithm based on masking presented at the DoE SC Associate Director's meeting.  
Nov. 2013 TTTSF 2013 Mini workshop on Resilience at the 10th workshop of the INRIA-Illinois-ANL joint laboratory on Petascale computing  
Nov 2013 Large presence of the ESR group at SC13: 2 Papers, 1 Panel, 2 bird of feather (BOF), 1 Emerging Technology Demo + Chairing the Test of time award  
Oct 2013: PUF (Partnership University Fund) project “Preparing for Next Generation Numerical Simulation Platforms” accepted  
Oct 2013: The Paris project on Silent soft errors/data corruptions detection funded for 3 years

**Topics and people**

- **Multi-level Checkpoint / Restart**: Franck Cappello, Sheng Di (Postdoc ANL), Leonardo Bautista Gomez (Postdoc now at BSC)  
- **Lossy compression for checkpointing**, Sheng Di (Postdoc ANL), Jon Calhoun (UIUC), Franck Cappello.  
- **Silent soft errors/data corruptions detectors and compression**: Sheng Di (Postdoc ANL), Pierre-Louis Guhur (ANL), Franck Cappello  
- **Failure characterization and prediction**: Sheng Di (Postdoc ANL), Rinku Gupta (ANL), Ana Gainaru (Ph. D. UIUC, now at Mallanox),  
- **Failure modeling and fault tolerance optimizations**: Sheng Di (Postdoc Inria)  
- **Fault tolerance protocols**: F. Cappello (ANL)

Main collaborators: Marc Snir (ANL and UIUC), Bill Kramer (UIUC), Bogdan Nicolae (IBM Dublin), Thomas Ropars (EPFL), Amina Guermouche (UVSQ), Frederic Vivien (Inria), Yves Robert (LIP), Satoshi Matsuoka (Titech), Mitsuhsa 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)**  
- **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 Joint Laboratory on Petascale Computing  
- G8 Extreme Scale Climate Simulations with France, Germany, Spain, Japan and Canada  
- EESI2: European Exascale Software Initiative 2, EESI2 Resilience Working Group
Recent Publications (from 2013)

- S. Di, F. Cappello, Fast Error-bounded Lossy HPC Data Compression with SZ, IEEE IPDPS 2016
- T. Marsinkevich, T. Ropars, F. Cappello, Addressing the last roadblock for message logging in HPC: alleviating the memory requirement using dedicated resources, EuroPar 2015 workshop on Resilience - Resiliency in High Performance Computing with Clouds, Grids, and Clusters, 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 HPCG 2015
- 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
- S. Di, D. Kondo, F. Cappello, Characterizing Cloud Applications on a Google Data Center, short paper, Proceedings fo ICPP2013
- B. Nicole, F. Cappello, AI-Ckpt: Leveraging Memory Access Patterns for Adaptive Asynchronous Incremental Checkpointing, Preceeding of ACM HPDC 2013
- M. El Mehdi Diour, O. Gluck, L. Lefevre, F. Cappello, ECOFIT: A Framework to Estimate Energy
Consumption of Fault Tolerance protocols during HPC executions, Proceedings of IEEE CCGRID 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 Proceedings of ACM PPoPP 2013