Fault-tolerant numerical iterative algorithms at scale

Deploying numerical kernels on very large scale platforms requires to complement them with fault-tolerance techniques. These techniques should mitigate the impact of fail-stop errors (permanent failures, e.g. processor crashes) and of silent errors (a.k.a. silent data corruptions). The techniques to deal with both error types rely on very different methods, but must be combined to guarantee a successful execution.

The internship will focus on two key iterative algorithms for the solution of sparse linear systems, namely CG (Conjugate Gradient, for symmetric systems) and GMRES (for non-symmetric ones). It will start with a review of the bibliography (provided to the student). While several papers have focused on various particular error types, none has yet proposed a global approach to resilience.

The main objective of the internship is to design and assess new algorithms for CG and GMRES that are robust to both error types and can be used as black-boxes for scientific applications deployed at Exascale.

The internship can be continued with a PhD thesis (which we have secured funding for, through the PEPR NumPEx, see https://anr.fr/fr/france-2030/programmes-et-equipements-prioritaires-de-recherche-pepr/numpex-numerique-hautes-performances-pour-lexascale/).

The internship (and eventual PhD thesis) will take place at ENS Lyon in the LIP laboratory and ROMA team (https://www.ens-lyon.fr/LIP/ROMA/), and it will be co-advised at Inria Bordeaux within the CONCACE team (https://concace.gitlabpages.inria.fr).

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