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C8 Solving Really Large Sparse Linear Problems from a Range of Applications

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Quarta-feira **Coordenador:** José Alberto Cuminato **Sala Turmalina**
11:30-12:30 h

We discuss the solution of large sparse linear systems from a range of application areas mainly from the discretization of three dimensional problems. By large, we mean that the system dimension is of order 107 or more.

We first establish the strength and limitations of direct methods. They are far more powerful than they are often given credit for but, for example, the structure of systems arising from the discretization of partial differential equations from three-dimensional modelling causes particular problems for direct methods inasmuch the factors are much denser than the original system. Moreover, their complexity causes major problems for the convergence of iterative methods and a universally successful preconditioning technique remains to be found.

In this talk we show how direct and iterative methods can be combined to solve problems that are intractable by one class of methods alone. Examples of these hybrid methods include using a direct method as a coarse grid solver in multigrid or to solve subproblems in domain decomposition. We show examples of these approaches and indicate how they can be used to solve very large problems. We also examine hybrid methods that use a fast but potentially inaccurate sparse factorization.

Researchers in the Parallel Algorithms Group at CERFACS in Toulouse have recently solved three-dimensional Helmholtz problems in seismic modelling with over 65 billion unknowns. We briefly discuss how this has been done.

More recently, we have been involved in an RTRA Project on data assimilation called ADTAO which involves the solution of very large sparse nonlinear least-squares problems. We hope to be able to report recent experiments on combining direct and iterative methods in the solution of such problems.