# P R I S M ’01

*1st announcement*

**Call for submissions of contributed papers**
**to the conference on**

# Preconditioned Robust Iterative Solution Methods for Problems with Singularities (PRISM2001)

**to take place at the University of Nijmegen**
**May 21-23, 2001**

**Important deadlines**
The deadline for submission of extended abstracts (2-4 pages) is **January 15, 2001**.
Notification of acceptance will take place on **February 7, 2001**.

The conference fee is DFL 325.- (U$ 130,-) if paid before **April 1, 2001** otherwise DFL 400.- (U$ 160,-), and will include a collection of accepted abstracts, coffee/tea and lunches during the conference, and the conference dinner.

**Special issue of NLA**
An issue of the journal Numerical Linear Algebra with Applications will be devoted to papers presented at the conference. They will be reviewed following the standard policy of the journal.

Invited speakers will include experts on the handling of problems with singularities arising in partial differential equations and their iterative solution.

Singularities in solutions may be caused by the geometry of the domain containing corners and are particularly difficult to handle for problems in three space dimensions (3D). They can also occur due to singular perturbation problem parameters taking near limit values, and causing very small eigenvalues of the corresponding operators and sharp layers in the solution.
The numerical solution of such problems require either local mesh refinement methods to resolve the singularities and/or layers or enrichment of the approximating subspace by basisfunctions approximating the dominating singularity of the solution. The first type of methods can be very costly, in particular for 3D problems, and the second can be very complicated (in 3D) requiring integral equation approaches for instance to construct the required basis functions. However, the latter analysis may be required to find the proper mesh sizes even when using successive refinements of the mesh. In general, combinations of the two approaches must be used for greatest efficiency.

Due to the normally very large size of the algebraic systems which arises which, however, are very sparse one must use iterative solution methods.

Iterative solution methods require much less memory than direct solution methods and can therefore be viable for much larger sized problems. However, due to lack of robustness with respect, in particular, to various problem parameters, these methods are still not widely used among practitioners who often prefer direct methods due to their better robustness even though this severely limits the size of the problems which can be tackled.

Typical difficulties with iterative solvers arise when the mesh is not aligned to the occurrence of discontinuities, and for problems exhibiting locking due to the structure being in a nearly limit stage whereby nearly all degrees of freedom become constrained.

For nonsymmetric problems other aspects, such as the degree of nonnormality, play a fundamental role in the performance of the iterative solution methods.

Such problems can give rise to very ill-conditioned systems causing too slow or stagnated convergence of the iterative solver, unless a proper preconditioning can be found. Indeed, there is an increasing computational evidence indicating that a good preconditioner holds the key to an effective iterative solver. For particular cases the theory of certain preconditioners, such as multilevel iteration methods, is well developed but in general there is still a lack of theory to explain the performance and guide the construction of preconditioners for problems with singularities. The preconditioners can be constructed purely algebraically, using approximate factorization and/or approximate sparse increases, using defect-correction methods based on operator splittings or based on the underlying mesh refinement and associated subspaces of basis functions.

The topics treated during the conference include among others:

- Construction of singularities resolving basis functions and regularization using dominating singularity via special 3D singular elements.
- Mesh refinements adapted methods: patched meshes, and successive mesh refinement methods.
- Mesh free approaches.
- Defect-correction methods.
- Computation of the angles between (basis) function subspaces (and the constant in the strengthened CBS inequality) for various finite element methods.
- Coarse mesh balanced block matrix preconditioners.
- Preconditioning of the matrix block corresponding to added basis functions (which may cause a singular behaviour).
- Multigrid and algebraic multilevel iteration methods.
- Iteration methods in function spaces.
- Robust iterative methods for general diffusion problems and systems of elliptic pde's including problems in elasticity (thin structures).
- Inner-outer iteration methods.
- Stopping criteria in iterative methods for linear and nonlinear problems.

*Scientific Committee*
Owe Axelsson (NL), Evgeny Glushkov (RU), Wolfgang Hackbusch (D), Ulrich Langer (A), Jean-Francois Maitre (F), Svetozar Margenov (BG), Panayot Vassilevski (USA).

*Speakers*

N.S. Bakhvalov, Moscow (RU)
Dietrich Braess, Bochum (D),
Evgeny Glushkov, Krasnodar, (RU)
Natalya Glushkova, Krasnodar, (RU)
Piet Hemker, CWI, Amsterdam (NL)
Igor Kaporin, Moscow (RU)
Janos Karátson, Budapest, (HU)
Georgij Kobelkov, Moscow (RU)
Yuri Kuznetsov, Houston (TX)
Ivo Marek, Prague (Cz)
Svetozar Margenov, Sofia (BG)
Jean-Francois Maitre, Lyon (F)
Ulrich Langer, Linz (A)
Raytcho Lazarov, T& M,College Station, TX
Yvan Notay, Brussels (B)
Yousef Saad, Minneapolis, Minn.
Panayot Vassilevski, LLNL, California
Freddy Wubs, Groningen(NL)
Alex Yeremin, Moscow (RU)

*Tentative further speakers*

B. Achchab, Settat (Morocco)
R. Blaheta, Ostrawa (Cz.R.)
C. Carstensen, Kiel (D)
Tony Chan, UCLA, California
W. Dahmen, Aachen (D)
Howard Elman, Maryland (US)
Michael Griebel, Bonn (D)
Ivar Gustafson, Göteborg (SW)
Wolfgang Hackbusch, Leipzig, (D)
A. Klawonn, Münster (D)
A. Knyazev, Boulder (CO)
L.S. Xanthis, London (GB)