

# Curriculum Vitae

Ragnar Winther

January 21, 2010

- Born in Norway, 1949.
- Ms. (cand. real.) in Mathematics, The University of Oslo, 1973.
- Ph.D. in Applied Mathematics, Cornell University, 1977 (supported by the Norwegian Research Council 1974–1977).
- Instructor of Mathematics, The University of Chicago, 1977–1979.
- Assoc. Professor Østfold Regional College, Norway 1979–1981.
- Professor at The University of Oslo, 1981–
- Director: Centre of Mathematics for Applications (CMA), A Norwegian Centre of Excellence, University of Oslo, 2003–

The CMA was one of thirteen centres of excellence appointed by the Norwegian Research Council in 2002, when the centre of excellence program in Norway started. It is the only centre in mathematics founded by the program.

During my years at University of Oslo I have been an advisor for approximately 35 master candidates and 12 Ph.D. candidates, and I have been acting as opponent at approximately 20 Ph.D. defenses in Scandinavia.

## **Editorial boards**

- BIT, Numerical mathematics
- SIAM journal on scientific computing (1998–2004)
- Computational methods in applied mathematics
- Numerical analysis and modeling
- EMS Lecture notes series, applied mathematics (special issues 1999–2003)

## Committees

Since June 2004 I have served as chairman of the board of the Niels Henrik Abel Memorial Fund. The board is a subcommittee of the Norwegian Academy for Science and Letters, and is responsible for all the activities associated the Abel prize, except the selection of the prize winners. I have also been a member of the prize committees for the ICTP–IMU Ramanujan prize (2008, 2009), and the ICIAM Su Buchin prize (for 2011). I was also a member of the SIAM nominating committee (2007, 2008).

## Selected presentations

I was an invited speaker at the Seventh International Conference on Hyperbolic Problems, Zürich, 1998, and at the Fifth European Conference on Mathematics, Amsterdam 2008. I also gave a series of lectures at the London Mathematical Society Durham Symposium in 2008.

## Visits of longer duration

- Cornell University, USA, 1974–1977.
- University of Chicago, 1977–1979, and 1980.
- University of Wisconsin, USA, 1981.
- Penn State University, USA, 1994, 1997, and 1999.
- Institute Mittag–Leffler, Sweden, 1998.
- University of Minnesota, USA, 2002.
- Rutgers University, USA, 2003.

## Projects

- In addition to directorship of the ongoing Centre of Excellence I have been acting as head of a number of research projects supported by the Norwegian Research Council and VISTA (Academy of Science–STATOIL).

## Scientific work

- 1 Master thesis, The University of Oslo, 1973  
A collocation method for eigenvalue problems (in Norwegian).
- 2 Ph.D. thesis, Cornell University, 1977  
Title: A numerical Galerkin method for parabolic control problems.

### Papers in international journals

- 3 A collocation method for eigenvalue problems, BIT 14 (1974), 96–105.
- 4 Error estimates for a Galerkin approximation of a parabolic control problem, Annali di Matematica pura ed applicata (IV) 107 (1978), 173–206.
- 5 A stable recurrence relation for trigonometric B-splines (with Tom Lyche), Jour. approx. theory 25 (1979), 266–279.
- 6 Initial value methods for parabolic control problems, Math. comp. 34 (1980), 115–125.
- 7 Some superlinear convergence results for the conjugate gradient method, SIAM jour. numer. anal. 17 (1980), 14–17.
- 8 A conservative finite element method for the Korteweg-de Vries equation, Math. comp. 34 (1980), 23–43.
- 9 A stable finite element method for initial-boundary value problems for first order hyperbolic systems, Math. comp. 36 (1981) , 65–86.
- 10 A superconvergent finite element method for the Korteweg-de Vries equation (with Douglas N. Arnold), Math. comp. 38 (1982) , 23–36.
- 11 A finite element method for a version of the Boussinesq equation, SIAM jour. numer. anal. 19 (1982) , 561–570.
- 12 The Korteweg-de Vries equation, posed in a quarter plane (with Jerry Bona), SIAM jour. math. anal. 14 (1983), 1056–1106.
- 13 The solution of the Riemann problem for a hyperbolic system of conservation laws modelling polymer flooding (with Thormod Johansen), SIAM jour. math anal. 19 (1988), 541–566.
- 14 The Riemann problem for multicomponent polymer flooding (with Thormod Johansen). SIAM jour. math. anal. 20 (1989), 909–929.
- 15 A Riemann solver for a two-phase multicomponent process (with Aslak Tveito and Thormod Johansen). SIAM jour. sci. stat. comp. 10 (1989), 846–879.
- 16 On the stability of relaxed incomplete LU factorization (with Are M. Bruaset and Aslak Tveito). Math. comp. 54 (1990), 701–719.
- 17 The Korteweg-de Vries equation in a quarter plane, continuous dependence results (with Jerry Bona), Diff. and integr. equat. 2 (1989), 228–250.
- 18 Convergence of a non-conservative finite difference scheme for a system of hyperbolic conservation laws (with Aslak Tveito). Diff. and integr. equat. 3 (1990), 979–1000.

- 19** Existence, uniqueness and continuous dependence results for a system of hyperbolic conservation laws modelling polymer flooding (with Aslak Tveito). SIAM jour. math. anal. 22 (1991), 905–933.
- 20** A preconditioned iterative method for saddle point problems (with Torgeir Rusten). SIAM jour. matrix anal. 13 (1992), 887–904.
- 21** Multicomponent chromatography in a two phase environment (with Olav Dahl, Thormod Johansen and Aslak Tveito). SIAM jour. applied math. 52 (1992), 65–104.
- 22** Instability of Buckley-Leverett flow in heterogeneous media (with Hans P. Langtangen and Aslak Tveito). Transport in porous media. 9 (1992), 165–185.
- 23** An error estimate for a finite difference scheme approximating a system of conservation laws (with Aslak Tveito). SIAM jour. num. anal. 30 (1993), 401–424.
- 24** A substructure preconditioner for elliptic saddle point problems (with Torgeir Rusten). Math. comp. 60 (1993), 23–48.
- 25** The solution of non-strictly hyperbolic conservation laws may be hard to compute (with Aslak Tveito). SIAM jour. scient. stat. comp. 16 (1995), 320–329.
- 26** On the convergence of operator splitting applied to conservation laws with source terms (with Jan O. Langseth and Aslak Tveito). SIAM jour. num. anal. 33 (1996), 843–863.
- 27** On the rate of convergence to equilibrium for a system of conservation laws with a relaxation term (with Aslak Tveito), SIAM jour. math. anal. 28 (1997), 136–161.
- 28** Interior penalty preconditioners for mixed finite element approximations of elliptic problems (with Torgeir Rusten and Panayot S. Vassilevski). Math. comp. 65 (1996), 447–466.
- 29** An  $L^1$ -error bound for a semi-implicit difference scheme applied to a stiff system of conservation laws (with Hans J. Schroll and Aslak Tveito), SIAM jour. num. anal. 34 (1997), 1152–1162.
- 30** Finite difference schemes for scalar conservation laws with source terms (with Hans J. Scroll). IMA jour. num. anal. 16 (1996), 201–215.
- 31** Preconditioning in  $H(\text{div})$  and applications (with Douglas N. Arnold and Richard S. Falk), Math comp 66 (1997) 957-984.
- 32** A system of conservation laws including a stiff relaxation term; the 2D case (with Wen Shen and Aslak Tveito). BIT 36 (1996), 786–813.

- 33** Preconditioning discrete approximations of the Reissner-Mindlin plate model (with Douglas N. Arnold and Richard S. Falk), *Math. modelling and num. anal.* 31 (1997), 517–557.
- 34** Multigrid preconditioning in  $H(\text{div})$  on non-convex polygons (with Douglas N. Arnold and Richard S. Falk), *Comp. appl. math.* 17 (1998), 307–319.
- 35** Domain embedding and the Dirichlet problem (with Einar Haug, Torgeir Rusten and Panayot S. Vassilevski), In M. Griebel et. al. (editors): *Large-Scale Scientific Computations of Engineering and Environmental Problems*, Notes on num. fluid dynamics, vol. 62 (1998), pp. 66–77.
- 36** A domain embedding preconditioner for the Lagrange multiplier system (with Einar Haug), *Math. comp.* 69 (1999), 65–82.
- 37** Domain embedding preconditioners for mixed systems (with Torgeir Rusten and Panayot S. Vassilevski), *Numerical Linear Algebra with Applications* 5 (1998), 321–345.
- 38** On the zero relaxation limit for a system modeling the motions of a viscoelastic solid (with Wen Shen and Aslak Tveito), *SIAM jour. math. anal.* 30 (1999), 1115–1135.
- 39** Multigrid in  $H(\text{div})$  and  $H(\text{curl})$  (with Douglas N. Arnold and Richard S. Falk), *Numer. math.* 85 (2000), 197–217.
- 40** A robust nonconforming  $H^2$ -element (with T. Nilssen and X.-C. Tai), *Math. comp.* 70 (2001), 489–505.
- 41** Mixed finite elements for elasticity (with Douglas N. Arnold), *Numer. math.* 92 (2002), 401–419.
- 42** A robust finite element method for Darcy–Stokes flow (with Kent A. Mardal and Xue-Cheng Tai), *SIAM jour. num. anal.* 40 (2002), 1605–1631.
- 43** Preconditioned iterative methods for scattered data interpolation (with Tom Lyche and Trygve K. Nilssen), *Adv. comp. math.* v. 17 (2002), pp. 237–256.
- 44** Numerical methods for incompressible viscous flow (with Hans P. Langtangen and Kent A. Mardal), *Advances in water resources* 25 (2002), 1125–1146.
- 45** Nonconforming mixed elements for elasticity (with Douglas N. Arnold), *Mathematical models and methods in applied sciences* 13 (2003), 295–307.
- 46** Mixed finite elements for elasticity in the stress–displacement formulation (with Douglas N. Arnold), *Contemporary mathematics* 329 (2003), 33–42.
- 47** Stability of a model of human granulopoiesis using continuous maturation (with Ivar Østby), *Journal of mathematical biology* 49 (2004), pp. 501–536.

- 48 Uniform preconditioners for the time dependent Stokes problem (with Kent A. Mardal), *Numer. math.* 98 (2004), 305–327.
- 49 An observation on Korn’s inequality for nonconforming finite element methods (with Kent–Andre Mardal), *Math. comp.* 75 (2006), pp. 1–6.
- 50 On constraint preservation in numerical simulations of Yang–Mills equations (with Snorre H. Christiansen), *SIAM Jour. on scientific computing* 28 (2006), pp. 75–101.
- 51 Differential complexes and stability of finite element methods. I: The de Rham complex (with Douglas N. Arnold and Richard S. Falk), In D. Arnold et. al. (eds.) *Compatible Spatial Discretizations*, vol. 142 of IMA Volumes in Mathematics and its Applications, Springer, Berlin, (2006), pp. 23–46.
- 52 Differential complexes and stability of finite element methods. II: The elasticity complex (with Douglas N. Arnold and Richard S. Falk), In D. Arnold et. al. (eds.) *Compatible Spatial Discretizations*, vol. 142 of IMA Volumes in Mathematics and its Applications, Springer, Berlin (2006), pp. 47–68.
- 53 Convergence of multipoint flux approximations on quadrilateral grids (with Runhild Klausen), *Num. meth. for part. diff. eq.* 22 (2006), 1438–1454.
- 54 Finite element exterior calculus, homological techniques, and applications (with Douglas N. Arnold and Richard S. Falk), *Acta numerica* (2006), pp. 1–155.
- 55 Robust convergence of multi point flux approximation on rough grids (with Runhild Klausen), *Numer. math.* 104 (2006), 317–337.
- 56 A discrete de Rham complex with enhanced smoothness (with Xue–Cheng Tai), *Calcolo* 43 (2006), 287–306.
- 57 Mixed finite element methods for linear elasticity with weakly imposed symmetry (with Douglas N. Arnold and Richard S. Falk), *Math. comp.* 76 (2007), 1699–1723.
- 58 A saddle point approach to the computation of harmonic maps (with Qiya Hu and Xue–Cheng Tai), *SIAM jour. nu. anal.* 47 (2009), 1500–1523.
- 59 Smoothed projections in finite element exterior calculus (with Snorre Christiansen), *Math. comp.* 77 (2008), 813–829.
- 60 Finite elements for symmetric tensors in three dimensions (with Douglas N. Arnold and Gerard Awanou), *Math. comp.* 77 (2008), 1229–1251.
- 61 Unified finite element discretizations of coupled Darcy–Stokes flow (with Trygve Karper and Kent A. Mardal), *Numer. methods for PDEs* 25 (2009), 311–326.

- 62** Geometric decompositions and local bases for spaces of finite element differential forms (with Douglas N. Arnold and Richard S. Falk), *Computer methods in appl. mech. and eng.* 198 (2009), 1660–1672.
- 63** Mixed finite element for linear viscoelasticity using weak symmetry (with Marie E. Rognes), To appear in *Math. models & methods in applied sciences*.
- 64** Preconditioning discretizations of systems of partial differential equations (with Kent A. Mardal), To appear in *Numerical linear algebra with applications*.
- 65** From Hodge theory to numerical stability (with Douglas N. Arnold and Richard S. Falk), To appear in the *Bulletin of the Amer. Math. Soc.*

### **Books**

- 66** *Introduction to partial differential equations, a computational approach* (with Aslak Tveito), *Texts in applied mathematics*, vol. 29, Springer Verlag 1998, German translation 2002.

### **Papers in books and conference proceedings**

- 67** Numerical and analytical solutions of a model describing polymer flooding (with Thormod Johansen and Aslak Tveito), *Proc. seminar on reservoir description and simulation*, Oslo 1986.
- 68** A fractional flow theory for EOR processes (with Aslak Tveito and Thormod Johansen), *Proc. seminar on fundamental oil and gas research*, Stavanger 1988.
- 69** A finite difference scheme for a polymer flooding problem (with Aslak Tveito). *The European Conference on the Mathematics of Oil Recovery*, Cambridge 1989.
- 70** A well-posed system of hyperbolic conservation laws (with Aslak Tveito). *The Third International Conference on Hyperbolic Conservation Laws*, Uppsala, June 1990, 888-898.
- 71** Mathematical and numerical analysis of a hyperbolic system modeling solvent flooding (with Thormod Johansen). *The Second European Conference on the Mathematics of Oil Recovery*, France, September 1990, 219-234.
- 72** Hyperbolic conservation laws, finite difference schemes and error estimates (with Trond Løvereide and Aslak Tveito). *The Fourth International Conference on Hyperbolic Problems*, Taormina, April 1992.
- 73** Mixed finite element methods and domain decomposition (with Torgeir Rusten). *The Ninth International Conference on Computational Methods in Water Resources*, Denver, June 1992.

- 74** Computer science and applied mathematics (in Norwegian, with Erik Bølviken). In P. Gottschalk (editor): *IT neste TI*, Gyldendal 1993.
- 75** A system of conservation laws with a relaxation term (with Hans Joachim Schroll and Aslak Tveito). The Fifth International Conference on Hyperbolic Problems, Stoney Brook 1994.
- 76** Preconditioning linear saddle point problems (with Torgeir Rusten). In M. Dæhlen and A. Tveito (editors): *Numerical Methods and Software Tools in Industrial Mathematics*. Birkhauser, 1997.
- 77** Preconditioning in  $H(\text{div})$  and applications (with Douglas N. Arnold and Richard S. Falk), Ninth International Symposium on Domain Decomposition Methods for Partial Differential Equations, 1996, pp. 12–19.
- 78** Preconditioning discrete approximations of the Reissner-Mindlin plate model (with Douglas N. Arnold and Richard S. Falk), Ninth International Symposium on Domain Decomposition Methods for Partial Differential Equations, 1996, pp. 215–221.
- 79** Rate of convergence for the zero relaxation limit (with Aslak Tveito and Wen Shen), The Seventh International Conference on Hyperbolic Problems, Zürich 1998, pp. 865–874.
- 80** Finite element differential forms (with Douglas N. Arnold and Richard S. Falk), *Proceedings Appl Math. Mech.* 7 (2007)