

# Pavel Solin: Curriculum Vitae

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## Professional Preparation

Charles University (Prague, Czech Republic)	MMCM <sup>1</sup>	M.S. Degree, 1996
Charles University (Prague, Czech Republic)	MMCM	Ph.D. Degree, 1999
Johannes-Kepler University (Linz, Austria)		Post-doc, 1999–2001
The University of Texas at Austin (Austin, TX)		Post-doc, 2001–2002
Rice University (Houston, TX)		Post-doc, 2002–2004

<sup>1</sup>MMCM = Mathematical Modeling and Computational Mathematics. An interdisciplinary M.S. and Ph.D. program combining Physics, Mathematics, and Computer Science.

## Appointments

Associate Professor, University of Nevada, Reno (UNR): January 2009 – present  
Associate Professor, University of Texas at El Paso (UTEP): Aug. 2004 – Dec. 2008

## Teaching

### Teaching at UNR:

- MATH 285 (Differential Equations)
- MATH 412/466 (Functional Analysis)
- MATH 429/629 (Advanced Computer Modeling in Engineering Applications)
- MATH 466/666 (Numerical Methods I)
- MATH 467/667 (Numerical Methods II)

### Teaching at UTEP:

- MATH 2326 (Ordinary Differential Equations)
- MATH 4329 (Numerical Analysis)
- MATH 5195 (Graduate Seminar)
- MATH 5310 (Elements of Applied Functional Analysis)
- MATH 5343 (Partial Differential Equations)

## Curricular Activities

### Design of New Teaching Tools

Dr. Solin and his students developed an *Online Numerical Methods Laboratory* (<http://lab.femhub.org>), a free web application that allows students, instructors, and the general public to experiment with numerical methods and scientific computing via the Internet. Computations are set up in the user's web browser, sent to a remote server for processing, and computed results are displayed back on the user's device. Dr. Solin himself implemented dozens of various numerical methods in the Online Lab.

### Design of New Courses

- Advanced Computer Modeling in Engineering Applications (UNR, 2010)
- Elements of Applied Functional Analysis (UTEP, 2005)
- Partial Differential Equations (UTEP, 2005)

### Creation of Ph.D. Program in Computational Science at UTEP

In the period 2004 - 2008, Dr. Solin prepared a proposal for the Texas Higher Education Coordinating Board (THECB) to create a new interdisciplinary Ph.D. program in Computational Science at UTEP. This proposal was approved in 2008 and the Ph.D. program is now running.

## Working with Students

### Students Supervised at UNR

#### *David Andrs*

David Andrs was a postdoctoral fellow who worked with Dr. Solin on computational methods for nuclear reactor simulations during the period January 2009 - March 2010. He is now a staff member at Idaho National Laboratory.

#### *Martin Butnik*

Martin Butnik has worked with Dr. Solin on computational methods for atmospheric modeling during the period August 2009 - May 2010.

#### *Ondrej Certik*

Ondrej Certik works with Dr. Solin on computational methods in electronic structure calculation (molecular analysis and design, quantum chemistry). He has been employed in Dr. Solin's research group since January 2009 until present.

Lenka Dubcova

Lenka Dubcova was a visiting Ph.D. student during the period August - November 2009. She worked with Dr. Solin on computational methods for nuclear reactor simulations.

Ivo Hanak

Ivo Hanak has worked with Dr. Solin on an image compression technique based on adaptive higher-order finite element methods during the period August 2009 - May 2010.

Aayush Poudel

Aayush Poudel works with Dr. Solin on computational methods for nuclear reactor simulations and is contributing to the Online Numerical Methods Laboratory project. He has been employed in Dr. Solin's research group since January 2010 until present.

Sameer Regmi

Sameer Regmi works with Dr. Solin on computational methods for nuclear reactor simulations and is contributing to the Online Numerical Methods Laboratory project. He has been employed in Dr. Solin's research group since May 2009 until present.

### **M.S. Theses of Students Supervised at UTEP**

Jose Avila: Finite Element Analysis of a Convection-Diffusion Equation (2007)

Jakub Cerveny: Higher-Order Adaptive FEM for Nonlinear Coupled Problems (2006)

Svatava Vyvialova: Analysis and Optimization of a Class of Hierarchic Finite Element Methods (2005)

Martin Zitka: hp-FEM for Large Scale Singular Problems in 3D (2005)

### **Student Recruitment**

Dr. Solin is actively recruiting students from other countries by involving them in his research, and by providing them with moderate financial support. Currently, he supports the following four foreign students:

Zhonghua Ma (China University of Petroleum, Beijing)

Mateusz Paprocki (Wroclaw University of Technology, Poland)

Milan Hanus (University of West Bohemia, Pilsen, Czech Republic)

Lukas Korous (Charles University, Prague, Czech Republic)

Dr. Solin has been working with these students remotely since Spring 2010 and the collaboration has concrete provable results in the form of contributions to Dr. Solin's open source projects. All these students plan to join UNR in near future.

## Summary of Research Interests

Dr. Solin is developing novel computational methods for partial differential equations (PDE) and in particular for multiphysics PDE systems. Examples of such problems include neutronics/thermal-hydraulic processes in lightwater nuclear reactors, hygro-thermo-mechanical processes in concrete, heating/melting/stirring of metals using high energy electric fields, and there are many others.

Multiphysics coupled problems typically exhibit highly nonlinear interaction of physical fields across vastly different spatial and temporal scales which makes their computer solution challenging. Note that these problems absolutely cannot be solved analytically, and even possibilities for their mathematical analysis are extremely limited. As a matter of fact, computational methods are the only way to solve these equation systems.

Several computational techniques developed by Dr. Solin are currently being adopted by students and researchers around the world, including large projects at U.S. National Laboratories and Research Centers. Examples of these projects include the MOOSE project at Idaho National Laboratory (INL), INTREPID project at Sandia National Laboratories (SNL), PHAML project at the National Institute for Standards in Technology (NIST), and the PYADTH project at the U.S. Army Engineer Research and Development Center. These techniques include:

- Robust PDE-independent adaptive algorithms for higher-order finite element methods.
- Higher-order finite element approximations with arbitrary-level hanging nodes.
- Adaptive algorithms with dynamically changing meshes for time-dependent problems.
- Multimesh higher-order finite element methods for monolithic discretization of multiphysics coupled problems.

## Publications

### Monographs:

1. I. Dolezel, P. Karban, P. Solin: *Integral Methods in Low-Frequency Electromagnetics*, John Wiley & Sons, 2009. Hardcover, 388 pages, ISBN: 978-0-470-19550-5.
2. P. Solin: *Partial Differential Equations and the Finite Element Method*, John Wiley & Sons, 2005. Hardcover, 504 pages, ISBN: 0-471-72070-4.
3. P. Solin, K. Segeth, I. Dolezel: *Higher-Order Finite Element Methods*, CRC Press/Chapman & Hall, 2003. Hardcover, 408 pages, ISBN 158488438X.

Refereed Journal Papers:

1. P. Solin, L. Dubcova, J. Cervený, I. Doležel: Adaptive hp-FEM with Arbitrary-Level Hanging Nodes for Maxwell's Equations, *Advances in Applied Mathematics and Mechanics* 2 (2010) 518-532.
2. P. Solin, L. Dubcova, J. Kruis: Adaptive hp-FEM with Dynamical Meshes for Transient Heat and Moisture Transfer Problems, *J. Comput. Appl. Math.* 233 (2010) 3103-3112.
3. P. Solin, D. Andrs, J. Cervený, M. Simko: PDE-Independent Adaptive hp-FEM Based on Hierarchic Extension of Finite Element Spaces, *J. Comput. Appl. Math.* 233 (2010) 3086-3094.
4. L. Dubcova, P. Solin, J. Cervený, P. Kus: Space and Time Adaptive Two-Mesh hp-FEM for Transient Microwave Heating Problems, *Electromagnetics* 30 (2010) 23-40, 2010.
5. P. Solin, J. Cervený, L. Dubcova, D. Andrs: Monolithic Discretization of Linear Thermoelasticity Problems via Adaptive Multimesh hp-FEM, *J. Comput. Appl. Math.* 234 (2010) 2350-2357.
6. T. Vejchodský, P. Solin: Discrete Maximum Principle for the Poisson Equation with Mixed Boundary Conditions Solved by the hp-FEM, *Advances in Applied Mathematics and Mechanics* 1 (2009) 201-214.
7. P. Solin, D. Andrs: On Scientific Data and Image Compression Based on Adaptive Higher-Order FEM, *Advances in Applied Mathematics and Mechanics* 1 (2009) 56-68.
8. P. Kus, P. Solin, I. Doležel: Solution of 3D Singular Electrostatics Problems Using Adaptive hp-FEM, *COMPEL* 27 (2008) 939-945.
9. T. Vejchodský, P. Solin: Static Condensation, Orthogonalization of Bubble Functions, and ILU Preconditioning in the hp-FEM, *J. Comput. Appl. Math.* 218 (2008) 192-200.
10. P. Solin, T. Vejchodský, R. Araiza: Discrete Conservation of Nonnegativity for Elliptic Problems Solved by the hp-FEM, *Math. Comput. Simul.* 76 (2007) 205 - 210.
11. P. Solin, T. Vejchodský: Higher-Order Finite Elements Based on Generalized Eigenfunctions of the Laplacian, *Int. J. Numer. Methods Engrg.* 73 (2007), 1374 - 1394..
12. P. Solin, K. Segeth: Hierarchic Higher-Order Hermite Elements on Hybrid Triangular/Quadrilateral Meshes, *Math. Comput. Simul.* 76 (2007) 198-204.

13. P. Solin, T. Vejchodsky: A Weak Discrete Maximum Principle for hp-FEM, *J. Comput. Appl. Math.* 209 (2007) 54-65.
14. P. Solin, J. Cerveny, I. Dolezel: Arbitrary-Level Hanging Nodes and Automatic Adaptivity in the hp-FEM, *Math. Comput. Simul.* 77 (2008) 117-132.
15. P. Solin, J. Avila: Equidistributed Error Mesh for Problems with Exponential Boundary Layers, *J. Comput. Appl. Math.* 218 (2008) 157-166.
16. T. Vejchodsky, P. Solin: Discrete Maximum Principle for a Problem with Piecewise-Constant Coefficients Solved by hp-FEM, *J. Numer. Math.* 15 (2007) 233-243.
17. M. Zitka, P. Solin, T. Vejchodsky, F. Avila: Imposing Orthogonality to Hierarchic Higher-Order Finite Elements, *Math. Comput. Simul.* 76 (2007) 211 - 217.
18. P. Karban, I. Dolezel, P. Solin: Computation of General Nonstationary 2D Eddy Currents in Linear Moving Arrangements Using an Integro-Differential Approach, *COMPEL* 25 (2006) 635-641.
19. P. Karban, I. Dolezel, P. Solin: Integrodifferential Model of Eddy Currents in Axisymmetric Nonmagnetic Bodies Heated by Moving Inductor, *Archives for Electrical Engineering* 54 (2006) 197-207.
20. T. Vejchodsky, P. Solin: Discrete Maximum Principle for Higher-Order Finite Elements in 1D, *Math. Comput.* 76 (2007) 1833 - 1846.
21. T. Vejchodsky, P. Solin, M. Zitka: Modular hp-FEM System HERMES and Its Application to the Maxwell's Equations, *Math. Comput. Sim.* 76 (2007) 223 - 228.
22. I. Dolezel, P. Solin, M. Zitka, B. Ulrych: On Electromagnetic Stirring of Molten Metals, *Acta Technica CSAV*, 48 (2005) 1-18.
23. P. Solin, K. Segeth: A New Sequence of Hierarchic Prismatic Elements Satisfying the De Rham Diagram on Hybrid Meshes, *J. Numer. Math.* 13 (2005) 295-318.
24. P. Solin, I. Dolezel, B. Ulrych: Induction Heating of 3D Non-Ferromagnetic Metal Bodies by Moving Inductors, *Scientific Computing in Electrical Engineering* 4 (2004) 373-381.
25. P. Solin, K. Segeth: Non-Uniqueness of Almost-Unidirectional Inviscid Compressible Flow, *Appl. Math.* 49 (2004) 247-268.
26. P. Solin, L. Demkowicz: Goal-Oriented hp-Adaptivity for Elliptic Problems, *Comput. Methods Appl. Mech. Engrg.* 193 (2004) 449-468.
27. P. Solin, K. Segeth: Application of the Method of Lines to Unsteady Compressible Euler Equations, *Int. J. Numer. Methods Fluids* 41 (2003) 519-535.

28. P. Solin, K. Segeth: Examples of Non-Uniqueness of Almost-Unidirectional Gas Flow, *Math. Comp. Sim.* 61 (2003) 229-237.
29. I. Dolezel, P. Solin, B. Ulrych: On a Fieldless Method for the Computation of Induction-Generated Heat in Three-Dimensional Non-Ferromagnetic Bodies, *Math. Comput. Sim.* 61 (2003) 239-247.
30. I. Dolezel, P. Kloucek, P. Solin, B. Ulrych: Distribution of Electrical Charge in Systems of Finite Conductors, *Acta Technica* 48 (2003) 1 - 13.
31. P. Solin: On the Solution of Axisymmetric Point-Source Problems Using Fourier Transformation and FFT Routines, *Acta Technica* 48 (2003) 227-238.
32. P. Solin, K. Segeth: Performance of Various ODE Solvers on FV-Semidiscretized Nonstationary Euler Equations. *Acta Technica* 47 (2002) 47-66.
33. I. Babuska, M. Feistauer, P. Solin: On One Approach to A Posteriori Error Estimates for Evolution Problems Solved by the Method of Lines, *Numer. Math.* 89 (2001) 225-256.
34. P. Solin, K. Segeth: Description of the Multi-Dimensional Finite Volume Solver EULER, *Appl. Math.* 47 (2002) 169-185.
35. J. Barglik, I. Dolezel, P. Solin, B. Ulrych: 3D Analysis of Coupled Quasi-Stationary Electromagnetic and Non-Stationary Temperature Fields in Non-Magnetic Inductively Heated Charge, *Zeszyty Naukowe Politechniki Lodzkiej - Elektryka* 885 (2001) 9-16.
36. J. Felcman, P. Solin: On the Construction of the Osher-Solomon Scheme for 3D Euler Equations, *East-West J. Num. Math.* 6 (1998) 43-64.
37. P. Solin: On a Model of Polluted Gas Flow, *Acta Technica* 45 (2000) 1-20.
38. I. Dolezel, M. Skopek, P. Solin, B. Ulrych: Stationary Temperature Field in a Non-Magnetic Thin Plate Heated by Transversal Harmonic Electromagnetic Field, *Acta Technica* 45 (2000) 109-128.
39. P. Solin, I. Dolezel, M. Skopek, B. Ulrych: Induction Heating of Thin Slabs in Nonmagnetic Media, *Lecture Notes Comput. Sci. Engrg.* 18 (2000) 379-388.
40. P. Solin: On a Mesh Generation Technique Based on a Special Smoothing Procedure for Uniform Inner Point Distribution, *Acta Technica* 45 (2000) 397-417.

Refereed Conference Proceedings Papers:

1. L. Dubcova, I. Dolezel, P. Solin: Automatic hp-Adaptivity for Inductively Heated Incompressible Flow of Liquid Metal. *Proc. PARA 2010, Reykjavik, June 2010.*

2. J. Cervený, I. Doležel, L. Dubcova, P. Karban, P. Solin: Higher-Order Finite Element Modeling of Electromagnetically Driven Flow of Molten Metal in a Pipe. Proc. ICEMS 2009, Tokyo, Japan, November 2009, CD-ROM. Included in IEEEExplore.
3. I. Doležel, L. Dubcova, P. Karban, J. Cervený, P. Solin: Inductively Heated Flow of Electromagnetically Conductive Liquid in Pipe. Proc. COMPUMAG 2009, Florianopolis, Brazil, November 2009, CD ROM.
4. P. Solin, O. Certik, S. Regmi: The FEMhub Project and Classroom Teaching of Numerical Methods. In online proceedings of the Scipy 2009 conference, Caltech, Pasadena, August 18 - 23, 2009.
5. P. Solin, J. Kruis: Computing Transient Heat and Moisture Transfer in Concrete With Space-Time Adaptive hp-FEM. In: CD-ROM proceedings of ECCOMAS Conference COUPLED PROBLEMS 2009 (M. Papadrakakis, E. Onate, B. Schrefler Eds.), CIMNE, Barcelona, 2009.
6. L. Dubcova, P. Solin, I. Doležel: On Automatic Adaptivity for Electromagnetics Problems. In: Proceedings of ACOMEN 2008 (CD-ROM), University of Liege, Belgium, May 26 - 28, 2008.
7. P. Kus, P. Solin, M. Simko: Adaptive hp-FEM with Arbitrary-Level Hanging Nodes for Time-Harmonic Maxwell's Equations in 3D. In: Proceedings of ACOMEN 2008 (CD-ROM), University of Liege, Belgium, May 26 - 28, 2008.
8. T. Vejchodský, P. Solin, Improving Conditioning of hp-FEM, in: SNA'07 Modelling and Simulation of Challenging Engineering Problems, Institute of Geonics AS CR, Ostrava, 2007, pp. 126-129.
9. Kus, P., Solin, P., Doležel, I.: On Adaptive hp-FEM with Arbitrary-Level Hanging Nodes in 3D. Proc. ENUMATH 2007, Graz, Austria, 2007 (CD-ROM).
10. T. Vejchodský, P. Solin, Discrete Green's function and Maximum Principles, in: J. Chleboun, K. Segeth, T. Vejchodský (Eds.), Programs and Algorithms of Numerical Mathematics 13, Mathematical Institute ASCR, Prague, 2006, pp. 247-252.
11. I. Doležel, P. Karban, P. Solin, B. Ulrych: Integral Solution of Linear Eddy Current Problems with Motion. In: Proceedings of International Conference XCLEEE 2007, Madeira.
12. P. Karban, I. Doležel, P. Solin, B. Ulrych: Integral Methods of Higher Order of Accuracy in Static or Low-Frequency Applications. In: Proceedings of International Conference ISTET 2007, Szczecin.
13. J. Barglik, I. Doležel, P. Karban, L. Musil, O. Solin, B. Ulrych: Electromagnetic Pumping of Liquid Metals: Selected Systems and their Numerical Modeling. In:

Proceedings of International Conference Elektroenergetika 2007, September 19 - 21, 2007, Stara Lesna, Slovak Republic.

14. P. Solin, J. Cerveny, L. Dubcova, I. Dolezel: Multi-Mesh hp-FEM for Thermally Conductive Incompressible Flow. In: Proceedings of ECCOMAS Conference COUPLED PROBLEMS 2007 (M. Papadrakakis, E. Onate, B. Schrefler Eds.), CIMNE, Barcelona, to appear.
15. P. Solin, T. Vejchodsky, M. Zitka: Orthogonal hp-FEM for Elliptic Problems Based on a Non-Affine Concept. In: Proceedings of ENUMATH 2005 (Santiago de Compostela, Spain, July 2005), Springer-Verlag.
16. T. Vejchodsky, P. Solin, M. Zitka: On Some Aspects of the hp-FEM for Time-Harmonic Maxwell's Equations. In: Proceedings of ENUMATH 2005 (Santiago de Compostela, Spain, July 2005), Springer-Verlag.
17. R. Muhanna, V. Kreinovich, P. Solin, J. Chessa: Interval Finite Element Methods: New Directions. In: Proceedings of Reliable Engineering Conference (REC 2006), Georgia Tech, Savannah, February 2006, pp. 229 - 245, 2006.
18. P. Solin, T. Vejchodsky, M. Zitka: Orthogonal hp-FEM for Elliptic Problems Based on a Non-Affine Concept. In: Numerical Mathematics and Advanced Applications (Proceedings of ENUMATH 2005; A. Bermudez, D. Gomez, P. Quintela, P. Salgado Eds.), Springer, 2006, pp. 683 - 690.
19. T. Vejchodsky, P. Solin, M. Zitka: On Some Aspects of the hp-FEM for Time-Harmonic Maxwell's Equations. In: Numerical Mathematics and Advanced Applications (Proceedings of ENUMATH 2005; A. Bermudez, D. Gomez, P. Quintela, P. Salgado Eds.), Springer, 2006, pp. 691 - 699.
20. P. Solin, M. Zitka, I. Dolezel: On hp-Finite Element Method for Singular Electro- and Magnetostatic Problems, In: Proceedings of ISEF, 15 - 17 September 2005, Baiona, Spain, ISBN 84-609-7057-4, 6 pages.
21. P. Karban, I. Dolezel, P. Solin: Computation of General Nonstationary 2D Eddy Currents in Linear Moving Arrangements Using an Integro-Differential Approach, In: Proceedings of ISEF, 15 - 17 September 2005, Baiona, Spain, ISBN 84-609-7057-4, 6 pages.
22. P. Karban, I. Dolezel, P. Solin: Integrodifferential Model of Eddy Currents in Axisymmetric Nonmagnetic Bodies Heated by Moving Inductor. In: Proceedings of International Conference on Research in Electrotechnology and Applied Informatics (ICREAI), August 31 - September 3, 2005, Katowice, Poland, 7 pages.
23. I. Dolezel, J. Barglik, P. Solin, P. Karban, B. Ulrych: Overview of Selected Numerical Methods for Computation of Electromagnetic and Other Physical Fields in

Power Applications. In: Proceedings of International Conference on Research in Electrotechnology and Applied Informatics (ICREAI), August 31 - September 3, 2005, Katowice, Poland, 12 pages.

24. P. Solin, M. Zitka, K. Segeth: Singularities in Electro- and Magnetostatics and Their Efficient Resolution by hp-FEM, Seminar on the Occasion of the 100 Anniversary of Birth of Prof. Vycichlo, Czech Technical University, Prague, 26 - 27 April, 2005, 20 pages.
25. P. Solin, K. Segeth, I. Dolezel: Numerical quadrature for higher-order finite element methods. Lecture Notes of IMAMM 03. (Proc. of the Industrial Mathematics and Mathematical Modelling, Roznov p. R. 2003.) Ostrava, VSB - Technical University of Ostrava 2005, pp. 121-130.
26. I Dolezel, P. Solin, L. Musil, B. Ulrych, P. Karban, J. Barglik: Techniques of Processing Solid and Liquid Metals Based on Electromagnetic Induction. In. Proceedings of SPETO 05, September 12 - 14, 2005, Pilsen, Czech Republic, pp. 1-12.
27. P. Solin, K. Segeth: Towards Optimal Shape Functions for Hierarchical Hermite Elements. In: Proceedings of the SANM conference, Srni, Czech Republic, 2005.
28. K. Segeth, P. Solin, I. Dolezel: Higher-order numerical quadrature in 2D and 3D. International Conference Presentation of Mathematics ICPM'04. (Proceedings of Conference, Liberec 2004.) Liberec, Technical University of Liberec 2005, pp. 203-210.
29. M. Zitka, P. Solin, K. Segeth: PARSYS\_2D – a higher-order FE solver for systems of nonlinear elliptic and parabolic equations. In: ECCOMAS 2004 CD ROM Vol. 2. (Proc. of Congress, Jyvaskyla 2004.) Jyvaskyla, University of Jyvaskyla 2004, 15 pp.
30. M. Zitka, P. Solin, K. Segeth: The hp-FEM Solver PARSYS\_2D and Applications in Electrostatics, IGTE Conference, September 2004, Graz, Austria. Publishing House Graz University of Technology, pp. 51 - 56.
31. P. Solin, K. Segeth: Three ways of Interpolation on Finite Elements, In: Proceedings of Programs and Algorithm of Numerical Mathematics (PANM) 12, Mathematical Institute of the AS CR 2004, pp. 230-241.
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33. K. Segeth, P. Solin: Application of the Method of Lines to Flow Problems, Proceedings of Workshop Simulation, Modelling and Numerical Analysis (SIMONA), Technical University of Liberec, 1 - 3 Sept. 2003, pp. 1 - 15.

34. K. Segeth, P. Solin, M. Zitka: Higher-order Methods of Lines and Error Estimates for 2D Nonlinear Parabolic Problems, Proceedings of Summer School SANM 2003, Hejnice, Czech Republic, pp. 109 - 117.
35. P. Solin, K. Segeth, I. Dolezel: Numerical quadrature for higher-order finite element methods, IMAMM Summer School, June 2003, Roznov, Czech Republic.
36. P. Solin, K. Segeth, I. Dolezel: Design of Scalar and Vector-Valued Hierarchic Finite Elements in 2D and 3D, In: CD-ROM Proceedings of ADMOS, Goteborg, Sept 29 - Oct 1, 2003, pp. 45 - 66.
37. P. Solin, L. Demkowicz: Automatic Goal-Oriented hp-Adaptivity Without Error Estimates, Proceedings of ENUMATH 2003 (August 2003, Prague, Czech Republic), Numerical Mathematics and Advanced Applications 5, Berlin, Springer 2004, 775 - 785.
38. M. Zitka, K. Segeth, P. Solin: Higher-order FEM for systems of nonlinear parabolic PDEs with a-posteriori error estimates, Proceedings of ENUMATH 2003 (August 2003, Prague, Czech Republic), Numerical Mathematics and Advanced Applications 5, Berlin, Springer 2004, 854 - 863.
39. J. Haskovec, P. Solin: On a novel technique for parallel unstructured mesh generation in 3D, ENUMATH 2003 (August 2003, Prague, Czech Republic), Numerical Mathematics and Advanced Applications 5, Berlin, Springer 2004, 420 - 429.
40. I. Dolezel, P. Solin, B. Ulrych, J. Haskovec: Integral Solution of Eddy Current Problems in Nonmagnetic Media, IGTE Graz, Austria, 16.-18.9. 2002, pp. 327 - 330.
41. K. Segeth, P. Solin: Some Remarks on the Method of Lines Applied to Nonstationary Compressible Euler Equations. In: ACOMEN 2002 CD-ROM. (Proc. of Conference, Liege 2002.) Liege, Universite de Liege and Universiteit Ghent 2002, 10 pp.
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43. P. Solin, K. Segeth: Adaptive Solution of Higher-Order Finite Element Discretized PDE's. In: Programs and Algorithms of Numerical Mathematics. (Proceedings of Summer School, Dolni Maxov 2002, invited plenary lecture), June 10 - 14, 2002, Plzen, University of West Bohemia 2002, pp. 232 - 248.
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45. P. Solin, I. Dolezel, M. Skopek, B. Ulrych: Stationary temperature field produced by external harmonic electromagnetic field in non-ferromagnetic thick metal slabs, SPETO 2001 International Conference, May 23-26 2001, Gliwice-Ustron, Poland, pp. 143 - 146.
46. P. Solin: Modelling of Orifice Flow in Complex Thermodynamic Cycle Simulations, Engineering Mechanics 2001, 14-17 May 2001, Svatka, Czech Republic, CD-ROM proceedings.
47. P. Solin, I. Dolezel, M. Skopek, B. Ulrych: Integral Mathematical Model of Induction Heating of Thick Nonmagnetic Plates, International Conference HIS 2001, 12 - 14 September 2001, Padua, Italy, ISBN 88-86281-64-1, pp. 182 - 190.
48. J. Barglik, I. Dolezel, P. Solin, B. Ulrych: High Frequency Induction Drying of Axisymmetric Metal Bodies, International Conference AMTEE 2001, 12 - 14 September 2001, Pilsen, Czech Republic, ISBN 80-7082-756-4, pp. A01 - A06.
49. I. Dolezel, P. Solin, B. Ulrych: Fieldless Methods for the Simulation of Stationary and Non-Stationary Induction Heating, EQUADIFF 10 CD ROM (Proc. of Conference, Praha, August 25 - 29, 2001), Masaryk University Publishing House Brno 2002, Czech Republic, pp. 143 - 157.
50. P. Solin, K. Segeth: Non-uniqueness of solution to quasi-1D compressible Euler equations. EQUADIFF 10 CD ROM (Proc. of Conference, Praha, August 25 - 29, 2001), Masaryk University Publishing House Brno 2002, pp. 379 - 389.
51. I. Dolezel, P. Solin, B. Ulrych: Fieldless Methods for the Simulation of Induction Heating of 3D Non-Ferromagnetic Metal Bodies, SANM 10 International Conference, September 3 - 7, 2001, Kvilda, Czech Republic, pp. 59 - 72.
52. K. Segeth, P. Solin, M. Kocirik: Some algorithmic aspects of higher-order finite element schemes in multidimensions. In: Software and Algorithms of Numerical Mathematics 14. (Proceedings of Summer School, Kvilda 2001, invited plenary lecture), September 3 - 7, 2001, Plzen, University of West Bohemia 2002, pp. 199 - 221.
53. P. Solin: Application of the Method of Lines to the Compressible Navier-Stokes Equations, Engineering Mechanics 2000, pp. 195 - 200, 15-18 May 2000, Svatka, Czech Republic.
54. P. Solin, K. Segeth: Application of the Method of Lines to Nonstationary Compressible Flows - Computational Aspects (Czech), PANM'2000, 12 - 16 July 2000, Libverda, Czech Republic, pp. 162 - 173.
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61. P. Solin: Finite Volume Methods for Three-Dimensional Inviscid Compressible Flow, In: Proceedings of Workshop Actual Problems in Fluid Dynamics, Prague, February 19, 1997, CD-ROM proceedings.
62. P. Solin: Computation of Riemann Invariants for Hyperbolic Systems, In: Proceedings of IMAMM Workshop, Cheb, June 30 - July 4, 1997.
63. P. Solin: Numerical Treatment of Dirichlet Boundary Conditions for Hyperbolic Problems, In: Proceedings of NMICM Conference, Prague, September 7 - 11, 1997.
64. P. Solin: Higher-Order Finite Element Methods for Viscous Compressible Flow, In: Proceedings of WDS Workshop, Prague, June 24 - 29, 1997.
65. P. Solin: Moving Particle Scheme for Triangular Grid Generation, In: Proceedings of Software and Algorithms of Numerical Mathematics, Nectiny, September 1999.
66. V.Dolejsi, M.Feistauer, J.Felcman, P. Solin: Numerics for Convection Dominated Flow, In: Proceedings of Software and Algorithms of Numerical Mathematics, Nectiny, September 1999.
67. M. Skopek, P. Solin, B. Ulrych: Mantling and Dismantling of Rivet Joints by Induction Generated Heating, In Proceedings of MARC Users Conference, Stirin, May 1999, ISBN 80-238-4292-7, pp. 82 - 91.

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69. P. Solin: Construction and Implementation of Finite Volume Solvers for 3D Euler Equations, Czech - U.S. Workshop on Iterative Methods and Parallel Computing, Milovy, May 16 - 21, 1997, CD-ROM proceedings.
70. P. Solin: Semi-Implicit Discretization of 3D Euler Equations by the Finite Volume Method, International School on Theory and Numerics for Conservation Laws, Freiburg, October 20 - 24, 1997, CD-ROM proceedings.
71. P. Solin: Unique Solvability and Precise Numerical Solution of Semi-Discretized Euler Equations, AMIF - ESF International Conference, San Feliu de Guixols, Spain, October 1 - 3, 1998, CD-ROM proceedings.
72. P. Solin: Mesh generation Tool XGEN based on an electromagnetic analogy, Engineering Mechanics 2001, 14-17 May 2001, Svatka, Czech Republic, CD-ROM proceedings.
73. I. Dolezel, P. Solin, B. Ulrych: Fieldless Method for the Simulation of Induction Heating, EQUADIFF 10, held 27 - 31 August 2001 in Prague, Czech Republic, CD-ROM proceedings.

#### Technical Reports and Survey Papers:

1. P. Solin, L. Demkowicz: Automatic Goal-Oriented hp-Adaptivity for Elliptic Problems, TICAM Report 02-32, (PDF version here, 31 pages), The University of Texas at Austin, August 2002.
2. P. Solin: Scalar and Vector-Valued Finite Elements of Variable Order, TICAM Report 02-36, (85 pages), The University of Texas at Austin, October 2002.
3. I. Mardanova, G. Cardwell, P. Solin, L. Demkowicz: Radiation from a Loop Antenna Wrapped Around a Metallic Cylinder Into a Conductive Medium, TICAM Report, The University of Texas at Austin.
4. P. Solin: P. Wesseling, Principles of Computational Fluid Dynamics, (Springer Series in Computational Mathematics, Vol. 29, 644 pages, Springer, Berlin Heidelberg New York Tokyo), Surveys on Mathematics for Industry.
5. I. Dolezel, P. Solin, B. Ulrych, M. Skopek, J. Barglik: Modelling of the Induction Heating of Metallic Materials and Connected Technological Processes - Part I, ELEKTRO, Vol. 11, 2001, No. 12, pp. 2 - 4, (in Czech).
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7. P. Solin: Towards Complex Thermodynamic Circuit Simulation I (Computational Fluid Dynamics), IMCC Report for AVL List Graz, GmbH, Institute of Industrial Mathematics, Johannes Kepler University, Linz, January 2001.
8. P. Solin: Towards Complex Thermodynamic Circuit Simulation II (Quasi-1D Modelling of Orifice Flow), IMCC Report for AVL List Graz, GmbH, Institute of Industrial Mathematics, Johannes Kepler University, Linz, March 2001.
9. P. Solin: Energy Treatment in the CFD-Part of the Software Package AVL-BOOST, IMCC Report for AVL List Graz, GmbH, Institute of Industrial Mathematics, Johannes Kepler University, Linz, August 2001.
10. P. Solin: Further Proposals for the Optimisation of the Software Product AVL-BOOST, IMCC Report for AVL List Graz, GmbH, Institute of Industrial Mathematics, Johannes Kepler University, Linz, December 2001.

Invited Lectures:

1. P. Solin et al: Adaptive Higher-Order Finite Element Methods for Multiphysics Coupled Problems, CE Seminar, Technical University of Darmstadt, 22 July 2010.
2. P. Solin, O. Certik, S. Regmi, A. Poudel: Making Scientific Computing Available to Everyone, Junior Science and Humanities Symposium (JSHS), Circus-Circus Casino, Reno, 18 March 2010.
3. P. Solin et al: The FEMhub Project and Classroom Teaching of Elementary Numerical Methods, Oregon State University, Corvallis, November 2 - 3, 2009.
4. P. Solin et al: Computing with Adaptive Higher-Order Finite Elements, Oregon State University, Corvallis, November 2 - 3, 2009.
5. P. Solin et al: Solving Nonstationary Multiphysics PDE Problems with Space-Time Adaptive hp-FEM on Dynamical Meshes, Idaho National Lab, Idaho Falls, September 9, 2009.
6. P. Solin et al: Hermes and FEMhub Projects, SciPy 2009 Conference, Caltech, Pasadena, August 18 - 23, 2009.
7. P. Solin et al: Computing with Adaptive Higher-Order Finite Elements, CST Darmstadt, Germany, August 3, 2009.
8. P. Solin et al: Solving Multiphysics PDE Problems with Space-Time Adaptive hp-FEM on Dynamical Meshes, INRIA, Sophia-Antipolis, France, July 16, 2009.
9. P. Solin et al: Computing with Adaptive Higher-Order Finite Elements, Institute of Physics, Academy of Sciences of the Czech Republic, July 14, 2009.

10. P. Solin et al: Computing with Adaptive Higher-Order Finite Elements, New Technologies Research Centre, Pilsen, June 30, 2009.
11. P. Solin et al: Solving Multiphysics PDE Problems with Space-Time Adaptive hp-FEM on Dynamical Meshes, Dortmund University of Technology, Dortmund, Germany, June 15, 2009.
12. P. Solin, D. Andrs, O. Certik, et al: Adaptive Finite Element Methods: From PDE to Image Compression, Department of Computer Science and Engineering, University of Nevada, Reno, April 3, 2009.
13. P. Solin: Adaptive Multi-Mesh hp-FEM for Time-Dependent Multi-Physics Problems, Los Alamos National Lab, August 2008.
14. I. Dolezel, P. Karban, P. Solin, B. Ulrych: Coupled Problems in Power Engineering Applications, International Conference Electric Power Engineering 2008, Brno, Czech Republic.
15. P. Solin: On the hp-FEM: From the Laplace Equation to Coupled Problems on Multiple Meshes, Applied Mathematics Seminar, University of Houston, March 2007.
16. P. Solin: On hp-FEM for Symmetric Elliptic Problems, University of New Mexico, Albuquerque, March 2005.
17. P. Solin: Semi-Orthogonal Shape Functions for hp-FEM, University of Iowa, Iowa City, May 2005.
18. P. Solin: Error Estimation and Automatic hp-Adaptivity in hp-FEM, The University of Texas at El Paso, May 2004.
19. I. Dolezel, P. Solin: On Electromagnetic-Thermal Treatment of Metals, The University of Texas at El Paso, October 2004,
20. P. Solin: Hierarchic edge elements for Maxwell's equations, Physics Department, Rice University, Houston (TX), May 2003.
21. I. Dolezel, P. Solin, B. Ulrych: Mathematical and Computer Modeling of Selected Coupled Electromagnetic-Thermal-Mechanical Processes by Nonstandard Techniques, CAAM Department Colloquium, Rice University, September 2003.
22. P. Solin, P. Kloucek, L. Demkowicz: Automatic hp-Adaptivity With No Error Estimates, CAAM Department Colloquium, Rice University, October 2003.
23. P. Solin, L. Demkowicz: Fully automatic goal-oriented hp-adaptivity for elliptic equations, CAAM, Rice University, Houston (TX), May 2002.
24. P. Solin, L. Demkowicz: Fully automatic goal-oriented hp-adaptivity, TICAM, UT Austin, Austin, Texas, September 2002.

25. I. Dolezel, P. Solin, B. Ulrych: Selected Integral Formulations for Electromagnetic and Associated Coupled Problems, TICAM, UT Austin, Austin, Texas, September 2002.
26. I. Dolezel, P. Solin, B. Ulrych: Selected Integral Formulations for Electromagnetic and Associated Coupled Problems, CAAM, Rice University, Houston, Texas, September 2002.
27. P. Solin, I. Babuska: A-Posteriori Error Estimation for Evolutionary Problems Solved by the Method of Lines, TICAM, UT Austin, Austin, Texas, October 2002.
28. I. Dolezel, P. Solin, B. Ulrych: Integral Methodology for the Solution of Selected Electromagnetic and Associated Problems, Department of Mathematics, University of Trento, November 2002.
29. P. Solin: On the Modelling and Numerics in Some Industrial Problems (Simulation Non-Stationary Induction Heating, Non-Uniqueness of Compressible Flow in Nozzles, Constrained Finite Volume Modelling of Compressible Pipe Flow), OCIAM, Oxford University, Oxford (UK), February 2001.
30. P. Solin: On the Non-Uniqueness of Compressible Flow in Axi-Symmetric Geometries, Mathematical Institute of the Academy of Sciences of the Czech Republic, Prague (Czech Republic), 5 October 2001.
31. P. Solin: On the Non-Unique Behaviour of Almost Unidirectional Inviscid Compressible Flows, Mathematical Institute, University of Stuttgart, Stuttgart (Germany), 9 October 2001.
32. P. Solin: On the Non-Unique Behaviour of Almost Unidirectional Inviscid Compressible Flows, On a Class of Novel Fieldless Methods for the Simulation of the Induction Heating, CAAM, Rice University, Houston (TX), October/November 2001.
33. P. Solin: On the Construction of the Osher-Solomon Scheme for the Finite Volume Discretisation of the Three-Dimensional Compressible Euler Equations, Mathematical Institute of the Academy of Sciences of the Czech Republic, Prague (Czech Republic), September 1996.
34. P. Solin: Analytical and Numerical Techniques for the Simulation of Transonic Flows in Tubes, Pipes, Ducts and Nozzles, Mathematical Institute, Technical University of Brandenburg, Cottbus (Germany), May 2000..
35. P. Solin: Analytical and Numerical Techniques for the Simulation of Transonic Flows in Tubes, Pipes, Ducts and Nozzles, Mathematical Institute, Karls Franzens University, Graz (Austria), May 2000.

36. P. Solin: Analytical and Numerical Techniques for the Simulation of Transonic Flows in Tubes, Pipes, Ducts and Nozzles, Institute of Technical and Economical Mathematics, Kaiserslautern (Germany), June 2000.
37. P. Solin: On Some Analytical and Numerical Techniques in Computational Fluid Dynamics and Computational Electromagnetics (On a Novel Approach to Grid Point Distribution in Unstructured Grid Generation, Construction of the Osher-Solomon Scheme for 3D Compressible Euler Equations, Application of the MOL to the Compressible Euler Equations and Profit from Advanced ODE Solvers, Compressible Flow in Nozzles and Non-Uniqueness of Stationary Solution, Simulation of Cleaning of Wet Steam Flow, Software Package EULER, On a Novel Method for the Induction Heating of Thin Non-Ferromagnetic Metal Slabs in Transversal Harmonic Electromagnetic Field, A Posteriori Error Estimation for Evolution Problems Solved by the Method of Lines), Mathematical Institute, Technical University of Munich, Munich (Germany), October 2000.

## Overview of External Funding

As of August 31, 2010, Dr. Solin attracted grant funding in the amount of **\$1,028,882** (**\$760,487** after joining UNR). A list of funded projects follows:

- 08/2010 - 12/2010: Batelle Energy Alliance LLC (DOE Intermediary) Grant "UNR Fundamental Algorithm Development of *hp*-Adaptive Discontinuous Galerkin Methods", PI: Pavel Solin, **\$86,561**.
- 06/2010 - 12/2010: Idaho National Laboratory Grant "Design of a New Graduate Course *Advanced Computer Modeling for Engineering Applications* at UNR", PI: Pavel Solin, **\$32,525**.
- 09/2009 - 05/2010: Batelle Energy Alliance LLC (DOE Intermediary) Grant "UNR Fundamental Algorithm Development to Support INL Fuel Performance Code Activities", PI: Pavel Solin, **\$54,019**.
- 09/2009 - 08/2012: DOE NEUP Grant "High-Fidelity Space-Time Adaptive Multiphysics Simulations in Nuclear Engineering", PI: Pavel Solin, **\$587,382**.
- 06/2007 - 09/2007: Sandia National Laboratories Contract No. 683215-00 "Design of Adaptive Higher-Order Finite Element Methods for Sandia INTREPID Software", PI: Pavel Solin, **\$23,500**.
- 06/2005 - 05/2006 National Science Foundation, Department of Mathematical Sciences Grant No. DMS-0532645 "Workshop Proposal: Finite Element Methods in Engineering and Science (FEMTEC 2006), El Paso, TX, 11 - 14 December 2006", PI: Pavel Solin, **\$13,200**.

- 09/2005 - 12/2005: UTEP seed money grant "Strengthening Interdisciplinary Research in Computational Science at UTEP", PI: Pavel Solin, **\$32,000**.
- 01/2005 - 12/2006: U.S. Office of Naval Research Grant No. 05PR07548-00: "High-Performance Computing Facility for UTEPs Mathematical Sciences Department", PI: Pavel Solin, **\$199,700**,

## Open Source Projects

By creating free software, Dr. Solin and his collaborators are hoping to bring their novel methods along with other most recent advances in scientific computing closer to the engineering and scientific community.

### Hermes (<http://hpfem.org>)

The open source project HERMES (Higher-Order Modular Finite Element System) comprises the most significant computational methods developed by Dr. Solin. The methods are implemented in the form of a C++ library with Python wrappers. The software already has several hundreds of users throughout the world.

### FEMhub (<http://femhub.org>)

FEMhub (Finite Element Methods hub) is a free distribution of open source scientific computing software with a unified Python interface. The project has multiple goals including facilitating comparisons between various free finite element codes and enabling web-based collaborative development.

## Professional Service

### Organization of International Conferences

Dr. Solin organizes two series of biannual international conferences: *European Seminar on Coupled Problems (ESCO 2008, ESCO 2010)* and *Finite Element Methods in Engineering and Science (FEMTEC 2006, FEMTEC 2009, FEMTEC 2011)*. More details on each conference can be found on its home page.

### Membership in Editorial Boards

Dr. Solin is the member of editorial boards of *Acta Technica*, *Surveys in Mathematics and Its Applications*, and *Advances in Applied Mathematics and Mechanics*. He is the member of three technical committees of IMACS.

### **Service as a Referee**

Dr. Solin serves regularly as referee of grant proposal for the Department of Defense (DOE), for numerous high-impact international scientific journals including SIAM J. Numer. Analysis, Int. J. Numer. Methods Engrg., J. Comput. Phys., Math. Comput. Sim., J. Comput. Appl. Math., Comput. Methods Appl. Math. Engrg., Int. J. Numer. Appl. Math., and Appl. Math. He reviews regularly manuscript proposals for CRC Press and J. Wiley & Sons.

### **Juror Service**

Dr. Solin served as juror for the INTEL ISEF competition for high-school students, Reno, May 2009, and on the regional level for the Junior Science and Humanities Symposium (JSHS) at Fernley high school. He held a keynote address "Making Scientific Computing Available to Everyone" at JSHS national level, Reno, 18 March 2010.

### **Committee Service**

Member of colloquium committee (UNR, January 2010 present), member of colloquium committee (UTEP, 2004 - 2005), chair of colloquium committee (UTEP, 2005 - 2008), member of faculty senate (UTEP, 2006 - 2008), member of undergraduate recruitment committee (UTEP, 2007 - 2008), member of search committee (UTEP, 2007).

### **Awards and Honors**

Bernardo Bolzano Prize (M.S. thesis, 1996), Josef Hlavka Prize (Ph.D. dissertation, 1999), Babuška Prize (Ph.D. dissertation, 1999), TICAM Postdoctoral Fellowship Award (UT Austin, 2001 - 2002), W.M. Rice Postdoctoral Fellowship Award (Rice University, 2002 - 2004), Prize of the First Degree by the President of the Czech Technical University (monograph *P. Šolín, K. Segeth, I. Dolezel: Higher-Order Finite Element Methods (CRC Press/Chapman & Hall, 2003)*, 2004), The article *P. Solin, K. Segeth: Non-Uniqueness of Almost-Unidirectional Inviscid Compressible Flow, Appl. Math. 49, pp. 247 - 268, 2004* was selected as the best paper published in Appl. Math. in 2004.