

Tomáš Dohnal

CONTACT INFORMATION

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RESEARCH INTERESTS

Nonlinear dispersive waves: nonlinear photonic structures (band-gap structures), Coupled Mode Equations, optical bullets, resonance mechanisms, trapping, solitary waves at surfaces, disorder, linear stability of solitary waves
NL Schrödinger Eqs.: perturbations, disorder, dispersion management
Numer. analysis: nonlinear wave IVP's, perfectly matched layers, iterative methods for solitary waves

EDUCATION

University of New Mexico (UNM), Albuquerque, NM, USA

Ph.D., applied mathematics (defended with distinction), Apr. 2005.

- dissertation title: Optical bullets in (2+1)D photonic structures and their interaction with localized defects
- advisor: Prof. Alejandro B. Aceves

M.S., applied mathematics, Dec. 2002

Technical University in Liberec, Liberec, Czech Republic

M.A., teaching of mathematics and of English as a foreign language, Jun. 2000

HONORS AND AWARDS

2005 CAS Student Prize, Center for Advanced Study, UNM, May 2005.

Kyner award: outstanding graduate student in applied mathematics, Department of Mathematics and Statistics, UNM, May 2004

Outstanding graduate oral presentation in mathematics at "Symposium 2003: Championing Scientific Careers", Los Alamos National Laboratories, Aug. 2003

PROFESSIONAL EXPERIENCE

University of Karlsruhe, Department of Mathematics Germany

Postdoc, Research Training Group 1294

from Jul. 2009

'Analysis, Simulation and Design of Nanotechnological Processes'

Humboldt Research Fellowship, University of Karlsruhe, Germany

Institute for Applied and Numerical Mathematics 2

Oct. 2007 - Jun. 2009

host: Prof. Willy Dörfler

Nonlinear photonic crystals - modeling via Coupled Mode Equations, perfectly matched layers, waveguiding by interfaces

ETH - Seminar for Applied Mathematics, Zürich, Switzerland

Postdoc (group of Prof. Ralf Hiptmair)

Sep. 2005 - Oct. 2007

nonlinear waves, periodic structures (photonic crystals), surface waves

University of New Mexico, Albuquerque, NM, USA

Research Assistant

Aug. 2003 - Jul. 2005

nonlinear optics, pulse propagation in photonic structures
principal investigator: Dr. Alejandro B. Aceves

Research Assistant

spring 2003

discontinuous Galerkin methods for modelling of wave propagation

principal investigator: Dr. Timothy Warburton

Teaching Assistant

2001 - 2002

teaching assistant of trigonometry, precalculus and calculus (4 semesters)

Los Alamos National Laboratories, group T7, Los Alamos, NM, USA

graduate student affiliate

summer 2004

perturbed cubic-quintic Nonlinear Schrödinger Equation, deterministic and stochastic models

mentor: Dr. Avner Peleg

graduate student affiliate

summer 2003

continuum models in spreading of infectious diseases

mentor: Dr. James M. Hyman

Euroregionální Gymnázium Liberec, Czech Rep.

1999-00

teaching of English language and theater

STUDENT
SUPERVISION

Nupur Aggarwal (IIT Delhi)- internship at Uni. Karlsruhe, topic: integration of the periodic nonlinear Schrödinger equation with a nonlinearity interface, May - Jul. 2009.

Elizabeth Blank - Diplomarbeit (\sim Master thesis) on spectral stability of surface gap solitons via the numerical Evans function method, Uni. Karlsruhe, Aug. 2008 - Mar. 2009.

Nisha M. Kannookodan - term project on Finite Element Galerkin approximation of Dirac equations, ETH Zurich, 2007.

Sebastian Walter - term project on spurious reflections due to nonuniform grids in finite difference computations of solitary wave propagation, ETH Zurich, 2006.

PUBLICATIONS

E. Blank and T. Dohnal, "Continuation and Stability of Families of Surface Gap Solitons at a Nonlinearity Interface," submitted, 2009. (arXiv:0910.4858)

T. Dohnal, M. Plum and W. Reichel, "Localized Modes of the Linear Periodic Schrödinger Operator with a Nonlocal Perturbation," *SIAM J. Math. Anal.* 41:1967-1993 (2009). (arXiv:0811.4514)

T. Dohnal, "Perfectly Matched Layers for Coupled Nonlinear Schrödinger Equations with Mixed Derivatives." *J. Comp. Phys.* 228:8752-8765 (2009). (arXiv:0905.2321)

A. Peleg, Y. Chung, T. Dohnal, and Q. M. Nguyen, "Diverging probability density functions for flat-top solitary waves," *Phys. Rev. E* 80:026602 (2009). (arXiv:0906.3001)

T. Dohnal and H. Uecker, "Coupled Mode Equations and Gap Solitons for the 2D Gross-Pitaevskii equation with a non-separable periodic potential," *Physica D* 238:860-879 (2009). (arXiv:0810.4499)

T. Dohnal, D. Pelinovsky and G. Schneider, "Coupled-mode equations and gap solitons for a two-dimensional nonlinear elliptic problem with a separable periodic potential," *J. Nonlin. Sci.* 19:95-131 (2009). (arXiv:0707.3731)

T. Dohnal and D. Pelinovsky, "Surface Gap Solitons at a Nonlinearity Interface," *SIAM J. Appl. Dyn. Syst.* 7:249-264 (2008). (arXiv:0704.1742)

T. Dohnal and T. Hagstrom, "Perfectly matched layers in photonics computations: 1D and 2D Nonlinear Coupled Mode Equations," *J. Comput. Phys.* 223:690-710 (2007).

A.B. Aceves and T. Dohnal, "Finite dimensional model for defect-trapped light in planar periodic nonlinear structures," *Opt. Lett.* 31:3013-3015 (2006).

A. Peleg, T. Dohnal and Y. Chung, "Effects of dissipative disorder on front formation in pattern forming systems," *Phys. Rev. E* 72:027203 (2005).

T. Dohnal and A.B. Aceves, "Optical soliton bullets in (2+1)D nonlinear Bragg resonant periodic geometries," J. Yang, editor, *Nonlinear Wave Phenomena in Periodic Photonic Structures*, Studies in Applied Math. 115:209-232 (2005).

A.B. Aceves and T. Dohnal, "Stopping and bending light in 2D photonic structures." Proceedings of OSA topical meeting on Nonlinear Guided Waves and their Applications, Toronto, March 2004.

A.B. Aceves and T. Dohnal, "Stopping and bending light in 2D photonic structures." p. 293 - 302, Proceedings of the NATO Advanced research workshop "Nonlinear Waves: Classical and Quantum Aspects", Estoril, Portugal. Kluwer Acad. Publishers (2004).

INVITED
COLLOQUIUM
PRESENTATIONS

"Coupled Mode Equations for Gap Solitons in 2D Periodic Structures with Finite Contrast," Department of Mathematics, Southern Methodist University, Dallas, USA, Mar. 2009.

"Surface Gap Solitons at a Nonlinearity Interface in the Periodic Schrödinger Equation," Fakultät Mathematik, Universität Oldenburg, Germany, Jun. 2008.

"Nicht ganz uebliche Wellen - Solitonen und Gap Solitonen," colloquium, Berliner Mathematische Gessellschaft and Freie Universität Berlin, Germany, May 2008.

"Interactions of 2D Gap Solitons with Localized Defects - Numerical Study," Institut für Analysis und Modllierung, University of Stuttgart, Germany, Apr. 2007.

"Solitary waves in nonlinear periodic structures - (quasi) gap solitons -," Czech Academy of Science, Institute of Radio Engineering and Electronics, Prague, Oct 2006.

"Asymptotic and Numerical Results on Solitary Waves in 2D Bragg Gratings," research group POems, ENSTA, Paris, Oct. 2006.

CONFERENCE
PRESENTATIONS

"Coupled Mode Equations for Gap Solitons in the 2D Periodic Nonlinear Schrödinger Equation," Waves 2009, Pau, France, Jun. 2009.

"Perfectly Matched Layers in Nonlinear Coupled Mode Equations," Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory, Athens, Georgia, USA, Mar. 2009.

"Surface Gap Solitons at a Nonlinearity Interface in the Periodic Schrödinger Equation," Workshop on Pulses and Modulations in Nonlinear Systems, Universität Stuttgart, Germany, Feb. 2009.

"Surface Gap Solitons at a Nonlinearity Interface," Nonlinear Waves - Theory and Applications, Beijing, China, Jun. 2008.

"2D Surface Gap Solitons at a Nonlinearity Interface," (poster) 403rd WE-Heraeus-Seminar "Periodic Nanostructures in Photonics", Bad Honnef (Germany), Feb. 2008.

“Surface Gap Solitons at a Nonlinearity Interface,” minisymposium on Strongly-nonlinear phenomena in optical and/or periodic media, ICIAM, Zurich (Switzerland), Jul. 2007.

“Gap solitons and coupled mode equations in two-dimensional low and finite contrast periodic media,” special themed session on Photonic crystals, Dynamics Days Europe, Loughborough (UK), Jul. 2007.

“Gap Solitons in 2D Photonic Crystals - Modeling and Numerics,” (poster) 386th WE-Heraeus-Seminar “Computational Nano-Photonics”, Bad Honnef (Germany), Feb. 2007.

“Gap Solitons in 2D Bragg Gratings with Periodicity on Two Scales,” 2006 SIAM Conference on Nonlinear Waves and Coherent Structures, Univ. of Washington, Seattle, USA, Sep. 2006.

“Solitary waves in doubly periodic nonlinear photonic waveguides,” (poster) Schweizer Numerik Kolloquium, EPFL, Lausanne, Apr. 2006.

“Interaction of Novel 2D Gap Solitons with Defects,” Nonlinear Guided Waves and Their Applications, Topical Meeting of OSA, Dresden, Germany, Sep. 2005.

“Optical bullets in (2+1)D photonic structures and their interactions with localized defects,” Center for Advanced Study, Univ. of New Mexico, Albuquerque, NM, USA, May 2005.

“Optical Trapping and Bending of Solitons in Nonlinear Periodic Structures,” (presented by A.B. Aceves) SIAM Nonlinear Waves and Coherent Structures, Univ. of Central Florida, Orlando, FL, Oct. 2004.

“Localized Stable Solitary Wave Bullets in 2D Periodic Structures,” (poster) Frontiers in Applied and Computational Mathematics, New Jersey Institute of Technology, Newark, NJ, May 2004.

“Stopping and Bending Light in 2D Photonic Structures,” (poster) OSA topical meeting on Nonlinear Guided Waves and their Applications, Toronto, Mar. 2004.

“Soliton Bullets in 2D Photonic Structures with Defects,” Arizona Days 2004, Los Alamos National Laboratories, Jan. 2004.

“Continuum Models for Disease Spreading - one and two species case,” S.C.A.M. seminar, Department of Mathematics, UNM, Albuquerque, NM, USA, Sep. 2003.

“Continuum Models for the Spread of a Disease Between Two Species,” Symposium 2003: Championing Scientific Careers, Los Alamos National Laboratories, Los Alamos, NM, USA, Aug. 2003.

TEACHING
EXPERIENCE
(MATHEMATICS)

University of Karlsruhe, Germany

Applied Mathematic Seminar

summer 09

Mathematical Modeling in Natural Sciences and Engineering (seminar)

summer 08

Mathematical Topics in Photonic Crystals (graduate level - 1/2 semester) **winter 07/08**

ETH Zürich, Zürich, Switzerland

Inverse Problems - Theory and Numerical Treatment (graduate level)
assistant

summer 07

Theory and Numerics of Solitary Waves (undergraduate/graduate level) - elective seminar

(sole instructor) - introduction to solitons and solitary waves, iterative methods for their computation and methods for their numerical time integration **winter 06/07**

Numerical Mathematics II (undergraduate level) - exercise class in ODE numerical integration and Krylov space methods **summer 06**

Geometric Numerical Integration (undergrad./graduate level) - elective seminar - supervision of students preparing presentations (incl. programming tasks), main source: *B. Hairer et al, Geometric Numerical Integration, Springer 2002* **winter 05/06**

University of New Mexico, Albuquerque, NM, USA

trigonometry, precalculus, calculus I, calculus II (undergrad. level) - one semester each, both lecture and exercise (sole instructor) **summer 01 - fall 02**

WORKSHOPS,
SUMMER SCHOOLS
(PARTICIPATION)

“Mathematical Modeling in Photonic Crystals,” University of Karlsruhe, Germany, Oct. 2006.

“Stability and instability of nonlinear waves,” University of Washington, Seattle, WA, USA, Sept. 2006.

“Global and Geometric Aspects of Nonlinear Partial Differential Equations,” ESF Programme, Switzerland, July 2006.