

VITTORIO RISPOLI

Curriculum vitae

February 6, 2012

University of Ferrara

Department of Mathematics,
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Personal Informations

Born in Termoli (CB) - Italy, on August 6, 1983.

Home address: Via Palestro, 11 - 44100 Ferrara (FE) - ITALY

Education

- **PhD in Mathematics** (Dottorato di Ricerca in Matematica) at University of Padova, on November 11, 2011.
Thesis title: *Physical properties of Carbon Nanotubes by computational methods*.
Supervisor: Prof. Maria Morandi Cecchi, University of Padova. Thesis defense scientific committee: Prof. Fabio Marcuzzi - University of Padova, Prof. Nicola Guglielmi - University of L'Aquila, Prof. Giovanni Russo - University of Catania.
- **Master's Degree** in Mathematics (Laurea Magistrale in Matematica) at University of Pisa, on October 26, 2007, final mark: 106/110.
Thesis title: *I problemi di "Posizionamento" e di "Irrigazione" ottimi*. (The "optimal Location" and "optimal Irrigation" problems.)
Supervisor: Prof. Giuseppe Buttazzo, University of Pisa;
- **Beachelor's Degree** in Mathematics (Laurea Triennale in Matematica) at University of Pisa, on January 29, 2006, final mark: 107/110.
Thesis title: *Il "valore rendez-vous" di uno spazio metrico*. (The "rendez-vous" value of a metric space)
Supervisor: Prof. Paolo Acquistapace, University of Pisa.
- **High School Diploma**, Liceo Scientifico, Termoli (CB), Final Mark: 100/100.

Visiting

Exchange Program at *Endo Laboratory*, "Institute of Carbon Science & Technology", Dept. of Electrical and Electronic Engineering, Shinshu University, Nagano, Japan.

Period: from August 30, 2009 to November 30, 2009.

Scholarships

- PhD grant in Computational Mathematics, University of Padova.
Period: from January 1, 2008 to December 31, 2010 (XXIII cycle).
- scholarship from Department of Electrical and Electronic Engineering,
Faculty of Engineering, Shinshu University, Nagano, Japan.

Presented seminars and talks

- V. Rispoli, Numerical simulations of the physical properties of Carbon Nanotubes, Num-Lab Seminar, Dept. of Pure and Applied Mathematics, May 25, 2011, Padova;
- V. Rispoli, Numerical simulation of the electrical behavior of Carbon Nanotubes, PhD Seminar, Dept. of Pure and Applied Mathematics, February 16, 2011, Padova;
- M. Morandi Cecchi, V. Rispoli, *Numerical solution of electrons and phonons coupled dynamics in Carbon Nanotubes*, X SIMAI (Società Italiana per la Matematica Applicata e Industriale) Congress, in collaboration with SEMA, June 21 – 25, 2010, Cagliari;
- V. Rispoli, *Carbon Nanotube Modeling for improved simulations*, talk at Department of Mechanical Systems Engineering, Faculty of Engineering, Shinshu University, November 27, 2009, Nagano (Japan);
- V. Rispoli, *Carbon Nanotubes Modeling by an algebraic point of view*, GNCS Congress 2009, February 3 – 5, 2009, Montecatini Terme (PT);
- M. Morandi Cecchi, V. Rispoli, M. Venturin, *An Atomic-Scale Finite Element Method for Single-Wall Carbon Nanotubes*, IX SIMAI Congress (in collaboration with SIAM), September 15 – 19, 2008, Roma.

Attended schools and conferences

- 2010 June 21 – 25, IX SIMAI Congress, Roma.
- 2010 February 9 – 11, course on “Ottimizzazione di codici scientifico-tecnici” (Scientific-technical codes optimization), at CASPUR, Roma.
- 2009 June 22 – 26, Dobbiaco Summer School, “ODEs with Discontinuous Right-Hand Side: Theory and Applications”, Dobbiaco (BZ).
- 2009 February 3–5, GNCS (Gruppo Nazionale Calcolo Numerico) Congress, Montecatini Terme (PT).
- 2008 October 9, “Isogeometric Analysis: Toward Unification of Computer Aided Design and Finite Element Analysis”, Prof. T. Hughes, Milan.
- 2008 September 15 – 19, IX SIMAI Congress, Roma.
- 2008 June 23–27, Dobbiaco Summer School, “Molecular Dynamics and Time Integration of PDEs”, Dobbiaco (BZ).

- 2008 June 6, INDAM day, Padova.

Publications

- V. Rispoli, *Kinetic modeling of Carbon Nanotubes' electrics with self consistent determination of electron-phonon coupling constants*, Phys. Rev. B. In preparation.
- M. Morandi Cecchi and V. Rispoli, *Numerical solution of electrons' and phonons' coupled dynamics in carbon nanotubes*, Communications in Applied and Industrial Mathematics, doi: 10.1685/journal.caim.379 (2011) ISSN: 2038 – 0909.
- M. Morandi Cecchi, V. Rispoli and M. Venturin, *An Atomic-Scale Finite Element Method for Single-Wall Carbon Nanotubes*, Applied and Industrial Mathematics in Italy III, editors R. Spigler, E. De Bernardis and V. Valente, volume 82 of Series on Advances Mathematics for Applied Sciences, pages 449 – 460. World Scientific Singapore (2009) ISSN: 1793 – 0901.

Research interest

The activity carried out during the PhD years regarded the simulation of Carbon Nanotubes (CNTs) physical properties by computational methods. Such work represents a contribution to the world-wide scientific research, both theoretical and experimental, regarding nanotechnology and its outstanding applications. Difficulties concerned essentially two main aspects: studying and improving the physical problem modeling and developing reliable numerical methods to solve and/or approximate the obtained dynamic of the system.

The main subject of interest were electrical properties of CNTs: our aim was to simulate the current generation inside of a nanotube when electric potential difference is applied at its ends.

Our main contribution to the physical modeling of this problem was to introduce an explicit formula to compute in a self-consistent way Electron-Phonon Coupling (EPC) parameters during the time evolution of the system. We considered a much less simplified formulation of the Fermi golden rule and used a lot of the computed system's data to compute the evolution of the system.

From the mathematical point of view, the given problem constitutes a system of multi-dimensional hyperbolic Conservation Laws with source terms at the right hand side. The numerical treatment of a problem of this type is a very difficult task, given the lack of a general theory regarding approximation methodologies which could guarantee reliability of the obtained results. Such difficult task gave me the opportunity to deeply study the theory regarding hyperbolic partial differential systems of equations and all the related problems regarding their numerical treatment. As a result of the studies I obtained very good knowledge and many skills regarding many numerical methods, in their Finite Differences or Finite Volumes versions, using fully discrete or quasi-continuous formulations. Since they were necessary for our targets, I delved into the theory of high-order reconstruction methods for derivatives approximations and Total Variation Diminishing time-integration schemes, especially designed for hyperbolic equations; I mostly used ENO and WENO methods and Runge-Kutta definitions of TVD time integrators. We also conducted an adimensional analysis of the equations under consideration, theoretically justifying most of our choices for the adopted numerical scheme. Thanks to the presented numerical scheme for the numerical approximation of our differential

problem, we found very good results in a wide range of situations. Even if qualitative criteria need yet to be proved, the proposed method can be used as a reliable reference scheme for computations of this type.

Other activities

From January to May 2011: I participated to the development and implementation of the website "JackSMS" (<http://www.jacksms.it/> now evolved in "<http://www.freesmee.com/>"). For this work, we developed a semantic interpreter and I contributed to the software and algorithmic definitions; to this aim, I deeply studied Natural Language Programming and semantic recognition.

Language skills

- **Italian** - mother tongue;
- **English** - fluent;
- **Japanese** - basic.

Computing skills

- **Programming languages:** C, C++ (both used to write all my scientific codes), MATLAB, Java;
- **Packages:** Code::Blocks, LAMP;
- **Operative System:** Ubuntu Linux, Microsoft Windows;

Ferrara, 06.02.2012

Vittorio Rispoli
