Curriculum Vitae - Dario Tamascelli

Dario Tamascelli, Dipartimento di Informatica Università degli Studi di Milano, via Comelico 39/41 20135 Milano Italy	Phone: +39 02 50316379 Mobile: +39 347 8935789 E-mail: tamascelli@di.unimi.it Home Page: http://homes.di.unimi.it/~tamascelli

GENERAL INFORMATION

First Name: Dario
Last Name: Tamascelli
Born: Milan, December, 4-th 1977
Nationality: Italian

PROFESSIONAL POSITION

Since September 2014, Visiting Researcher at the Institut für Theoretische Physik, Ulm Universität (prof. Martin Plenio research group).

Since February 2014, Assistant Professor at the Department of Physics, Università degli Studi di Milano.

From September 2007 to January 2014, Assistant Professor at the Department of Information Science, Università degli Studi di Milano.

EDUCATION

March 2, 2007, Ph.D. in Applied Mathematics with full marks, Università degli Studi di Milano
Ph.D. Thesis: "Interacting Quantum Walks".
Supervisor: D. de Falco

May 6. 2003, Master Degree in Information Science with full marks and honors (110/110 cum laude) , Università degli Studi di Milano.
Master Thesis: Quantum Synchronization Problems.
Supervisors: D. de Falco, A. Bertoni.

September 2001-March 2002: Erasmus sojourn at the Brandenburgische Technische Universität Cottbus, Germany.

RESEARCH ACTIVITY

Main research Area: Quantum Computation and simulation.

Research interests: quantum computation, quantum transport, quantum annealing, stochastic processes, GPU computing.

Research Topics:

Improved Matrix Product States (MPS) techniques.

When the amount of entanglement in a quantum system is limited, the relevant dynamics of the system is restricted to a very small part of the state space. When restricted to this subspace the description of the system becomes efficient in the system size. A class of algorithms, exemplified by the Time-Evolving Block-Decimation (TEBD) algorithm, make use of this observation by selecting the relevant subspace through a decimation technique relying on the Singular Value Decomposition (SVD). In these algorithms, the complexity of each time-evolution step is dominated by the SVD. Here we show that, by applying a randomized version of the SVD routine (RRSVD), the power law governing the computational complexity of TEBD is lowered by one degree, resulting in a considerable speed-up. We exemplify the potential gains in efficiency at the hand of some real world examples to which TEBD can be successfully applied to and demonstrate that for those system RRSVD delivers results as accurate as state-of-the-art deterministic SVD routines (see Ref. 15).

GPU Accelerated Molecular Dynamics.

Graphics Processing Units make the power of hundreds of small processors available in a simple desktop computer. While not suited for all computational problems, GPU can considerably speed up the execution of highly demanding simulation codes, such as the Monte-Carlo based Molecular Mechanics ones. (see Ref 13)

Adiabatic quantum computation.
Adiabatic computation is a quantum computation paradigm equivalent to the circuital one. Similarly to the simulated thermal annealing technique, the solution of hard optimization problems is encoded into the ground state of an Hamiltonian. The target ground state is then reached starting from an arbitrary (easy to prepare) initial state and letting the evolution undergo a time-dependent Hamiltonian which interpolates between the initial one and the final one. By taking into account the features of the space of admissible solutions to the input problem, it is possible to restrict the evolution to a much smaller subspace; in this way the search of the solution of the input optimization problem can be made more

effective. (see Ref. 14)

Density functional theory for open spin systems

Under suitable conditions the evolution of an open quantum system can be mimicked by a closed quantum system subject to a suitable time-dependent potential. Conversely, the detrimental effects of noise and decoherence on a quantum system can be compensated by means of time-dependent potentials. See Reference 11.

Noise-assisted quantum transport and quantum computation.

The transmission of an excitation along a line can be hindered by the presence of imperfections. The presence of a thermal bath, usually considered detrimental for transmission, can assist the transport.
In the Interacting Quantum Walk perspective, the motion of the excitation corresponds to a computation. Noise-assisted transport extends to Noise-assisted computation only as long as entanglement is not involved.

Quantum dissipative dynamics and its application to quantum annealing.

The Schrödinger-Langevin-Kostin equation describes the unitary effective dynamics of a quantum system interacting with a dissipative environment. The unitary dissipative evolution can be exploited to suppress genuinely quantum effects such as Anderson localization and Bloch oscillations. Moreover, it may stabilize quantum annealing with respect to level crossing.
See References: 7, 8, 9.

Quantum dynamics by means of classical stochastic processes.

It is believed that quantum walks are able to visit some kind of graph faster that any classical random walk. We showed that, if the graph is the discretized line, it is possible to can define a completely classical controlled stochastic process, which behaves as the quantum counterpart.
See References: 5, 6.

Feynman quantum computer (Master and Ph.D. Thesis)

The model of quantum computer proposed by R.P. Feynman in 1985 uses an internal “clock” quantum clock to synchronize the application of the computational primitives to the input/output register. I contributed to investigate the timing problems and the appearance of irreversibility in a model of reversible computation.
See References: 1, 2, 3, 4, 10, 12.

GRANTS

- 2007 "*PUR*", Università degli Studi di Milano
- *2009* "*Cinque per mille*", starting grant by the Università degli Studi di Milano.
- *2013-14, 2014-15 LISA* "Interdisciplinary Laboratory for Advanced Simulation", CINECA High Performance Computing center. *Project title: Design of new material for the reduction of pollutant through quantum and semiclassical computational methods.*
- 2014 Piano Sviluppo UniMi. *Project Title: Generation, characterization and application of continuous-variable non-classical states for the application in quantum information protocols.*

REFEREE FOR

MIUR (Ministero dell'Università e della Ricerca), Journal of Physics A: Mathematical and Theoretical, Neural Networks.

CONFERENCES/SCHOOLS/VISITS

- Quantum Simulations and Quantum Walks, Centro di Ricerca Matematica Ennio De Giorgi, Pisa, November 11th-15th. Contributed Talk.
- Noise Information and Complexity at the Quantum Scale, Communication at the Quantum Scale, Erice, October 6th-13th.
- Invited Seminar on Wave-Function Monte Carlo methods, Mathematics Department, Politecnico di Milano. October 4th 2011.
- QIP 2010, 13-th Workshop on Quantum Information Processing, Zurich, Swiss, 15-22 January 2010 - Poster.
- QIPC 2009, International Conference on Quantum Information Processing and Communication. Rome, Italy, September 21-25, 2009 - Poster.
- ICTCS '09. 11th Italian Conference on Theoretical Computer Science. Cremona, Italy, September 28-30, 2009 - Contributed Talk.
- 29th Conference: Quantum Probability and White Noise Analysis. Hammamet, Tunisia, October 13-18, 2008, - Contributed Talk.

- D. de Falco Italian Quantum Information Science Conference 2008. Camerino, Italy, October 24-29, 2008 - Contributed Talk.
- SOFSEM 08, Current Trends in Theory and Practice of Computer Science, Novy Smokovec, Slovakia, January 19-25, 2008 - Contributed Talk.
- Noise, Information and Complexity at Quantum Scale, Erice, Italy, November 4-10, 2007 - Poster
- Seminar invited by Prof. Sougato Bose, Interacting Quantum Walk, Department of Physics and Astronomy, University College London. October 12th 2006.
- 7-th European QIPC Workshop- Quantum Information Processing and Communication , London, UK, October 13-14 2006.
- Workshop on Theory and Technology in Quantum Information, Communication, Computation and Cryptography, Abdus Salam International Center for Theoretical Physics, Trieste, Italy, June 17-23 2006.
- School on Theory and Technology in Quantum Information, Communication, Computation and Cryptography, Abdus Salam International Center for Theoretical Physics, Trieste, Italy, June 12-16 2006.
- QIP 2010, 13-th Workshop on Quantum Information Processing
- QIP 2006, 9-th Workshop on Quantum Information Processing, Paris, France, January 16-20 2006.
- STACS05, Symposium on Theoretical Aspects of Computer Science, Stuttgart, Germany, February 24-26 2005.
- QIP 2005, 8thWorkshop on Quantum Information Processing, Boston, US, January 13-17 2005.
- Workshop "Entropy and Relative Entropy in the Mathematical, Physical and Engineering Sciences, Padova, Italy, June 24-26 2004.

LIST OF PUBLICATIONS

Papers:

15- DT, R. Rosenbach and M.B. Plenio, Improved scaling of Time-Evolving Block-Decimation algorithm through Reduced-Rank Randomized Singular Value Decomposition, arXiv:1504.00992 [quant-ph] (to appear in Phys.Rev. E), 2015.

14- DT and L. Zanetti, A quantum-walk-inspired adiabatic algorithm for graph isomorphism, to appear in J. Phys. A: Math. Theor. , 2014.

13- DT, F.S. Dambrosio, R. Conte, M. Ceotto, Graphics processing units accelerated semiclassical initial value representation molecular dynamics, J.Chem. Phys., 140:174109, 2014

12- D. de Falco and DT, Noise-assisted quantum transport and computation, J. Phys. A: Math. Theor. 46:225301,2013

11- D. de Falco and DT, Time-dependent density-functional theory for open spin systems, Phys. Rev. A, 85:022341, 2012.

10- D. de Falco and DT, Dissipative dynamics of a spin system with three-body interaction, J. Phys. A: Math. Theor., 44:325303, 2011.

9- D. de Falco and DT, An Introduction to Quantum Annealing, RAIRO: Theoretical Informatics and Applications, 45, 99-116, 2011.

8- D. de Falco, E. Pertoso, DT, Dissipative Quantum Annealing, Proc. 29th Conference: Quantum Probability and White Noise Analysis, 25. Singapore: World Scientific, 2011.

7- D. de Falco and DT, Quantum annealing and the Schrödinger-Langevin-Kostin equation, Phys. Rev. A, 79:012315, 2009.

6- D. de Falco and DT, Dynamical kickback and noncommuting impurities in a spin chain, Int. J. Quant. Inf., 6, pp. 807-813, 2008.

5- D. de Falco and DT, Quantum Walks: a Markovian perspective. - In: SOFSEM 2008: Theory and Practice of Computer Science, Lecture Notes in Computer Science, 4910. Berlin: Springer, 2008.

4- D. de Falco and DT, Entropy generation in a model of reversible computation, RAIRO: Inf. Theor. Appl., 40, 93-105, 2006.

3- D. de Falco and DT, Speed and entropy of an interacting continuous time quantum walk, J. Phys. A: Math. Gen., 39, 5873-5895, 2006.

2- D. de Falco and DT, Quantum timing and synchronization problems, Int. J. Mod. Phys. B, 18, 623-631, 2004.

1- D. de Falco and DT, Grover's algorithm on a Feynman computer, J. Phys. A: Math. Gen., 37, 909-930, 2004.

Preprints

DT and L. Zanetti, A quantum-walk inspired adiabatic algorithm for graph isomorphism, arXiv: 1401.1278 [quant-ph]

Books

A.M. Zanaboni, A.M., D. de Falco and DT, Problemi di Probabilità e Statistica per le Lauree Triennali. - Napoli: Liguori, 2009.

TEACHING EXPERIENCE

Current teaching duties:

- C Programming Language (Postgraduate course, Department of Chemistry, University of Milan).

- Computer Programming (in C++) (Undergraduate course, Department of Physics, University of Milan).

Previous relevant experiences:

2011-2012: Computational Physics (Ph.D. Course in Physics and Astronomy, University of Milan).

2009-2011: Probabilistic Methods (Postgraduate course, Department of Informatics) University of Milan).

Spring 2007: Undergraduate Lectures in Mathematical Statistics, System Department, Politecnico di Milano.

Other experiences:

Problem-solving classes at University of Milan: Probability and Statistics .

Problem-solving classes at University of Milan: Geometry, Algebra.

Problem-solving classes: Undergraduate course in Mathematical Analysis.

PROGRAMMING

Programming languages: C, C++, CUDA C, Java, Pascal.

Scientific Software: Wolfram Mathematica, MatLab, R, SPSS.

IDE: Eclipse, NSight (CUDA 5.0), XCode.

LANGUAGES

Italian (native speaker).

English: very good.
Cambridge First Certificate in English (Grade A).

German: moderate.