PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Valentino Scalera

XXXII Cycle

Training and Research Activities Report – First Year

Tutor: Claudio Serpico

Information

Name and MS Degree
Valentino Scalera, Master of Science in Electrical Engineering - Università di Napoli Federico II

PhD cycle and University
XXXII Cycle - ITEE – Università di Napoli Federico II

Tutor
Prof. Claudio Serpico

Study and Training activities

Courses

Courses attended with certification

- "***Real and Functional Analysis***" - MS. Course of Mathematical Engineering
- "***Introduction to Quantum Electrodynamics***" – ad Hoc Module

Courses attended

- "***Nonlinear Systems***" - Ms. Course of Mathematical Engineering
- "***Termodinamica dei Materiali***" - MS. Course of Ingegneria dei Materiali
- "***Fisica Moderna***" - Fisica
- "***Istituzioni di Meccanica Quantistica***" - Fisica
- "***Information Theory***" - MS. Course of Mathematical Engineering

Seminars

Seminars attended

- "***Thermodynamics in Spintronics: the spin Seebeck and the spin Peltier effects***"
- "***Magnetic Refrigeration: Thermodynamics of novel magnetic materials for an efficient cooling technique***"
- "***An exact knapsack procedure for structured binary integer programming problems***"
- "***A shared memory parallel heuristic algorithm for the large-scale p-median problem***"
- "***Wireless Opportunistic Networking***"
- "***Selected problems on lighting energy efficiency for indoors***"
- "***LEDs in multispectral applications***"
- "***Medical Imaging: why not let the data speak for themselves***"
- "***L'AIS ed il sistema nazionale per il monitoraggio del traffico marittimo***"
- "***Challenges and Opportunities for IT innovation in the space business***"
- "***Il sensore radar: Aspetti operativi, prestazionali, criteri di progetto e problemi realizzativi***"

- "***(Effective) Machine learning in the time of big data***"
- "***Internet of medical things***"
- "***Beyond 5G: Data throughput optimization at mm Wave and THz frequencies for vehicle to infrastructure communication***"
- "***Graph Queries: Generation, evaluation and learning***"
- "***Optimal Control of networks: Energy scaling and open challenges***"
- "***Dal GPS al GNSS e la modernizzazione per il precise positioning nel campo automotive***"

External Courses

Scuola Nazionale Dottorandi di Elettrotecnica "F. Gasparini"
28 Giugno 2017 – Politecnico di Milano

Scuola Nazionale Dottorandi di Elettrotecnica "F. Gasparini"
23 Ottobre 2017 – 27 Ottobre – Università degli studi di Napoli Federico II

Research activity

Title: Micromagnetics and Spintronics

Study:

Micromagnetics is a field of physics dealing with the prediction of magnetic behaviors at sub-micrometer length scales. The length scales considered are large enough for the atomic structure of the material to be ignored (the continuum approximation), yet small enough to resolve magnetic structures such as domain walls or vortices.

Spintronics is the study of the intrinsic spin of the electron and its associated magnetic moment in solid-state devices.

Spintronics fundamentally differs from traditional electronics in that, in addition to charge state, electron spins are exploited as a further degree of freedom, with implications in the efficiency of data storage and transfer.

Research description:

The target of the research is the comprehension of the behaviour of ferromagnetic particles or spintronic devices when magnetic fields and spin-polarized currents are applied.

Both analytic methods and numerical simulation are employed in the research and great attention is dedicated to uniform magnetized particle and magnetic vortices.

The results of the research are useful in the realization and improvement of magnetic memories, such as hard disks and Magnetic Random Access Memory (MRAM), and nano-oscillators.

Some specific target I worked on are:

- The realization of a bifurcation map for the ferromagnetic resonance (FMR), which is useful for the comprehension of the synchronization mechanism of a nanomagnet with an external AC magnetic field

- The realization of a normal form model which describe both the behaviour of uniformed magnetized particles and magnetic vortices

Some topic I will work on in the next years are:

- The application of Central Manifold for the analysis nonlinear systems with a high number of variables

- The use of Stochastic Differential Equation for the comprehension of the effects of the temperature on the magnetization dynamics

- The application of Information Theory in order to quantify channel capacity of information of the writing process in magnetic memories

Publications

Published Journal Paper

- "***Current-driven hysteretic synchronization in vortex nanopillar spin-transfer oscillators***"
  D'Aquino M., Perna S., Quercia A., Scalera V., Serpico C.
  IEEE Magnetics Letters

- "***Normal form of nonlinear oscillator model relevant to spin-torque nano-oscillator theory***"
  Quercia A., d'Aquino M., Scalera V., Perna S., Serpico C.
  Physica B: Condensed Matter

Published Conference Paper

- "***Effect of Temperature in Hysteretic Synchronization of Magnetic Vortex Spin-Torque Nano-Oscillators***"
  D'Aquino M., Perna S., Quercia A., Scalera V., Serpico C
  IEEE Transactions on Magnetics

- "***Analytical Treatment of Nonlinear Ferromagnetic Resonance in Nanomagnets***"
  D'Aquino M., Quercia A., Scalera V., Perna S., Bertotti G., Mayergoyz I.D., Serpico C.
  IEEE Transactions on Magnetics

Conferences

INTERMAG 2017
Dublin, 24 April 2017 – 28 April 2017

- Poster presentation of the work :
  "***Analytical Treatment of Nonlinear Ferromagnetic Resonance in Nanomagnets***"

11th Symposium on Hysteresis Modeling and Micromagnetics (HMM 2017)
Barcelona, 29 May 2017 – 21 May 2017

- Oral presentation of the work :
  "Normal form of nonlinear oscillator model relevant to spin-torque nano-oscillator theory"

- Poster presentation of the work :
  "Hysteretic Synchronization in Magnetic Vortex Spin-Torque Nano-Oscillators"

XXXIII Riunione Annuale dei Ricercatori di Elettrotecnica
Milano, 29 Giugno 2017- 30 Giugno 2017

Credits Summary

	Credits year 1								Credits year 2								Credits year 3									
	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	Summary	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	Summary	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	Summary	Total	Check
Modules	12	0	3	0	9	0	0	12	12															0	12	30-70
Seminars	5	0	0	0,8	1	2	1,2	5	5															0	5	10-30
Research	43	10	7	9,2	0	8	8,8	43	43															0	43	80-140
	60	10	10	10	10	10	10	60	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	180