

Curriculum Vitae

Andrea Alfonsi

PERSONAL INFORMATION

Name: Andrea Alfonsi
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Nationality: Italian
Permanent Resident (Green card holder)

CORE COMPETENCIES

- Reactor Physics
- Nuclear Safety
- Fuel Cycle
- Thermal Hydraulics
- Numerical Algorithms
- Parallel Computing
- Code Development
- Uncertainty Quantification
- Problem Solving

PROFESSIONAL EXPERIENCE

- November 2010 to Present **Idaho National Laboratory**, (Idaho Falls, Idaho, USA)
Job Title: Modeling and Simulation scientist
Job Responsibilities :
 - Technical Leader (Team composed by 7 developers) and Lead developer of the Risk Analysis and Virtual Environment code – RAVEN framework (<https://raven.inl.gov>)
 - Technical Leader and Lead developer of the depletion code MRTAU
 - Technical Leader and Lead developer of the Reactor Physics Code Parallel and Highly Innovative Simulation for INL Code System (PHISICS)*Activities:*
 - Developer of the probabilistic risk assessment, uncertainty quantification and data analysis framework RAVEN
 - Developer of the burn-up code MRTAU integrate in the reactor physics code PHISICS
 - Developer of the criticality search module in the reactor physics code PHISICS
 - Developer of the neutron cross-section mixing, interpolation and manipulation module MIXER in the reactor physics code PHISICS
 - Developer of the SPH module for burn-up dependent SPH correction using the extended transport approximation within the PHISICS code
 - Developed MCNP models for the validation of the ENDF VII-B library within the multi-laboratory project “Cross section adjustment of Na23”
 - Analyst for assessment of different fuel cycle scenarios (impurities’ impact) using SCALE code within the DOE Fuel Cycle Campaign for PWRs
 - Developer of the Dynamic Event Tree (DET) module, a Dynamic

Probabilistic Risk Assessment methodology aimed to investigate system failures in presence of intrinsic stochastic phenomena or events

- Developer of the Hybrid Dynamic Event Tree (HDET) method for the treatment of epistemic and aleatory uncertainties in a dynamic fashion, and its implementation into UQ and PRA code RAVEN
- Developer of the Adaptive Dynamic Event Tree (ADET) method for goal oriented “optimization-like” analysis for acceleration in the identification of the transition boundaries and risk margins in complex dynamic systems. Its implementation in the code RAVEN
- Developer of the Adaptive Hybrid Dynamic Event Tree (AHDET) method, a novel methodology for goal oriented “optimization-like” analysis for acceleration in the identification of the transition boundaries and risk margins in complex systems, affected by aleatory and epistemic uncertainties. Its implementation in the RAVEN code
- Developer of the optimization framework based on the Simultaneous Perturbation Stochastic Approximation method (SPSA) within the RAVEN code
- Developer of the optimization framework based on the Simultaneous Perturbation Stochastic Approximation method (SPSA) within the RAVEN code
- Developer of the Ensemble and Surrogate Modeling system for UQ and PRA application within the RAVEN framework
- Developer of Coarse/Multi-Grid iterative algorithms for Limit Surface (Reliability Surface) identification and usage in adaptive sampling strategies within the RAVEN framework
- Developer, within the RAVEN framework, of hybrid surrogate/high-fidelity models (high-fidelity model automatically replaceable by surrogate models) for accelerated UQ and PRA applications using advanced local validation metrics
- PWR Core design leader for “Industry Application Emergency Core Cooling System Cladding Acceptance Criteria” project within RISMC Industrial Applications program

Internal consultant for:

- INL Fuel Cycle group, as expert of the MRTAU depletion software
- NGNP INL Group, as Reactor Physics and software consultant for the Phase I and II of the OECD/NEA MHTGR-350 MW Benchmark
- Neutron Cross Sections’ adjustment project as modeling and simulation expert
- Japan Atomic Energy Agency for HTR modeling with PHISICS/RELAP5-3D

Mentoring:

- Physics based adaptive time-stepping strategies for Time-Dependent Transport calculation in the PHISICS code (PhD student mentor)
- Implementation of Perturbation Theory and Quasi-Static approaches within the PHISICS code (PhD student mentor)
- Implementation of fuel re-shuffling capability in the PHISICS code (MSs student mentor)
- Analysis of a depletion thermo-hydraulic coupled benchmark using the

- PHISICS code (MSs student co-mentor).
- Development of a Stochastic Polynomial Sampler for Dynamic Probabilistic Risk Assessment analysis (PhD student co-mentor)
- Introduction of a general Markov-model aging module (PhD student mentor)
- Development of a complete PRA analysis on accident scenarios using RELAP-7 as system code and Support Vector Machine based algorithms for the emulation of the plant with respect some key figures of merits (MSs student mentor)
- Development of the validation path for the RELAP-7 code in connection with the RAVEN code (MSs student mentor)
- Development of a control rod criticality search capability in PHISICS criticality module and 3D fuel management code (MSs student mentor)
- Application of RAVEN Dynamic Event Tree-based methodologies for sever accident scenarios using the MAAP5 code (PhD student mentor)

- February 2010
to
July 2010

Nuclear Measurement Laboratory of Energy and Nuclear Engineering Department – University La Sapienza, (Rome, Italy)

Job Title: Laboratory Assistant.

Activities: Post-graduate collaboration with Prof. Romolo Remetti:

- Experimental activities, using calibrated gamma sources, in order to assess the full energy peak efficiency (FEPE) of several HPGe detectors;
- Gamma spectrometry waste characterization of nuclear wastes via experimental activities and data interpretation using the CANBERRA code Genie2000.

- August 2009
to
January 2010

ENEA Research Center "Casaccia" at NUCLECO S.p.A., (Rome, Italy)

Job Title: Intern

Activities: Cross validation of experimental data and Monte Carlo simulation (MCNP), to assess the detection efficiency of several gamma spectrometry set ups, using HPGe detectors and spectrum acquisition software, such as Genie2000, ISOCS and LabSOCS.

- January 2008 to
January 2009

Studio Tecnico Alfonsi, (Teramo, Italy)

Job Title: Engineer

Activities:

- Electrical system designs for industrial plants and residences
- Solar system design for residences
- Energy efficiency and optimization for residences

- September 2007
to
December 2007

Department of Mechanical and Aerospace engineering at University La Sapienza (Rome, Italy)

Job Title: Intern

Activities:

- Theoretical studies about the available fuel cell technologies;
- Experimental activities using PEMFC (Proton exchange membrane fuel cell), AFC (Alkaline fuel cell), DMFC (Direct methanol fuel cell), in order to evaluate the operational limits.

EDUCATION

- November 2012 to February 2016: Doctor of Philosophy (PhD) in Energy Engineering (Nuclear engineering) at the University La Sapienza (Rome, Italy)
Thesis title: Advanced Methods for Safety Analysis and Probabilistic Risk Assessment applied to Thermo-Hydraulic and Multi-Physics codes.
Thesis topic: Development of advanced methods for uncertainty quantification and probabilistic risk assessment through novel adaptive techniques, exploiting acceleration algorithms based on surrogate models. The main activities are now focused on the adaptivity based on Dynamic Event Tree methodologies.
- January 2010: Master of Science in Energy Engineering (Nuclear engineering) at the University La Sapienza (Rome, Italy)
Grade: 110/110 cum laude (GPA 4.0/4.0)
Thesis title: Validation of a calculation code system dedicated to in-laboratory gamma spectrometry, using Monte Carlo Calculations and experiments.
Thesis topic: Development of a procedure, based on cross validation of experimental data and Monte Carlo simulation (MCNP), to assess the detection efficiency of gamma spectrometry set ups. The framework was validated through experimental results with calibrated sources, and then used for evaluating accuracy of the CANBERRA codes LabSOCS and IsoSOCS.
Principle subjects of the course of study: Nuclear Power Plants, Reactor Physics, Technology of Materials, Control and Safety in Nuclear Reactors, Thermo-fluid dynamics, Industrial Electronics, Industrial Measurements, Applied Radioprotection, Radiometric techniques, Technology of Electricity Conversion, Electrical Systems, Mathematical and Numerical Methods for Engineering.
- December 2007: Bachelor of Science in Energy Engineering at the University La Sapienza (Rome, Italy)
Grade: 105/110 (GPA 3.81/4.0)
Thesis title: Energy recovery from biogas using molten carbonate fuel cells.
Thesis topic: Design of an anaerobic digestion system for recovering biogas from animal manure or crops. Comparative analysis of efficiency of the conversion of the generated biogas into electricity either by Molten Carbonate Fuel Cells (MCFC) or conventional technologies (ICE). Economical comparison performed using discounted cash flow models for the initial investment and long term maintenance.
Principle subjects of the course of study: Physics, Inorganic and organic Chemistry, Abstract Algebra, Advanced Calculus, Mathematical Logic, Numerical Analysis, Computer Science, Instrumentation and Methods of Measurements, Diagnostic and Control of Power Plants, Thermo and Fluid dynamics, Thermo-dynamics and Technology of Heat Exchangers, Turbo Machines, Technology of Materials, Synchronous and Asynchronous Generators, Electrical Plants, Statistics, Economics.
- July 2004: Scientific High School Diploma at the Liceo Scientifico G. Peano (Nereto, Italy)
Principle subjects covered: Mathematics, Physics, English, Chemistry, Biology, Latin.

AWARDS, LICENSES AND MEMBERSHIPS

Licenses and Copyrights:

- Licensing and Copyright (2014) - PRA, UQ and Risk Management code RAVEN
- Licensing and Copyright (2012) - Reactor Physics code PHISICS (Parallel and Highly Innovative System for INL Code System)

Awards:

- INL Nuclear Science and Engineering Division award for the development of the RAVEN code, 2017
- INL instant recognition award for exceptional work on RAVEN Ensemble Modeling, 2016
- Certificate of Appreciation – employee special recognition award from Associate Lab Director, Nuclear S&T, 2013
- INL instant recognition award for exceptional work on RAVEN code, 2013
- INL patent award for the licensing and copyright of the reactor physics code PHISICS, 2012
- INL golden medal for outstanding personal work performance, 2011
- INL instant recognition award for exceptional work on PHISICS, 2011

Memberships:

- Member of the American Nuclear Society (ANS) since 2012
- Member of the Italian Nuclear Society (ANI) since 2013
- Member of Italian Licensed Engineers since 2010
- Member of the technical program committee of the ANS Reactor Physics division (2015-2018)

LANGUAGES

- Italian: Native speaker
- English: Professional fluency

SOFTWARE SKILLS

- Simulation codes: RELAP5-3D, DRAGON, SCALE 5.x/6.x, HELIOS, MCNP, ERANOS, EMPIRE, MAAP5, BISON, RAVEN
- Simulation tools: MATLAB, Mathematica, Simulink, R, Genie2000, ISOCS, LabSOCS.
- CADs: AutoCAD
- Visualization tools: ParaView, Visit, AptPlot
- Software packages: Microsoft Office Suite
- Programming languages: Fortran 90/95/2003/2008, C++, Python, LaTeX
- Operating systems: Microsoft Windows, Linux, iOS

PUBLICATIONS**90 publications:**

- 11 articles in peer-reviewed journals,
- 46 papers in proceedings of international conferences
- 33 publicly available reports