Dr. Narjisse Kabbaj

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EDUCATION

Nov 2015 – Mar 2019	**University Paul Sabatier, PhD. in Plasma physics and Mechanical Engineering**	*Toulouse*

Thermal Plasma: Composition, Transport coefficients, Integral collisions, Radiative properties, Radiative Transfer

Computational Fluid Dynamics: Coupled Navier-Stockes and Maxwell equations, User-Defined-Functions.

Sep 2012 – Sep 2015	**ENSE3- Grenoble Institut National Polytechnique, Engineer**	*Grenoble*

*Three years program***:** Electric power, Computational Fluid Dynamics, Hydraulics, Heat Transfer
*Specialization***:** Mechanical engineering and Energy

Sep 2009 – Jun 2012	**Lycée Michel Montaigne**	*Bordeaux*

Intensive preparation in mathematics and physics for the competitive entrance exams to French "Grandes Ecoles".

TEACHING EXPERIENCE

Assistant Professor at Effat University, Jeddah KSA (2022)
- Teach 4 courses a semester
- Develop course material and lectures
- Maintain active research
- Electrical engineering general department secretary
- Students advising

Courses:
- Precalculus
- Calculus for engineers

- Fluid dynamics

Student advising
- Supervise Ph.D students.
- Adviser for the winter school in KAUST
- Train highly qualified personnel, researchers, Ph.D./Master students, and Engineers.
- Supervise groups for practical projects in their bachelor studies

RESEARCH AND PROFESIONAL EXPERIENCE

My principal research interests lie in the field of modeling and implementing numerical models of multiphysics couplings in mechanics.

I am currently interested on the development of low computational cost Nanosecond Repetitively Pulsed (NRP) discharges models. These models enable to perform Direct Numerical Simulation (DNS) of plasma-assisted combustion, and help understanding the complex physics underlying thermal non-equilibrium reactive flows.

| *Jul 2019 – Present* | **Postdoctoral fellow** | *Thuwal* |

Plasma assisted combustion:
- ➢ Developed a low computational cost Nanosecond Repetitively Pulsed (NRP) discharges models for a better understanding of the complex physics underlying thermal non-equilibrium reactive flows in OpenFOAM.

Ionic wind:
- ➢ Developed a 1D simplified ionized layer model for a better understanding of the electric field response when alternative current (AC) is applied to a flame
- ➢ Studied the effect of the phenomenological time scales to understand the behavior of the electric current
- ➢ Developed a 2D axisymmetric simulation in OpenFOAM for a counterflow configuration when AC electric field is applied into flames

Supervisor: Prof. Hong G. Im

| *Nov 2015 – Mar 2019* | **PhD. in Plasma Physics and Mechanical Engineering.** | *Toulouse* |
| | **Research Engineer at Siemens / University Paul Sabatier** | |

Study of radiative transfer of Air thermal plasma: Influence of radiative properties in the simulation of a free-burning arc:
- ➢ Determined the thermo-physical properties under Local Thermodynamic Equilibrium of Air+Cu plasma: Composition, Thermodynamic properties, Transport coefficients.
- ➢ Calculated radiative properties using two different approximate methods (Net emission coefficient and Mean Absorption Coefficient).
- ➢ Optimized the approximate methods in order to procure more accurate prediction in the radiative transfer in Air+Cu plasma
- ➢ Developed a Magneto-Hydro-Dynamic model of a free-burning arc to see the impact of radiative properties on the arc temperature.

Supervisors: Yann Cressault, Philippe Teulet (LAPLACE) and Eric Durhone (Siemens).

Feb 2015 – **Research Assistant, The Petroleum Institute / ADNOC** *Abu Dhabi*
Aug 2015

Development of a CFD-based Heat Exchanger Geometry optimization Framework:

➢ Reviewed previous published studies on heat exchanger optimization, in terms of geometries, applications, operational conditions, optimization methodologies and findings.
➢ Developed a modeling framework for heat exchanger numerical optimization, based on the coupling of ANSYS/Fluent Version 16.1 (CFD software) with modeFRONTIER 2014 (numerical optimization software) and MATLAB 2013 (for heat exchanger geometry parametrization).
➢ Applied the developed modeling environment to the optimization of unfinned tube bank and webbed tube bank for a range of solid wall thermal conductivities, composite polymers, and metallic alloys.

Supervisors : Valerie Eveloy, Peter Rodgers (The Petroleum Institute)

Jun 2014 – **Internship, General Electric** *Grenoble*
Sep 2014

Documentation and analysis of a database to optimize Turbines-Pumps characteristics:

➢ Gathered in a database a large number of configurations tested for Turbines-Pumps.
➢ Developed functions to find hydraulics characteristics related to experimental tests using Scilab software
➢ Established correlations between the relevant parameters for all configurations retained.

Supervisors: Laetitia Balarac, Yann Laurant (General Electric)

PUBLICATIONS

Thesis

➢ N. Kabbaj. Study of radiative transfer of Air thermal plasma : Influence of radiative properties in the simulation of a free-burning arc. PhD Thesis, Université de Toulouse Paul Sabatier.
➢ N. Kabbaj. Development of a CFD-based Heat Exchanger Geometry Optimization Framework. Master Thesis,
Institut National Polytechnique de Grenoble. (Grenoble INP).

Peer-Reviewed Journals

➢ M. Belhi, N. Kabbaj, H. G. Im, Numerical investigation of the chemical effects of sub-breakdown DC electric fields on non-premixed counterflow methane-air flames, Physica Scripta, (2022).Submitted
➢ N. Kabbaj, H. G. Im, Response of one-dimensional ionized flames to oscillatory electric fields, Combust. Theory Model (2021).Accepted
➢ X. Zhang, S. Tian, Y. Cressault, N. Kabbaj et al. Research Status of Substitute Gas for Greenhouse Gas SF_6 in Power Industry. AIP Adv., 10 (5) (2020).
➢ Y. Cressault, Ph. Teulet, N. Kabbaj et al. State of art and challenges for the calculation of radiative and transport properties of thermal plasmas in HVCB, Plasma physics and technologies (2019).

➢ N. Kabbaj, Y. Cressault, P. Teulet, F. Reichert, A. Petchanka. Numerical optimization of Mean Absorption Coefficient in Air using Planck Modified Mean Function. J. Phys. Conf. Series (2019).

Conference Proceedings

➢ N. Kabbaj, X. Shao, D. Lacoste, H. G. Im, APS DFD, A Phenomenological model for the impact of nanosecond repetitively pulsed discharges on a laminar methane-air flame, Indianapolis (USA),2022.

➢ N. Kabbaj, X. Shao, H. G. Im, 13th Asia-Pacific Conference on Combustion 2021, AC electric field into flames, Abu Dhabi (UAE), 2021.

➢ N. Kabbaj, Y. Cressault, P. Teulet. Optimisation des Coefficients Moyens d'Absorption utilisant la moyenne de Planck Modifiée pour un plasma thermique d'Air. 14ème Colloque sur les Arcs Electriques, Bourges (France), March 2019.

➢ N. Kabbaj, Y. Cressault, P. Teulet, F. Reichert, A. Petchanka. Effect of optimized / non-optimized Mean Absorption Coefficients on the radiative transfer of Clean Air. 22nd International Conference on Gas Discharges and Their Applications, Volume I, p. 191.Novi-Sad (Serbia), September 2018.

➢ N. Kabbaj, Y. Cressault, P. Teulet, F. Reichert, A. Petchanka. Effect of radiative properties in Air+Cu plasma for free-burning arc simulation. 15th High Technology Plasma Processes International Conference, Toulouse (France), July 2018.

➢ N. Kabbaj. Etude du transfert radiatif d'un plasma thermique Air-Cu : Influence des propriétés radiatives dans la modélisation d'un arc libre. Génie Electrique, Electronique, Télécommunications, Toulouse (France), April 2018.

➢ N. Kabbaj, Y. Cressault, P. Teulet, F. Reichert. Simulation du comportement thermique d'un plasma SF6 dans un sectionneur 13ème Colloque sur les Arcs Electriques, Nancy (France), March 2017.

COMPUTING SKILLS

Numerical simulation:	Computer Aided Design (CAD)	Optimization:	Programming language:
Fluent-ANSYS (Expert) MATLAB(Expert) OpenFOAM(Good Knowledge)	Ansys Design modeler Catia V5 Solidworks	ModeFRONTIER(Good Knowledge)	Fortran (expert) C (Good knowledge) C++ (Good knowledge) Python(Good knowledge) Javascript (Beginner)

RELEVANT SKILLS

Languages:

English Fluent
Arabic Fluent
French Fluent