# Dina Soltani Tehrani

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## Personal Information

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## Education

2018–2021 **Bachelor of Science in Electrical Engineering, Specialization in Electromagnetics**
Amirkabir University of Technology, Tehran, Iran
– GPA : 3.88/4 (18.18/20)

2016–2021 **Bachelor of Science in Aerospace Engineering, Specialization in Aerodynamics**
Amirkabir University of Technology, Tehran, Iran
– GPA : 3.89/4 (18.10/20)

## Research Experiences

2021–Present **Persistent Homology in Relativistic Hydrodynamical and Magnetohydrodynamical Simulations**

- Studying the mathematical formulation of the classic **relativistic non-viscous hydrodynamics**.
- Investigating the **relativistic viscous hydrodynamics** and **resistive relativistic magnetohydrodynamics**.
- Implementing the **Persistent Homology** technique to examine the topological properties of **large-scale structure** in hydrodynamical simulations.

2021–Present **Electrodynamic Analysis of Dielectric Barrier Discharge Actuators Based on The Properties of Low-Frequency Plasmons**, for completing the degree of B.Sc. in Electrical Engineering, Electromagnetics

- Conceptualized the dielectric barrier discharge actuators as a **two-layered medium**.
- Implemented the properties of **low-frequency plasmons** based on the **Lorentz Model** to simulate the plasma layer of the actuator's structure.
- Numerically discretized the integral equation relating the electric potential to the charge density on the actuator's electrodes based on the **Method of Moments**.
- Determined the closed-form spatial Green's Function based on the **Complex Images Method for electrostatic fields** and the **Generalized pencil-of-function** numerical algorithm.
- Implemented Finite Difference Approximation to post-process the fields for validation purposes.

2020–2021 **Computational Modelling of Dielectric Barrier Discharge Actuators Based on The Properties of Low Frequency Plasmons**, for completing the degree of B.Sc. in Aerospace Engineering, Aerodynamics

- Studied the dominant phenomenological models for the simulation of dielectric barrier discharge actuators.
- Developed a computational model by implementing the properties of **low-frequency plasmons** based on the **Lorentz Model** to incorporate the plasma generation.
- Formulated the energy transfer from the plasmonic region to the ambient flow in terms of body force components incorporated into the Navier Stokes equations as the source terms.
- Experimented the plasma actuation with the metric of maximum induced velocity proportional to the total body force and validated the performance of the presented model.

## Selected Academic Projects

### Numerical

2020-2021 **Electrostatic Field Computation of a Dielectric Barrier Discharge Actuator | MATLAB, Mathematica**

- Polished and Programmed the method of analyzing arbitrarily oriented microstrip transmission lines in arbitrarily-shaped dielectric media
- Computed the electrostatic fields and the capacitance matrix for the structure of a dielectric barrier discharge actuator based on the programmed method.

2020-2021 **Derivation of The Closed-Form Electrostatic Green's Function for The Structure of a Dielectric Barrier Discharge Actuator | MATLAB, Mathematica**

- Implemented the numerical method for evaluating the highly oscillatory Bessel transform based on rewriting the Bessel function in terms of the **WhittakerW function**.
- Rewrote the Bessel transform as the sum of two integrals; transformed one into the Fourier type, and computed by the **generalized Gauss–Laguerre quadrature and logarithmic Gauss–Laguerre quadrature**; computed the other integral based on the evaluation of special functions.

2019-2020 **Three Dimensional Analysis of the Shock Patterns and Flow Interactions With Aerodynamic Shapes | COMSOL Multiphysics**

- Simulated the supersonic flow over two cone models with different shape angles and a spherical model in the 3D Domain to explore the flow field before and after the shock waves
- Collaborated with a team of 5 to conduct a visualization experiment using the **Schlieren photography** method to validate the numerical simulation results.

2019-2020 **Numerical Analysis of The Flow over an RAE Airfoil in Transonic Flow Regime | Ansys Meshing, Ansys Fluent**

- Simulated the flow over the RAE2822 airfoil in the 2D domain within the transonic regime with the domain and mesh study included.
- Accurately captured the Lambda shock in terms of the location and the power.
- Presented a comparison on three RANS methods, the k-omega SST, Spalart Allmaras, and the Transition SST. Found the latter as the most accurate with the most computational cost.

### Experimental

2020-2021 **Flow Visualisation Experiment For The Investigation of The Effects of Vortex Generators Over an Epler airfoil (E361) | Aerodynamics Research Laboratory**

- Partnered as a research assistant intern with a Ph.D. student in the low-speed, open-return wind tunnel.
- Conducted the experiment in two steps: First, visualized the flow over an E361 airfoil to track the location where the separation bubble occurs to the leading edge at different angles of attack. Second, visualized the flow to investigate the effects of vortex generators on the flow and the existence of the separation bubble.
- **My duties:** 1.Prepared the non-Newtonian and fluorescent visualization paint, 2.Set the wind tunnel and the test setup for each case, 3.Recorded and Documented the events during each test case.

2019-2020 **Investigating of The Effects of Winglets on The Aerodynamic Performance of a Wing With a NACA 64-412 Airfoil | Aerodynamics Research Laboratory**

- Collaborated with a team of 4 as the leader to investigate the aerodynamic performance a NACA 64-412 wing, with and without two types of winglets in the low-speed, open-return wind tunnel
- Measured Lift, Drag, and Moment vectors as the performance metrics
- **My duties:** 1.Managed to have the test setup prepared for each test case. 2. Managed to document the measured data during each test and have the data to be preprocessed. 3. Presented conclusion of analyses and submitted a report for the Experimental Aerodynamics Course.

## Research Interests

Scientific Computation

Numerical Algorithm Development

Numerical and Data-driven Modeling of Hydrodynamical Systems

Machine Learning and Data Analysis in Scientific Computation

## Publication

**D.Soltani Tehrani**, G.R.Abdizadeh, S.Noori, "Numerical modeling of dielectric barrier discharge actuators based on the properties of low-frequency plasmons", Scientific Reports Journal (under review).

**D.Soltani Tehrani**, AN Askarpour, "Electrodynamic layered-medium field computation of dielectric barrier discharge actuators based on the properties of low-frequency plasmons", (to be submitted).

**D.Soltani Tehrani**, Gh.Esmaeili, S.Noori, M.Eetesami, "Numerical Study Of Shock Wave Patterns And Interactions With Aerodynamic Models Using Adaptive Grids", (in preparation).

## Computer Skills

**Programming** MATLAB, Python (TensorFlow, SciPy| AstroPy, GammaPy| ScaPy), Mathematica (xAct), C++, Julia, VHDL, (Familiar with PSO and Genetic Algorithm)

**Computation** Comsol Multiphysics, Ansys Fluent, Open Foam, CST Studio Suite

**General** Microsoft Office Collection, Git, LaTeX

## Academic Experiences

2021-Present **Research Intern**
Complex Systems Laboratory, Shahid Beheshti University, Tehran, Iran
**Duties:** Investigation, Computation and Simulation, Data Analysis, Documentation

2020-2021 **Research Assistant**
Compressible Flow Laboratory, Amirkabir University of Technology, Tehran, Iran
**Duties:** Investigation, Computation and Simulation, Experimentation, Data Analysis, Documentation

2018-2020 **Research Assistant Intern**
Aerodynamics Research Laboratory, Amirkabir University of Technology, Tehran, Iran
**Duties:** Investigation, Experimentation, Data Analysis, Documentation

2020-2021 **Teaching Assistant**
Engineering Dynamics, Amirkabir University of Technology, Tehran, Iran
**Duties:** Weekly Lectures, Review Sessions, Office Hours, Grading, and Discussion Material Preparation

## Additional Experiences

Oct 2021 School on Statistical Analysis of Cosmic Fields, Computational Cosmology Group, Shahid Beheshti University

Sep 2021 Advanced School on Computing: Artificial Intelligence, IPM Institute for Research in Fundamental Sciences

Jun 2021 ESCAPE Summer School Participant on Data Science for Astronomy, Astroparticle and Particle Physics, Laboratoire d'Annecy de Physique des Particules, (LAPP - CNRS-IN2P3 - USMB)

## Honors and Certificates

2020-2021 Direct Entry Elected for Masters in Aerospace Engineering since ranked among the top three students of the same entry year by Sharif University of Technology, (3rd of 120 entries).

2019-2020 Direct Entry Elected for Masters in Aerospace Engineering as an elite student by Amirkabir University of Technology.

2018-2019 Selected as an elite student, Allowed to take on a second major, Aerospace Engineering Department, Amirkabir University of Technology.

## Notable Courses

Coursera Machine Learning by Andrew Ng, Data Science Math Skills, Julia Scientific Programming, The Introduction to Quantum Computing

Graduate Audited Advanced Viscous Flows, Advanced Computational Fluid Dynamics, Cosmology (**Sharif University of Technology**), Computational Physics and High Performance Computing (**University of Tehran**)

Mandatory Numerical Analysis, Electromagnetics, Fields and Waves, Intro to Computational Fluid Dynamics

## Voluntary Experience

2018-2019 Aerodynamics Specialist, CANSAT competition 2019, Amirkabir University of Technology, Tehran, Iran

2017-2018 Competition Strategist, National Aerup Competition, Amirkabir University of Technology, Tehran, Iran

## Language Skills

English: Excellent command in spoken and written English
- Toefl IBT: Tested on 10/10/2020, 107/120
  Reading: 24, Listening: 28, Speaking: 29, Writing: 26.

Persian: Native

## References

Available upon request