

Ahmed A. Hussein

Contact Information

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Research Interests

- Unsteady Aerodynamics, Reduced Order Modeling of Dynamical Systems, and Fluid Mechanics, Nonlinear and Optimal Control of Dynamical Systems, Fluid-Structure Interaction, Optimization.

Education

PhD Engineering Mechanics **Virginia Tech, Blacksburg, Jan 2015-Dec 2018**

- Dissertation : Dynamical System Representation and Analysis of Unsteady Flow and Fluid-Structure Interactions. Course Work **CGPA 3.8/4**.

M.Sc. Mathematics **Virginia Tech, Blacksburg, Aug 2015-Dec 2017**

- Focused on Optimal Control and Reduced Order Modeling of Fluids and Dynamical Systems. Course Work **CGPA 3.62/4**.

M.Sc. Aerospace Engineering **Cairo University, Egypt, Sep 2012- Dec 2014**

- Thesis: Static and Dynamic Stability of Hingeless Helicopter Blade in Hover. Course Work **CGPA 3.8/4**.

B.Sc. Aerospace Engineering **Cairo University, Egypt, Sep 2005- Jun 2010**

- Ranked 3rd in class with honors, **CGPA 3.7/4**.
- Senior Project: Design and Manufacturing of Carbon Fiber Mini **Unmanned Tailless Flying Wing**.
- Assessed the area for the control surfaces (Flap, Aeliron and Elevator) of the Flying Wing required for the horizontal flight mission, by solving the static stability problem that couples the quasi-steady aerodynamic and control surfaces loads.

Professional Skills

- **Programming** : C/C++, Java, OpenMP, Matlab/Simulink, Mathematica
- **Platforms** : Linux, Microsoft Windows
- **Packages** : ICLOCS¹, ANSYS Fluent, NX Nastran, CATIA, NX Unigraphics, Microsoft Office, LaTeX
- **Experimentation** : Wind tunnel testing on wing sections, fish-like bodies, and micro-air vehicles.
- **Workshop Experience** : Fabrication of wing sections using carbon fiber and fiberglass.

Professional Experience

Bauhaus Aviation e. V., Taufkirchen, Germany

Research Engineer-Intern

May 2018 - August 2018

- Developed a tool using Java to generate the finite element model for wing with engine and landing gear to optimize for the primary structure components.
- Integrated the wing finite element Java tool with Calculix to solve for the required internal structure geometry.
- Performed an optimization to minimize the wing weight using the developed tool and Calculix.

Unmanned Aerial Vehicles Start-up, Giza, Egypt

Co-Founder, Flight Dynamics and Performance Engineer.

Jul 2011 - Jan 2013

- Co-founded a startup that aimed at providing affordable unmanned aerial systems for monitoring and control of car traffic across Cairo, Egypt.
- Supported the planning of 2013 fiscal year budget of amount \$10,000.
- Assessed the performance envelope required for different unmanned aerial vehicle missions.
- Designed the control surfaces required to accomplish different maneuvers and missions
- Performed flight tests measurements to support autopilot design.

Egypt-Air Maintenance and Engineering, Cairo, Egypt

Intern

June 2009 - Sep 2009

- Received training in the maintenance of aircraft engines and other different parts.
- Helped with wind tunnel testing of aircraft engines after maintenance.

¹Imperial College London Optimal Control Software

Research Experience**Virginia Tech**, Blacksburg, Virginia**Research Assistant****Jan 2015 - Present**

- Assessed the fish-tail flexibility effect on the propulsive efficiency of a fish by solving the coupled hydro-elastic problem between the tail and loads.
- Postulated a new Lagrangian function from which we obtained the dynamics of unsteady point vortices shed from sharp edges of flat plate in arbitrary motion.
- Solved the minimum time transition flapping wing micro-air vehicles (FWMAV) from hovering to forward flight, by integrating the body and wing dynamics of FWMAV through an optimal control framework **ICLOCS**¹ and Matlab.
- Developed the **UVLM** panel code (including leading-edge separation) in **C++** and optimized the performance by using commands OpenMP and applying them to existing linear algebra solvers (**LAPACK**), efficient memory allocation and handling, and distributing the calculations on CPU's.
- Obtained reduced order model for the unsteady aerodynamic loads on a finite wing by performing wind tunnel tests at Virginia Tech facilities.

Cairo University, Giza, Egypt**Research Assistant****Sep 2012 - Dec 2014**

- Formulated nonlinear finite element model for the aeroelastic problem of helicopter rotating blades in hover. Code developed in Mathematica.
- Obtained the trim conditions for rotating blade in Hover by solving the nonlinear finite element equations by developing **Newton-Raphson** solver using Mathematica.
- Obtained different forms in the frequency domain (using Padé approximations i.e. Bode Plot), as a reduced order model for the unsteady aerodynamics loads of rotating blades, by applying different **GBO**² algorithms in Matlab.
- Performed flutter analysis of the rotor blade in time domain using Padé approximations, and compared it to those obtained by **p-k** method, free wake model and experimental data.

Teaching Experience**Virginia Tech**, Blacksburg, Virginia*College of Engineering***January 2015 - Present**

- Gave a weekly instruction session in several medium size classes (average of 20 students), including Statics, Mechanics of deformable bodies, Fluid Mechanics Laboratory, and Fluid Mechanics-Differential Analysis.

Cairo University, Giza, Egypt*Department of Aerospace Engineering***Sep 2010 - December 2014**

- Assisted in teaching several large sized classes (average of 60 students), including Flight Mechanics, Classical and Modern Control, Advanced Thermodynamics, Programming using Matlab and introduction to Linux systems, and Machine Drawing classes.

Publications

- Hussein, A. Ahmed, Taha E. Haitham, Ragab, Saad, and Hajj R. Muahmmmed. "A Variational Approach for the Dynamics of Unsteady Point Vortices." **Aerospace Science and Technology**, Vol. 78, July 2018, pp. 559-568.
- Hussein, A. Ahmed, and Canfield A. Robert "Unsteady Aerodynamics Stabilization Effects on the Dynamic Instability of a Hingeless Rotor Blade in Hover." **AIAA**, Vol. 56, No. 3 (2018), pp. 1298-1303.
- Hussein, A. Ahmed.; Hajj, R. Muhammad; Elkholy, Samir; and Elbayoumi, Gamal; "Dynamic Stability of Hingeless Rotor Blade in Hover Using Padé Approximations." **AIAA**, Vol. 54, No. 5 (2016), pp. 1769-1777.

Affiliations, Honors and Awards

- **AIAA**³ Student Member
- **AIAA** journal paper DOI: 10.2514/1.J054751 got the **3rd** rank in **Young Professional Paper Competition** organized by **AIAA Hampton Roads Section** on 5/4/2016, Series 2,016.007.
- Senior project awarded the title of Best Project in Mechanics by Egyptian Engineering Day Conference (**EED**), **IEEE**⁴ July 2010 and Youth Innovation Prize **YIA**

²Gradient Based Optimization³American Institute of Aeronautics and Astronautics⁴Institute of Electrical and Electronics Engineers