Mostafa A. Rushdi

Research Assistant Professor, Aerospace Engineering

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Education

Doctor of Philosophy (Ph.D.)

Fukuoka, Japan

Kyushu University, Interdisciplinary Graduate School of Engineering Sciences (IGSES), (ESST) — October 2017 - March 2021

- **Concentration**: Airborne Wind Energy Systems.
- **Awarded**: Scholarship for Ph.D. from Japanese Government (MEXT), 2017-2020.

Master of Science (M.Sc.)

Cairo, Egypt

Cairo University, Aeronautical and Aerospace Engineering. — October 2013 - September 2017

- **Concentration**: Optimal aircraft trajectory evasion.
- **Cumulative GPA**: 3.7
- **Graduate courses**: Nonlinear control ● PLC ● Experimental Methods in Aerospace Engineering ● Aero Elasticity ● Continuum Mechanics ● Heat Transfer ● Advanced Numerical Analysis ● Partial Differential Equations.

Bachelor of Science (B.Sc.)

Cairo, Egypt

Cairo University, Aeronautical and Aerospace Engineering. — September 2008 - July 2013

- **Concentration**: Control and System Dynamics.
- **Graduation project**: Micro-Flapping Air vehicle
- **Courses**:
  - Fluid Mechanics ● Gas Dynamics ● Aerodynamics ● Boundary Layer Theory ● High Speed Aerodynamics ● Aircraft Performance ● Aerodynamic Design of Airplanes ● Computational Fluid Dynamics.
  - Aircraft Structural Analysis ● Structural Mechanics ● Finite Element Methods (FEM).
  - Thermodynamics, Combustion and Heat Transfer ● Internal Combustion Engines ● Aircraft Engines ● Turbo Machinery ● Engine Maintenance ● Rocket Propulsion.
  - System Dynamics ● Automatic Control ● Flight Mechanics ● Instrumentation ● Digital Control ● Autopilot Design

Skills

Languages	Python, MatLab/ Simulink, C/C++
AI/ML/DL	Jupyter, Sciket-Learn, Tensorflow
Platforms, Framework	AutoCAD, NX Unigraphics, Ansys
Tech Writing	LaTeX, MS Office

Work Experience

Research Assistant Professor

Fukuoka, Japan

Kyushu University, RIAM — May 2022- present

- Floating Offshore Wind Turbine (FOWT) Project: Working on analyzing typhoon data to estimate EEWS for certain wind direction change as a design condition for offshore WT.
- ML with CFD applications: Working on creating a new generation of numerical finite volume schemes using machine learning to reduce the reliance on mesh resolution.

Postdoctoral Fellow

Fukuoka, Japan

Kyushu University, RIAM — March 2021- April 2022

- Working on wind solar tower (WST) project to predict the thermal updraft using machine learning techniques, in case of ”no wind turbine”.
- For the case of ”with WT”, I am using deep learning to predict the output power.
- Managing a team of 3 masters student to build and develop the second phase of 10-kW kite power system (KPS) project.

Teaching Assistant

Giza, Egypt

Future University in Egypt (FUE) — April 2015- October 2017

- **Duties**: leading lectures, discussion sessions, laboratory experiments, managing groups and projects, preparing exams, and grading.
- **Courses**: Introduction to Embedded systems ● PLC ● Quality control ● Dynamics of rigid bodies ● Mechanical Mechanisms ● Stress Analysis ● Properties of materials.

Research and Publications

Journal Papers

1- Rushdi, M. A., Yoshida, S., Watanabe, K., Ohya, Y., 'Deep learning approach for power prediction of wind solar tower systems', under review in ELSEVIER, Cleaner Production.

2- Ibrahim Maamoun, Rushdi, M. A., Omar Falyouna, Ramadan Eljamal, Osama Eljamal, 'Insights into machine-learning modeling for Cr (VI) removal from contaminated water using nano-nickel hydroxide', ELSEVIER, Separation and Purification Technology (2022).

3- Rushdi, M. A., Yoshida, S., Watanabe, K., Ohya, Y., 'Machine learning approaches for thermal updraft prediction in wind solar tower systems', ELSEVIER, Renewable Energy (2021).

4- Rushdi, M. A., Dief, T. N., Schemhl, R., Yoshida, S., 'Towing test data of the Kyushu University kite system', MDPI, Data (2020).

5- Rushdi, M. A., Rushdi, A., Dief, T. N., Schemhl, R., Halawa, A., Yoshida, S., 'Power Prediction of Airborne Wind Energy Systems using Multivariate Machine Learning', MDPI, Energies, April 2020.

6- Rushdi, M. A., Dief, T. N., Halawa, A., Yoshida, S., 'System Identification of a $6\ m^2$ Kite Power System in Fixed Tether Length Operation', International Review of Aerospace Engineering (IREASE), August 2020.

7- Dief, T. N., Fechner, U., Schmehl, R., Yoshida, S., Rushdi, M. A., 'Adaptive Flight-Path-Control of Airborne Wind Energy Systems', MDPI, Energies, 13 (3), 2020.

Peer-Reviewed Conference Articles

1- Rushdi, M. A., Hussein, A., Dief, T. N., Yoshida, S., & Schmehl, R. Simulation of the Transition Phase for an Optimally Controlled Tethered VTOL Rigid Aircraft for Airborne Wind Energy Generation, AIAA (American Institute of Aeronautics and Astronautics), January 6-10th, 2020.

2- Dief, T. N., Rushdi, M. A., Halawa, A. M., Yoshida, S., Hardware-in-the-Loop (HIL) and Experimental Findings for the 7 kW Pumping Kite Power System, AIAA (American Institute of Aeronautics and Astronautics), January 6-10th, 2020.

3- Dief, T. N., Rushdi, M. A., Halawa, A. M., Yoshida, S., Hardware-in-the-Loop (HIL) and System Identification of a Pumping Kite Power', in Book of Abstracts of the Airborne Wind Energy Conference 2019 (R. Schmehl, eds.), (Glasgow, UK), p. 134, Albert Ludwigs University of Strathclyde, 2019.

4- Rushdi, M. A., Yoshida, S., Dief, T. N., 'Simulation of a Tether of a Kite Power System Using a Lumped Mass Model', 4th Intellectual Exchange and Innovative Conference on Engineering and Science (IEICES), Oct. 18th, 2018.

5- Rushdi, M. A., Kassem, A. H., El-Bayyoumi, G. M., 'A new game-based methodology for discovering optimal escape maneuver', 3rd Intellectual Exchange and Innovative Conference on Engineering and Science (IEICES), Oct. 23rd, 2017.

Projects

ML with CFD applications: Currently working on cutting-edge research that aims to create a new generation of numerical finite volume schemes that replace the high-order functions and linear and quadratic interpolation that are currently used as industry standards with new, more complex nonlinear schemes that use machine learning to reduce the reliance on mesh resolution. This strategy also seeks to get past the requirement for flow field smoothness in currently implemented techniques, which makes it very challenging to accurately solve discontinuous functions and non-smooth field functions.

ML application in water treatment: Utilizing ML in the applications of water treatment and environmental remediation to have better insights into the performance of adsorbents and functional materials in contaminants removal from aqueous solution. Hence, ML models are used for the validation of experimental data and for predicting the remediation efficiency considering several conditions within chemical reactions.

Floating Offshore Wind Turbine (FOWT): Analysing a LFM raw data collected over 6 years for 34 Typhoons at southern part of Japan using the Extreme Value Analysis (EVA) with Gumbel distribution to calculate the Expected Extreme Wind Speed (EEWS) for certain wind direction changes (WDC) during storms. This will be important information for FOWT farms, as it is a single point moored system.

Wind Solar Tower (WST): A wind solar tower system was built in chikuchi campus, Kyushu University for electricity generation as a hybrid system that benefit from solar and wind energies. Several data entities were collected using sensors. Then, I applied machine learning algorithms to predict thermal updraft and wind turbine output for the cases of "no wind turbine" and "with wind turbine", respectively

Kite Power System (KPS): An Airborne Wind Energy System (AWEs) utilizing the wind to generate power using kites. It consists of

inflatable kite that flies in Figure-of-Eight motion with control algorithm to harvest the optimal power from the lifting force comes from the kite. We built a Kite Control Unit (KCU) to control the kite maneuver and do several towing tests to collect data like kite orientation and position, truck velocity as kite velocity for non windy days, and tension force in the main tether. Then, I performed sensitivity analysis which agreed with model-based sensitivity analysis. After that, I applied machine learning algorithms and the neural network was promising to model and predict the tether force.

VTOL Rigid Aircraft: A main challenge for AWE technology is how to automate the launching and landing procedures for wing kite power systems (KPS), whether they are flexible or rigid. Such procedures must be robust and reliable under different weather conditions. I worked on the AP-2 aircraft, developed by Ampyx power company, to formulate and solve the transition phase as an optimal control problem (OCP) using ICLOCS. I introduced the optimal trajectory of the aforementioned transition phase based on a satiable desired cost function, which is minimizing the power consumption, to the AWE community. This minimization of energy will cause a reduction in the total mass of the airborne component (especially battery) and this leads to enhancement in the flight operation. Also, achieving the required thrust to perform the transition, will help in modifying the AP-2 aircraft.

Micro-Flapping Air vehicle: Designed a micro air vehicle with low power consumption, low pollution emission, and low noise levels, using the theory of natural birds. Implemented the flapping bird in micro scale under aerodynamic and material constraints. Quantified the resultant aerodynamic force produced by a flapping wing in the fluid lab.

CanSat: An Educational Nanosatellite microcontroller project utilizing various sensors, actuators, transmitters, and receivers. It consists of two Microcontrollers communicating through radio transmissions from the satellite to a ground station. The satellite collects temperature, humidity, pressure, geolocation, acceleration and orientation measurements, stores it onto an SD card, and then sent to the ground station where data was processed and visualized in a dashboard built with LabVIEW. A PCB board was designed and manufactured to electrically connect the sensors and electric components of the device. I also wrote an Arduino Library to interface with the GPS module. The components used include Atmega328, MPU-6050 (Accelerometer and Gyroscope sensor), BMP085 (pressure sensor), DHT11 (humidity and temperature sensor), RF or Xbee (for wireless communication through UART protocol).

Internships and Conferences Attended

Internships

Aircraft Control Engineer

Delft, Neterlands

TU Delft and Kitepower company

April 2019- July 2019

- Working with the company team on dynamic modelling and control of a rigid vertical take off landing aircraft and simulation of the power cycle aiming to maximize the generated electricity.
- Achieved the optimal trajectory of the transition phase based on the desired cost function,which is minimizing the power consumption, to the AWE community
- Achieved the required thrust to perform the transition, will help in modifying the AP-2 aircraft.

Embedded Systems Engineer

Giza, Egypt

Egypt CAN-Sat program, Space Systems Technology Laboratory (SSTL)

July 2011- August 2013

- Developed an Mbed microcontroller to interface with different sensors: pressure, temperature, accelerometer, gyroscope, GPS sensors, and wireless module XBEE.
- Organized Can-Sat Training Program (CTP2).
- Won top Mechanical Project Award at Egyptian Engineering Day (EED - 2011), Cairo-Egypt

Aeronautical Engineer

Cairo, Egypt

Aeronautical Engineering Labs, EgyptAir

July 2012- August 2013

- Trained on the systems of the commercial passenger jet Airbus 320.
- Attended workshops on: “Turbofan Engine Overhaul”.
- Tested and validated oxygen cylinders, landing gears, and escape slides.

Aircraft Design Engineer

Giza, Egypt

Unmanned Aerial System Development Center (UDC)

October 2009- October 2010

- Attended a workshop on “Glider Design”.
- Attended a workshop on “Unmanned Control line airplanes”.
- Designed and manufactured both aforementioned airplane types.

Conferences Attended

1 week	**2022**,	Grand Renewable Energy (GRE).	*(Online) Tokyo, Jp*
3 days	**2022**,	TORQUE.	*(Online) Delft, NL*
1 day	**2021**,	JSES.	*(Online) Japan*
1 week	**2020**,	AIAA SciTech.	*Orlando, USA*
1 week	**2018**,	Cross Straits Symposium (CSS-ESST 20).	*Busan, Korea*
1 week	**2018**,	Grand Renewable Energy (GRE).	*Yokohama, Japan*
3 days	**2018**,	4th International Exchange and Innovation Conference on Engineering & Sciences (IEICES).	*Fukuoka, Japan*
3 days	**2017**,	3rd International Exchange and Innovation Conference on Engineering & Sciences (IEICES).	*Fukuoka, Japan*

Online Courses

- **Deep Learning Specialization**
  - Structuring Machine Learning Projects.
  - Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization.
  - Neural Networks and Deep Learning.
  - Convolutional Neural Networks.
  - Sequence Models.
- **Google Data Analytics** (in progress 2/8)
  - Foundations: Data, Data, Everywhere
  - Ask Questions to Make Data-Driven Decisions

Research Interest

- Data Science, Machine Learning, Deep Learning.
- Control Engineering, Optimal Control, Optimization.
- System Dynamics, Airborne Wind Energy Systems.

Languages

Arabic: **Native Tongue**
English: **Advanced**
Japanese: **Basic**

Extracurricular Activities

IEICES 2018 Conference — *Fukuoka, Japan*, *Oct 2018*

- Organizing Committee Member of the International Exchange and Innovation Conference on Engineering & Science (IEICES), 2018.

Phoenix Student Club — *Giza, Egypt*, *2011 - 2012*

- Headed the social committee at the Aerospace Engineering Department.
- Co-organized the annual department convention: Aero Day