

CURRICULUM VITAE

ARMAN HEMMATI, PHD

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RESEARCH INTERESTS

Computational Fluid Dynamics, Aerodynamics, Hydrodynamics, Turbine & Propeller Design, Alternative Energy Systems, Bio-inspired Engineering Design, Aerospace Systems and Vehicles.

EDUCATION AND TRAINING

- PDF. Mechanical and Aerospace Engineering.** Princeton University (2017)
Research Topics: Bio-inspired propeller design, urban heat centers, vertical wind turbines.
Supervisor: Prof. Alexander J. Smits
- PhD. Mechanical Engineering.** University of Calgary, Canada (2016) **GPA 4.0/4.0**
Research Topic: Evolution of Large-Scale Structures in the Wake of Thin Flat Bodies
Supervisor: Prof. David H. Wood
- B.Sc. Mechanical Engineering.** University of Calgary, Canada (2011) (*Distinction*) **GPA 3.8/4.0**
BSc. Thesis: P.V. Panel Wind Loads – Aerodynamics of Flat Plates at High Angles of Attack and High Reynolds Numbers
Advisor: Professor David H. Wood

SELECTED HONORS AND AWARDS

- **NSERC Post-Doctoral Fellowship** June 2016 – June 2018
- **Alberta Innovate Technology Future (AITF) Ingenuity Fellow** May 2013 – January 2016
- University of Calgary Eyes-High Leadership Scholar May 2014 – January 2016
- **NSERC PGS M Pre-Doctoral Graduate Fellow** May 2012 – May 2013
- Awards Recipient for Teaching Excellence 2011 & 2014
- Jason Lang Scholarship Recipient 2009 – 2011
- **NSERC Undergraduate Student Research Award** (*declined*) 2008
- Alberta Undergraduate Blue-Cross Scholarship Recipient 2006 – 2008
- Engineering Dean's List for Academic Excellence 2006 - 2011

ACADEMIC EXPERIENCE

- **Assistant Professor – Mechanical & Aerospace Engineering** January 2018 – Present
University of Alberta (*Dept. of Mechanical Engineering*)
 - Research topics include Computational Fluid Dynamics (CFD), Turbulence Modeling, Bio-inspired Designs and Technologies, Alternative Energy Technologies, Wind Engineering and Aerodynamics

• **Research Fellow**

June 2016 – June 2018

Princeton University (*Dept. of Mechanical and Aerospace Engineering*)

- Main Research Topic: Biology inspired design of an efficient, high-speed, biomimetic propulsion and energy extraction mechanism for the next generation of high-speed and efficient marine propulsors
- Interdisciplinary initiative through ONR with 5 top-tier universities including Harvard, Virginia, Lehigh and West Chester Universities.
- Numerical (CFD) study of fins in locomotion using **ANSYS CFX** and **OpenFOAM**

• **Research Associate**

January 2016 – May 2016

University of Calgary (*Dept. of Mechanical and Manufacturing Engineering*)

- Research Topic: Impact of wake dynamics on surface pressure fluctuations for PV Modules
- CFD simulation of the flow around PV modules at high angles of attack using ANSYS, OpenFOAM

• **Sessional Instructor - University of Calgary**

January 2014 – January 2015

- Mechanics of Solids (introductory) with 90 students, & FEA/CFD (advanced) with 29 students
- Nominated for the University Teaching Award by the Dept. Head
- Obtained support from the Engineering School Dean's Office to establish the **High-Power Computing Lab** in the Department of Mech. and Manuf. Engineering (**\$100k in funding**)

• **Research Assistant**

September 2011 – January 2016

University of Calgary (*Dept. of Mechanical and Manufacturing Engineering*)

- Studied the Evolution of Large-Scale Structures in the Wake of Thin Flat Bodies
- Study of bluff body wakes, turbine blades and other systems using CFD and experiments
- Experienced with Hotwire **Anemometry, LDV, PIV, Force & Pressure Transducers**
- Used Direct Numerical Simulation (DNS) and Large Eddy Simulation (LES)
- Extensive experience with ANSYS CFX, OpenFOAM, Comsol Multiphysics.
- Side projects: **biomimetic of honeybee flight, aerodynamics of trailer trucks, blade cascade dynamics**, etc.

ACADEMIC COMMITTEE MEMBERSHIPS

- Schulich School of Eng. Diversity and Equality Committee (*Advisory to Dean*) January 2015 – December 2015
- Schulich School of Eng. Safety Improvement Committee (*Advisory to Dean*) April 2015 – January 2016
- Chair of 9th and 10th Annual Mechanical Engineering Research Conference 2013 - 2014
- Engineering Dean Search Committee 2013
- Executive Team of 24th Conference of the CFD Society of Canada 2012

WORK EXPERIENCE

- **Principal Simulation Consultant** April 2014 – Present
AeroEnergy Consulting
Project: Tanker Trailer PSV failure – Contamination Investigation
 - CFD simulation of the collision and its impact on the multiphase fluid content of the tanker
 - Used as expert witness evidence in an insurance related lawsuit
Project: New Generation of slurry hydro transport pipelines
 - Feasibility of a new pipeline clearing technology for tailing-pond pipeline slurry flow transport
 - Expert recommendations used for patent applications by the clients

- **Expert Observer - Engineering** May 2015 – December 2015
UNFCCC / World Federation of Engineers
 - Served as an official Expert Observer at the following UN Framework Convention on Climate Change (UNFCCC) meetings:
 - 21st Conference of the Parties (COP21) – Paris, France
 - UNFCCC Subsidiary Body for Implementation (SBI) – Bonn, Germany / Paris, France
 - UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) – Bonn, Germany / Paris, France
 - Provided expertise support on engineering topics to negotiating parties to assist in technologically suitable policies on adaptation and mitigation.

- **Production Technology Researcher** May 2009 – January 2011
Royal Dutch Shell (*In-Situ R&D - Projects & Technologies*)
 - Confidential projects in areas of metering, In-Situ heating, well completion, drilling, etc.
 - Extensive experience with computational (COMSOL, ProEngineer and Wolfram Mathematica) and analytical analysis of engineering problems
 - Investigated application of tomography processes in multiphase flow metering
 - Multiphysics simulations on electrode placement, voltage and heat distribution
 - CFD simulation using COMSOL and Analytical modeling of the new meter cooling design

- **Maintenance and Integrity Summer Intern** May 2008 – September 2008
Shell Canada Ltd. (*Exploration and Production*)
 - Project: Waterton Well-site Field and Gas Plant optimization during turn-around period
 - Reviewing P&ID's, MFD's, and UFD's with the physical instrumentations verified to be in use at site
 - Identifying the criticality of equipment (i.e. safety, environment, financial gain/loss, etc.)
 - Recognizing the behavior of fluids under extreme situations and their consequences
 - Learning the overall instrumentation and process techniques in engineering design along with the required safety measurements and modifications for recovery and processing of sour gas

AFFILIATIONS & OTHER MEMBERSHIPS

- American Physical Society (APS) 2014 – Present
- Director of the Univ. of Calgary Aero-Energy Seminar Series 2012 – 2016
- Founding President of the Mech. Engineering Grad. Students Association 2012 - 2013
- Head of Engineering Books for Africa Initiative (*book donation for Ethiopian universities libraries*) 2012 - 2013
- American Society of Mechanical Engineers (ASME) 2008-2009, 2010 - 2011

HIGHLIGHTED CONFERENCE PARTICIPATION & INVITES

- Bi-Annual iTi Conference on Turbulence 2014, 2016
- United Nations' 21st Conference of Parties (COP21) – Paris Climate Agreement December 2015
- Annual Meeting of American Physical Society (APS) Division of Fluids 2014 - 2017
- International Symposium on Turbulence & Shear Flow Phenomenon (TSFP) 2015, 2017
- UNFCCC Subsidiary Body for Implementation 2015
- UNFCCC Subsidiary Body for Scientific and Technological Advice 2015
- World Energy Engineering Congress 2014

PUBLICATIONS/PRESENTATIONS**Peered-Review Journal Articles:**

- Hemmati, A., Smits, A.J. (2018) The wake of pitching square and convex panels at a range of Reynolds numbers and frequencies, *Journal of Physical Review Fluids*. (*In Preparation*)
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2018) Surface pressure and wake dynamics behind flat plates. *Journal of Physical Review Fluids*. (*In Preparation*)
- Hemmati, A., Senturk, Utku, Smits, A.J. (2017) Effect of trailing edge surface pressure fluctuations on thrust generation for underwater locomotion. *J. of Fluids and Structures*. (*Submitted*)
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2016) Evolution of vortex formation in the wake of thin flat plates with different aspect-ratios. *Progress in Turbulence*. Springer.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2016) On simulating the flow past a normal thin flat plate. *Journal of Wind Engineering and Industrial Aerodynamics*.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2016) Characteristics of distinct flow regimes in the wake of an infinite span normal thin flat plate. *International Journal of Heat and Fluid Flow*. (62 Part B), pp. 423-436
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2016) Effect of side-edge vortices and secondary induced flow on the wake of normal thin flat plates. *International Journal of Heat and Fluid Flow* (61 Part A), pp. 197-212.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2015) Wake dynamics behind a normal thin flat plate at

moderate Reynolds numbers. *Progress in Turbulence*. Springer (6): 265-269.

- Singh, K., Hemmati, A., Wood, D.H. (2012) The Aerodynamic characterization of generic tail fin shapes. *Wind Engineering*, 36(5) pp. 493-507.
- Oritz, X., Hemmati, A., Rival, D., Wood, D.H. (2012) Instantaneous forces and moments on inclined flat plate. *Bluff Body Aerodynamics and Applications (BBAA VII)*, pp. 1124-1131.

Other Peered-Review Publications:

- Hemmati, A., Martinuzzi, R.J., Wood, D.H., Ferrari, S., Hu, J. (2017) Vortex identification by local normalization of velocity gradients. *IUTAM Symposium on Dynamics and Topology of Vorticity and Vortices*, Carry-le-Rouet, Marseille.
- Senturk, Utku, Hemmati, A., Smits, A.J. (2016) Effect of trailing edge on underwater locomotion based on Immersed Boundary Method simulations. 10th *Symposium on Turbulence & Shear Flow Phenomenon*.
- Senturk, Utku, Hemmati, A., Smits, A.J. (2016) Performance of an open-source, sharp interface immersed boundary method in simulating the flow past rigid bodies. *Bulletin of the American Physical Society*.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2016) The effect of wake structure development on surface pressure fluctuations. 10th *Symposium on Turbulence & Shear Flow Phenomenon*.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2016) The implications of regions of spin and splat contributions to pressure fluctuations in the wake of normal flat plates. *Bulletin of the American Physical Society*.
- Hemmati, A., du Plessix, P., Martinuzzi, R.J., Wood, D.H. (2016) Using DNS Data to Validate Pressure-Velocity Statistics Determined from Stereo-PIV Measurements. In *Proceedings of 11th International ERCOFTAC Symposium on Engineering Turbulence Modeling and Measurements*, Italy.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2016) Effect of aspect-ratio on evolution of wake structures: from rectangular to square normal flat plates. 2016 *iTi Conference on Turbulence*, Italy.
- Hemmati, A., Wood, D.H., Martinuzzi, R.J. (2015) Momentum transport in the wake of a finite-length thin flat plate. *Bulletin of the American Physical Society*.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2015) Direct numerical simulation of the wake of a normal thin flat plate: infinite vs. finite width. *Turbulence & Shear Flow Phenomenon*. (9) pp: 1-6.
- Hemmati, A., Wood, D.H., Martinuzzi, R.J. (2014) Comparing wake structures behind a finite aspect ratio and an infinite span normal thin flat plate. *Bulletin of the American Physical Society*.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2013) Experiences in modeling wind loading on Photovoltaic modules and solar collectors. In *proceedings of COMPDYN: Wind Effects on Structures*.

Conference Presentations / Posters:

- Senturk, Utku, Hemmati, A., Smits, A.J. (2017) Effect of trailing edge on underwater locomotion based on Immersed Boundary Method simulations. *TSFP10*, Chicago, IL, USA.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2017) The effect of wake structure development on surface pressure fluctuations. *TSFP10*, Chicago, IL, USA.

- Hemmati, A., Senturk, Utku, Smits, A. J. (2016) Simulating underwater propulsion using an immersed boundary method based open-source solver. *69th Annual Meeting of the American Physics Society (APS) Division of Fluids*, Portland, OL.
- Hemmati, A., et al. (2016) Vortex dynamics and surface pressure fluctuations on a normal flat plate. *69th Annual Meeting of the American Physics Society (APS) Division of Fluids*, Portland, OL.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2016) The evolution of wake structures based on the normal flat plate aspect ratio. *2016 iTi Conference on Turbulence*, Italy.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2015) The wake of a square thin flat plate normal to uniform flow. *68th Annual Meeting of the American Physics Society (APS) Division of Fluids*, Boston.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2015) Effect of aspect ratio on the wake patten behind a finite span normal thin flat plate. *Ninth International Symposium on Turbulence and Shear Flow Phenomenon (TSFP9)*, Melbourne, Australia.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2014) Comparing wake structures behind a 3D and 2D normal thin flat plates. *67th Annual Meeting of the American Physics Society (APS) Division of Fluids*, San Francisco, CA, USA.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2014) Evolution of the wake structures behind an infinite span normal thin flat plate. *iTi Conference on Turbulence*, Italy.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2014) Computational Modeling of Turbulent Flow around flat plates at high angles of attack. *4th Annual Mechanical Engineering Research Conference*, Canada.
- Hemmati, A., Martinuzzi, R.J., Wood, D.H. (2013) On Modeling wind loads on Photovoltaic modules and solar collectors. *4th International Conference on Computational Methods in Structural Dynamics and Earthquake Engineering: Wind Effects on Structures*, Kos, Greece.
- Hemmati, A., Harris, C. (2010) Multiphase flow metering needs for Canada heavy oil. *Calgary Global Petroleum Conference*, Calgary, AB.
- Hemmati, A., Harris, C. (2010) Air natural convection for cooling of high-temperature enclosures. *Shell Production Technology Workshop*, Calgary, AB.

Theses:

- Hemmati, A. (2016) Evolution of large-scale structures in the wake of sharp-edge thin flat bodies, *PhD Thesis, University of Calgary*, Calgary, AB.

Industry R&D Contributions (Confidential):

- Giuliani, V., Hemmati, A., Harris, C. (2010) Joule heating electrode simulation - surface electrical potential difference. *Royal Dutch Shell – Projects and Technologies*, Houston, TX.
- Hemmati, A., Giuliani, V., Harris, C. (2010) Enclosure cooling by air natural convection. *Royal Dutch Shell. Royal Dutch Shell – Projects and Technologies*, Calgary, AB.
- Hemmati, A., Giuliani, V., Harris, C. (2010) Multiphase flow metering for Canada heavy oil. *Royal Dutch Shell – Exploration & Production*, Calgary, AB.
- Hemmati, A., Harris, C. (2009) The idea of neutron detection in multiphase flow metering. *Royal Dutch Shell – Exploration & Production*, Calgary, AB.