JAY YOUNG
Curriculum Vitae

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Education

Cornell University (August 2014-May 2021)
M.S. Mechanical & Aerospace Engineering, 2017
Ph.D., Mechanical & Aerospace Engineering (Fluid Dynamics), May 2021
Thesis: "A Cyber-Physical Approach to Oscillating Airfoil Propulsion"
Advisor: Prof. Charles Williamson

Overall GPA: 4.127
GRE: Verbal 163, Quantitative 170, Analytical Writing 5.0

Brown University (August 2010-May 2014)
B.S. Mechanical Engineering
Magna Cum Laude

Overall GPA: 4.0

Research Experience

Cornell University — Fluid Dynamics Research Laboratories (2014-Present)

My research as a Ph.D. candidate involves investigating the performance of an oscillating airfoil using an innovative cyber-physical fluid dynamics (CPFD) approach. CPFD is a powerful technique that combines the flexibility of setting arbitrary parameters inherent to computational methods with the real-time speed and infinite resolution of an experiment. A force feedback system combines measured forces on the physical body with virtual forces defined in software to make the system behave as if it experiences both the real, physical forces as well as any additionally implemented virtual forces. My current research efforts focus on a novel experimental approach to self-propulsion, which couples the forces experienced by the airfoil to the travelling speed, allowing it to accelerate forwards until a steady-state velocity is reached. This more accurately models real-world conditions compared to the traditional approach of tethering the airfoil in the travel direction and imposing an arbitrary incoming flow speed. Previously, I studied the sailing-inspired motion called "hybrid-heave", which emulates the unsteady sail-flicking technique used by sailors in rockable Olympic sailboats. Hybrid-heave can generate large amplifications of lift, which leads to a significant increase in the driving force applied to the boat. I have also studied passive dynamics by implementing a virtual torsional spring with CPFD to introduce passive pitching to an actively heaving airfoil. This passive pitching can amplify the thrust by an order of magnitude compared to a purely-heaving airfoil, and comes at no cost to efficiency, while also cutting the cost, complexity and weight of a second actuator. In these projects, I examine the underlying vortex dynamics behind the optimal efficient cases using Particle Image Velocimetry (PIV). I have also developed analytical tools using MATLAB and Python to analyze and process large quantities of data. Ultimately, this research could be used to design and development of maneuverable and efficient micro-air vehicles (MAVs) and autonomous underwater vehicles (AUVs), which have applications in terrain mapping, search and rescue missions, and military reconnaissance.

Lawrence Livermore National Laboratory — National Ignition Facility (May 2014-August 2014)

As an intern at Lawrence Livermore National Laboratory (LLNL) in the National Ignition Facility (NIF), I upgraded the Diagnostic Instrument Manipulators (DIMs). NIF houses the world's largest and most energetic laser, and the DIMs insert and position interchangeable diagnostic instruments into the target chamber, where the 192 laser beams are focused and fired, to measure and record data from experiments. I was responsible for designing a tensioner

system that ameliorated ergonomic strain for operators using the DIMs, validating the design's safety standards, performing off-line load testing, and implementing the final design for use at NIF. I presented my work at a department seminar and at the LLNL Poster Symposium.

Palo Alto Research Center – Hardware System Labs. (May 2013-August 2013)

My project as an intern at Palo Alto Research Center was to generate microspray using acoustic horns. My responsibilities there were to perform experimental characterization of acoustic horns and the interaction of acoustic waves with the fluids. I obtained insight into horn amplitude and efficiency using a Laser Doppler Vibrometer and NI LabVIEW and presented my findings in a research department seminar and poster symposium.

Duke University – Microscale Physicochemical Hydrodynamics Laboratory (May 2012-August 2012)

For the summer of 2012, I was selected to do a Research Experience for Undergraduates (REU) at Duke University, working in the Microscale Physicochemical Hydrodynamics Laboratory under Professor Chuan-Hua Chen. There, I studied the effects of induction rings on electrohydrodynamic (EHD) jets. My responsibilities included building experimental set ups at difference scales and imaging to characterize the EHD jet width. I presented my findings at the Duke Engineering REU Seminar at the end of the summer.

University of Texas MD Anderson Cancer Center (Summers of 2010 and 2011)

At the University of Texas MD Anderson Cancer Center, I worked in the Division of Diagnostic Imaging, designing and developing automated modules for radiotracer synthesis. I worked with a team of chemists to develop a manual synthesis process for synthesizing ^{18}F-FHTP with high yield and purity. I manufactured two automated modules, one capable of synthesizing ^{18}F-labeled amino acid compounds and the other capable of synthesizing iodine labeled radiotracers. Afterwards, I developed an algorithm in LabVIEW for the automated module's software to emulate the manual synthesis process and finally performed software validation to ensure capability of high yield and purity.

Academic Experience

Teaching Assistant and Grader —Cornell University and Brown University (August 2011-present)

At Brown University I was a grader and teaching assistant for four courses, and at Cornell University, I have been a teaching assistant for four courses. My responsibilities included grading homework assignments and laboratory reports, holding office hours, teaching recitation sections, and supervising laboratory hours. Through this experience, I discovered the joy of imparting knowledge and mentoring others. The courses for which I was a TA and grader were:

- Brown University
  - Introduction to Engineering
  - Dynamics and Vibrations (twice)
  - Digital Electronics System Design
  - Fluid Mechanics (Grader)
- Cornell University
  - Mechanical Property and Performance Lab
  - Wind Power
  - Experimental and Applied Mechanics of Structures
  - Fluid Mechanics Lab (Head TA)

Secretary –Sibley Graduate Student Symposium (SGRS) (September 2014-May 2016)

As the secretary of Cornell's SGRS, I was on the committee that organizes a research symposium for the Department of Mechanical and Aerospace Engineering, organizing the meetings and weekly itinerary. This experience has been exciting, as the symposium spreads excitement and knowledge in the field of engineering.

Corresponding Secretary –Tau Beta Pi (November 2012-May 2014)

I was initiated into Tau Beta Pi, the engineering honor society, upon exhibiting distinguished scholarship and exemplary character. As the corresponding secretary, I was responsible for communication between the local chapter and the National Headquarters and maintaining a "good standing" status for the local chapter. I also organized tutoring sessions for underclassmen, arranging volunteer tutors to teach material from introductory engineering courses. In addition, I arranged and led tours for prospective students.

Brown University Formula Society of Automotive Engineers (FSAE) (September 2010-May 2014)

As a member of the Brown FSAE team, I was involved in all facets of designing, modeling, manufacturing, and tuning a high performance formula style race car for the annual Michigan FSAE competition. On the team, I served as the business case presentation lead in 2013 and 2014. I was also the subsystem lead for the impact attenuator from 2012 to 2014, where I researched materials, did computer modeling and simulations, physical testing, and manufacturing to decrease the weight of the impact attenuator while maintaining the strength. I was heavily involved in the design and manufacturing of the aerodynamics of the car all four years. Through this experience, I gained valuable knowledge for using useful engineering tools such as CAD modeling and machining with the lathe, mill, CNC, and Electrical Discharge Machining, while also gaining the opportunity to mentor younger members by passing these skills and knowledge down to them. I also gained valuable experience working with a team, strengthening teamwork and leadership skills.

Publications

Young, J.D., Luo. J.Y., & Williamson, CHK. (2021) "Optimization of a Self-Propelled, Lift-Generating Airfoil." *Journal of Fluid Mechanics* (in preparation).

Young, J.D., Asselin, D.J., & Williamson, CHK. (2021) "Self-Propulsion of a Pitching and Heaving Airfoil." *Journal of Fluid Mechanics* (in preparation).

Asselin, D.J., Young, J.D., & Williamson, CHK. (2021) "Addition of passive dynamics to a heaving airfoil to improve performance." *Journal of Fluid Mechanics* (in submission).

Young, J.D., Morris, S.E., Schutt, R.R., Williamson, CHK. (2019) "Effect of hybrid-heave motions on the propulsive performance of an oscillating airfoil." *Journal of Fluids and Structures* **89**, 203-218.

Presentations and Posters

Young, J.D., Luo, J.Y., & Williamson, CHK. (2020) "Cyber-Physical Approach to a Self-Propelled Flapping Airfoil". Oral presentation at: 73rd Annual Meeting of the APS Division of Fluid Dynamics. Virtual.

Young, J.D., Morris, S.E., & Williamson, CHK. (2019) *Effect of Hybrid-Heave Motions on the Lift of Oscillating Airfoils*. Oral presentation at: 72nd Annual Meeting of the APS Division of Fluid Dynamics. Seattle, WA.

Young, J.D., Morris, S.E., & Williamson, CHK. (2018) *Mechanism to Improve Propulsive Performance of an Oscillating Airfoil Employing Hybrid Heave Motions*. Oral presentation at: 71st Annual Meeting of the APS Division of Fluid Dynamics. Atlanta, GA.

Williamson, CHK., Young, J.D., & Asselin, D.J. (2018) *Self-propulsion of an airfoil in combined heave-pitch motion*. Oral presentation at: 71st Annual Meeting of the APS Division of Fluid Dynamics. Atlanta, GA.

Morris, S.E., Young, J.D., & Williamson, CHK. (2018) *Effect of hybrid-heave motions on the propulsive performance of an oscillating airfoil*. Oral presentation at: 7th Conference on Bluff Body Wakes and Vortex-Induced Vibrations. Carry-le-Rouet/Marseille, France.

Young, J.D., Asselin, D.J., & Williamson, CHK. (2017) *Self-propulsion of a flapping airfoil using cyber-physical fluid dynamics*. Oral presentation at: 70th Annual Meeting of the APS Division of Fluid Dynamics. Denver, CO.

Asselin, D.J, Young, J.D., & Williamson, CHK. (2017) *Addition of Passive Dynamics to a Flapping Airfoil to Improve Performance*. Oral presentation at: 70th Annual Meeting of the APS Division of Fluid Dynamics. Denver, CO.

Young, J.D., Asselin, D.J., & Williamson, CHK. (2016) *Implementation of CPFD to Control Active and Passive Airfoil Propulsion*. Poster presentation at: 69th Annual Meeting of the APS Division of Fluid Dynamics. Portland, OR.

Asselin, D.J., Young, J.D., & Williamson, CHK. (2016) *Performance of active and passive control of an airfoil using CPFD*. Oral presentation at: 69th Annual Meeting of the APS Division of Fluid Dynamics. Portland, OR.

Young, J. & Plummer, R. (2014) *Upgrading the Polar Diagnostic Instrument Manipulators Cable Track Container*. Oral and poster presentation at: Lawrence Livermore National Laboratory Department Seminar and Poster Symposium. Livermore, CA.

Young, J., Smullin, S., & Paschkewitz, J. (2013) *Microspray Generation Using Acoustic Horns*. Oral and poster presentation at: Palo Alto Research Center Department Seminar and Poster Symposium. Palo Alto, CA.

Young, J. & Chen, C. (2012) *Effects of Induction Rings on Electrohydrodynamic Jets*. Oral presentation at: Duke University REU Seminar. Duke University. Durham, NC.

Awards and Honors

Teaching Assistant of the Year for Mechanical and Aerospace Engineering, 2019 & 2020
I was nominated for teaching assistant of the year in my department due to highly rated feedback of my clarity in explaining concepts and understanding of the subject for fluid mechanics.

National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP) Fellowship Recipient, 2015
I was selected to receive a 2015 NSF GRFP Fellowship based on my demonstrated potential to contribute to strengthening the vitality of US science and engineering enterprise.

National Defense Science & Engineering Graduate (NDSEG) Fellowship Recipient, 2015
I was selected to receive a 2015 NDSEG Fellowship based on my ability and special aptitude for advanced training in science and engineering. I declined this fellowship due to accepting the NSF GRFP Fellowship.

Cornell University Graduate Fellowship Recipient, 2014
I was selected to receive the Cornell University Graduate Fellowship, which covered my tuition and stipend for my first semester at Cornell.

Magna Cum Laude, Brown University, May 2014

Tau Beta Pi Honor Society, Brown University Rhode Island Alpha Chapter, November 2012
Membership in Tau Beta Pi is granted to those students in the top $1/8^{th}$ of the junior class who also demonstrate leadership and community service.

National Merit Scholarship Recipient, 2010
National Merit Scholarships are competitive national awards that provide funding for post-secondary education based on scholastic achievement.

Joint Chinese College Alumni Association Scholarship Recipient, 2010
This scholarship awarded funding for post-secondary education based on scholastic achievement

Skills

Experimental and Manufacturing Techniques
Particle image velocimetry (PIV), Laser induced fluorescence (LIF), laser doppler velocimetry (LDV), laser doppler vibrometer (LDV), machining (lathe, mill, CNC, EDM), composites layups, 3D printing

Software
SolidWorks, MATLAB, ANSYS, Microsoft Office (Word, PowerPoint, Excel), LaTeX, Python, C, Java, Scala, LabVIEW, Inkscape, Photoshop, Gimp

Languages
English, Chinese, and Spanish (President and Treasurer of the Spanish National Honor Society in high school)

Personal Interests and Activities
Golf, skiing, basketball, ultimate frisbee (captain of the two-time intramural championship team), kickball, drums, guitar, photography, video editing, cooking, web-development