

# Ethan Pickering, Ph.D.

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## Personal Information

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## Education

Aug 2016 – Feb 2021 **California Institute of Technology** *Pasadena, California*  
Doctorate of Philosophy, Mechanical Engineering, **Advisor: Tim Colonius**  
Aug 2016 – Jun 2018 **California Institute of Technology** *Pasadena, California*  
Master of Science, Mechanical Engineering  
Jan 2016 – Jul 2016 **Case Western Reserve University** *Cleveland, Ohio*  
Master of Science, Mechanical Engineering  
*Thesis: EDIFES 0.4: Scalable Data Analytics for Commercial Building Virtual Energy Audits*  
Aug 2011 – Dec 2015 **Case Western Reserve University** *Cleveland, Ohio*  
Bachelor of Science, Mechanical & Aerospace Engineering *summa cum laude*

## Research Appointments

Mar 2021 – Present **Massachusetts Institute of Technology** *Cambridge, Massachusetts*  
Postdoctoral Associate, Mechanical Engineering, **Advisor: Themis Sapsis**

## Research Interests

FLUID DYNAMICS aeroacoustics, reduced-order modeling, turbulence, flow mechanisms/instabilities, energy  
STOCHASTIC MODELS rare & extreme events, uncertainty quantification, Bayesian optimal experimental design  
DATA SCIENCE machine learning, deep learning of operators, data-assimilation  
CONTROL active and passive flow control, precursor identification, shape optimization

## Academic Awards

- **Thomas J. R. Hughes Fellow and NSF Presenter Fellowship**, International Conference of Theoretical and Applied Mechanics, 2021
- MIT Mechanical Engineering Research Exhibition Award Winner, 2021
- MIT Postdoctoral Symposium Finalist, 2021
- International Conference of Theoretical and Applied Mechanics Travel Grant, 2020+1
- Caltech Data to Discovery Program - Proposal Winner: Visualizing Turbulence in Jets, 2018
- **National Defense Science and Engineering Graduate Fellowship** – Award Winner, 2017
- **National Science Foundation Graduate Research Fellowship Program** – Award Winner (Declined), 2017
- **National Science Foundation Graduate Research Fellowship Program** – Honorable Mention, 2016
- Data Science Symposium Travel Award – Tohoku & Case Western Reserve University, 2016

- **Clapp Memorial Graduate Scholarship**, 2016
- SOURCE Summer Research Funding Recipient, CWRU, 2015
- Case Alumni Association Scholarship, 2014
- **Michelson-Morley STEM Scholarship**, 2011

## Teaching

Caltech	Dimensional and Data Analyses in Engineering, undergraduate, (co-instructor/co-designer)
Case Western	Calculus II for Scientists and Engineers, undergraduate (TA)
Case Western	Calculus I for Scientists and Engineers, undergraduate (TA)

## Academic Service & Memberships

Paper Referee	Journal of Fluid Mechanics, Journal of Fluid Mechanics Rapids, Journal of the Acoustical Society of America, Theoretical and Computational Fluid Dynamics, Sustainable Cities and Society, Aerospace
Session Chair	Euromech Colloquium Jet Noise Modelling and Control (Reactive Flows, 2021), AIAA/CEAS Aeroacoustics Conference (Jet Noise II-III, 2019)
Member	American Institute of Aeronautics and Astronautics (AIAA), American Physical Society (APS), Acoustical Society of America (ASA), Tau Beta Pi

## Journal Articles

1. **Pickering, E.**, Towne, A., Jordan, P., and Colonius, T., Resolvent-based modeling of turbulent jet noise, *The Journal of the Acoustical Society of America*, Vol. 150, No. 4, 2021, pp. 2421–2433
2. Towne, A., Rigas, G., **Pickering, E.**, and Colonius, T., Efficient global resolvent analysis via the one-way Navier-Stokes equations. Part 1. Forced response, *Submitted to the Journal of Fluid Mechanics*, *arXiv preprint arXiv:2111.09269*, 2021
3. **Pickering, E.**, Rigas, G., Schmidt, O. T., Sipp, D., and Colonius, T., Optimal eddy viscosity for resolvent-based models of coherent structures in turbulent jets, *Journal of Fluid Mechanics*, Vol. 917, 2021
4. **Pickering, E.**, Rigas, G., Nogueira, P. A. S., Cavalieri, A. V. G., Schmidt, O. T., and Colonius, T., Lift-up, Kelvin–Helmholtz and Orr mechanisms in turbulent jets, *Journal of Fluid Mechanics*, Vol. 896, 2020, pp. A2
5. **Pickering, E.**, Hossain, M. A., French, R. H., and Abramson, A. R., Building electricity consumption: Data analytics of building operations with classical time series decomposition and case based subsetting, *Energy and Buildings*, Vol. 177, 2018, pp. 184–196
6. **Pickering, E.**, Hossain, M. A., Mousseau, J. P., Swanson, R. A., French, R. H., and Abramson, A. R., A cross-sectional study of the temporal evolution of electricity consumption of six commercial buildings, *PloS one*, Vol. 12, No. 10, 2017, pp. e0187129

## Manuscripts in Preparation

1. **Pickering, E.**, Colonius, T., and Schmidt, O. T., Bispectral mode decomposition for non-resonant, homogeneous turbulent flows, *In preparation*, 2021
2. **Pickering, E.**, Karniadakis, G. E., and Sapsis, T. P., Active learning of nonlinear operators via neural nets for predicting extreme events, *In preparation*, 2021
3. **Pickering, E.**, Karniadakis, G. E., and Sapsis, T. P., On the quality of uncertainty of Deep Neural Networks and their comparison to Gaussian Process Regression, *In preparation*, 2021

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## Conference Papers

1. **Pickering, E.**, Towne, A., Jordan, P., and Colonius, T., Resolvent-based jet noise models: a projection approach, *AIAA Scitech Conference and Forum*, 2020
2. **Pickering, E.**, Rigas, G., Sipp, D., Schmidt, O. T., and Colonius, T., Eddy viscosity for resolvent-based jet noise models, *25th AIAA/CEAS Aeroacoustics Conference*, 2019, p. 2454
3. Rigas, G., **Pickering, E.**, Schmidt, O. T., Nogueira, P. A., Cavalieri, A. V., Brès, G. A., and Colonius, T., Streaks and coherent structures in jets from round and serrated nozzles, *25th AIAA/CEAS Aeroacoustics Conference*, 2019, p. 2597
4. Nogueira, P. A., Cavalieri, A. V., Schmidt, O. T., Jordan, P., Jaunet, V., **Pickering, E.**, Rigas, G., and Colonius, T., Resolvent-based analysis of streaks in turbulent jets, *25th AIAA/CEAS Aeroacoustics Conference*, 2019, p. 2569

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## Theses

Ph.D. Thesis

**Pickering, E.**, *Resolvent modeling of turbulent jets*, Ph.D. thesis, California Institute of Technology, 2021

Master's Thesis

**Pickering, E.**, *EDIFES 0.4: Scalable Data Analytics for Commercial Building Virtual Energy Audits*, Master's thesis, Case Western Reserve University, 2016

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## Invited Talks

- Euromech Colloquium on Uncertainty Quantification in Computational Mechanics, **Active learning of nonlinear operators via neural nets for predicting extreme events** (2021)
- Case Western Reserve University, Mechanical & Aerospace Engineering Seminar, **Means & Extremes - Modeling the impacts of the ordinary and the extraordinary** (2021)
- Case Western Reserve University, SDLE Center Seminar, **Active learning of nonlinear operators via neural nets for forecasting extreme events** (2021)
- Mechanistic Machine Learning and Digital Twins for Computational Science, Data-Driven Reduced-Order Methods for System Control, **On Predictive Resolvent-Based Turbulence Models** (2021)
- Euromech Colloquium on Jet Noise Modelling and Control, **Resolvent-based modeling of jet noise** (2021)
- Bayer Crop Sciences, **Means & Extremes: Modeling the impacts of the ordinary and the extraordinary** (2021)
- Massachusetts Institute of Technology, USA, Stochastic Analysis and Nonlinear Dynamics (SAND) Lab Group Talk, **Reduced-order modeling of turbulent jets** (2020)
- Instituto Tecnológico de Aeronáutica (ITA), Brazil, Divisão de Engenharia Aeronáutica e Aeroespacial, Special Seminar, **Resolvent-based modeling of turbulent jets** (2020)

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## Research Projects

Mar 2021 - Present

### **Active Learning of Extreme Events via Neural Nets**

*Stochastic & Nonlinear Dynamics, Massachusetts Institute of Technology, Cambridge, MA*

- Leverage infinite-dimensional neural nets for predicting extreme transient events.
- Develop active learning (i.e. data-selection) schemes for optimal training of neural nets.
- Permit identification of extremes in parameter spaces too intractable for complete Monte Carlo simulation.

Jun 2017 - Present

### **Next Generation Jet Noise Models for Complex Geometry Nozzles**

*Computational Flow Physics Group, California Institute of Technology, Pasadena, CA*

- Produce numerous databases through Large Eddy Simulations of various geometry nozzles
- Determine stochastically forced solutions through LES databases
- Validate jet noise solutions of spatial marching technique, one-way Euler (OWE) equations
- Extend OWE method to various complex geometries for noise reduction

- Aug 2014 – Aug 2016 **Data Analytics for Virtual Energy Audits and Value Capture Assessments of Buildings - EDIFICE**  
*Great Lakes Energy Institute, Case Western Reserve University, Cleveland, OH*
- Formed basis for now startup company EDIFICES: <http://www.edificeanalytics.com/>
  - Funded through Department of Energy ARPA-E 2015 Selection
  - Project Funds Awarded: \$1,433,281
  - Conducted preliminary research used in project proposal and assisted in proposal development

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## Non-Academic Employment History

- Jun 2014-Aug 2014 **NASA Glenn Research Center, Thermal Energy Branch, Mech. Eng. Test Analyst Intern** *Cleveland, OH*
- Fission Surface Power System Project (FSP) - Power System for Extra Terrestrial Colonies
  - Helped develop, run, and refine a thermal and fluid dynamic system model written in MATLAB
- Jun 2013 - Jan 2014 **Philips Healthcare, Cleveland, OH, GCX CT Engineering, Mechanical Co-Op**
- ATLAS Patient Table Project –First Multi-Modality Patient Table for CT applications
  - Lead Proto Build Engineer: Led two teams from Suzhou, China to build first 8 prototypes and develop production WI

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## Community Service

- 2020 Caltech Y Pasadena LEARNs Program
- 2017-2019 Assistant Varsity Baseball Coach, Caltech
- 2013-2015 The Haley School Tutoring Program, Case Western

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## Leadership Awards

- **International Balfour Award** – Most Outstanding Senior in the International Fraternity of Sigma Chi, 2016
- **Watson Founders/Bell Chapter Scholarship** - Top Overall Applicant, International Fraternity of Sigma Chi, 2014
- **Glenn Nichols Character of Distinction** Case Western Reserve University, 2015

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## Leadership Roles

- Jun 2020 – Present **Diversity, Equity, and Inclusion Commission, International Fraternity of Sigma Chi**
- Sep 2020 – Apr 2021 **Greek Life Sexual Misconduct Task Force, Case Western Reserve University, Advisor**
- Jun 2020 – Feb 2021 **Academics Chair, Graduate Student Council** *Caltech*
- Oversee institute wide academic programs/workshops, promote collaboration and communication among student researchers, and advocate for student concerns.
- Jun 2016 – Jun 2018 **Board of Directors, International Fraternity of Sigma Chi**
- One of 12 voting members overseeing the governance of 244 chapters of Sigma Chi in the United States and Canada
- May 2017 – Feb 2021 **Mechanical Engineering Option Representative, Graduate Student Council** *Caltech*
- Represent mechanical engineering graduate student interests for the betterment of the campus and the graduate student experience at Caltech