

Benjamin Herrmann

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Research Interests

Machine learning: *Physics informed ML, dimensionality reduction, sparse regression, dynamic mode decomposition.*
Dynamics and control: *Koopman theory, nonnormal systems, sensor/actuator placement, machine learning control.*
Fluid dynamics: *Bio-inspired flow control, unsteady aerodynamics, hydrodynamic stability, resolvent analysis.*

Affiliations

University of Chile

2021 – present Assistant Professor, Department of Mechanical Engineering

Education

University of Chile

Ph.D. in Fluid Dynamics, 2018.

Dissertation: *Heat transfer enhancement strategies in a swirl flow channel heat sink based on hydrodynamic receptivity*

Advisor: Williams R. Calderón-Muñoz, wicalder@ing.uchile.cl

M.Sc. in Mechanical Engineering, 2014. GPA 4.0

Dissertation: *Siting of urban wind turbines and available energy potential based on urban configuration*

Advisor: Williams R. Calderón-Muñoz, wicalder@ing.uchile.cl

B.Sc. in Mechanical Engineering, 2014. GPA 4.0

Research Experience

Research associate: University of Washington, USA, May 2019-May 2021.

Supervisor: Steven L. Brunton, sbrunton@uw.edu

Development of data-driven methods for stability and receptivity analyses of large-scale dynamical systems.

Research associate: Technische Universität Braunschweig, Germany, Apr 2019-Nov 2020.

Supervisor: Richard Semaan, r.semaan@tu-bs.edu

Data-driven modeling of aerodynamic systems for experimental feedback control.

Researcher: University of Chile, Chile, Jul 2018-Jan 2019.

Principal investigator: José Miguel Cardemil, jcardemil@ing.uchile.cl

Model development for the conjugate heat transfer and fluid flow in a volumetric solar receiver.

Visiting graduate student: University of California-Merced, Jun-Aug 2017.

Hosted by Gerardo Diaz, gdiaz@ucmerced.edu

Experimental work on the performance of a swirl flow minichannel heat sink subject to flow pulsations.

Research assistant: CSIRO Chile International Centre of Excellence, Santiago, Chile, Nov 2014- Dec 2015.

Principal investigator: Manuel Duarte, mduarte@ing.uchile.cl

Research on the fluid dynamics of a parallel disc turbine for energy recovery from mineral pipelines.

Intern engineer: Keppel Offshore and Marine Technology Centre, Singapore, Jan-Feb 2012.

Supervised by: Quek Choon Kiat, choonkiat.quek@keppelshipyard.com
Research and development in shipyard processes.

Teaching Experience

Instructor: University of Chile, Department of Mechanical Engineering

- Heat transfer, Fall Semesters 2022–2023.
- Statics, Fall Semesters 2022–2023.
- Introduction to nonlinear dynamics, Spring Semesters 2021–2023.

Co-instructor (with S. L. Brunton): University of Washington, Department of Mechanical Engineering

- Machine learning control, Spring Quarter 2020.

Lecturer: University of Chile, Department of Mechanical Engineering

- Fundamentals of heat transfer – Diplomado en climatización 2018.

Teaching assistant: University of Chile, Department of Mechanical Engineering

- Aerodynamics, Mar 2014–Jun 2014.
- Thermal and fluids engineering, Mar 2014–Jun 2014.
- Fluid mechanics, Aug 2011–Jun 2013.
- Solid mechanics, Aug 2009–Nov 2009.

Awards and Service

PRIME Fellowship – DAAD: Postdoctoral Researchers International Mobility Experience, 2019-2020

Beca Doctorado Nacional 2015 – CONICYT: Fellowship for Doctoral Studies, 2015-2018.

Scientific societies: SIAM, APS Division of Fluid Dynamics, ASTFE.

Paper reviewer: *Nat. Comp. Sci.*, *SIAM J. Sci. Comp.*, *J. Fluid Mech.*, *Int. J. Heat Mass Transfer*, *Int. J. Mech. Sci.*, *J. Appl. Comput. Mech.*, *Proc. 2nd Th. Fluids Eng. Conf.*

Research Grants

1. U-Inicia UI-003 / 21, *Métodos para el modelamiento basado en datos de sistemas dinámicos con aplicaciones a control, optimización y análisis de flujos de fluido*, PI, 2022–2023.
2. FONDECYT 11220465, *Methods for data-driven modeling of dynamical systems with applications to control, optimization and analysis of fluid flows*, PI, 2022–2024.

Journal Publications

1. **B. Herrmann**, P. Baddoo, R. Semaan, S. L. Brunton, and B. J. McKeon
Interpolatory input and output projections for flow control
Journal of Fluid Mechanics, **971**: A27, 2023.
2. P. Baddoo, **B. Herrmann**, B. J. McKeon, J. N. Kutz, and S. L. Brunton
Physics-informed dynamic mode decomposition
Proceedings of the Royal Society A, **479**: 20220576, 2023.
3. **B. Herrmann**, J. E. Pohl, S. L. Brunton, and R. Semaan
Gust mitigation through closed-loop control. II. Feedforward and feedback control
Physical Review Fluids, **7**: 024706, 2022.
4. J. E. Pohl, R. Radespiel, **B. Herrmann**, S. L. Brunton, and R. Semaan
Gust mitigation through closed-loop control. I. Trailing-edge flap response
Physical Review Fluids, **7**: 024705, 2022.
5. P. Baddoo, **B. Herrmann**, B. J. McKeon, and S. L. Brunton

Kernel learning for robust dynamic mode decomposition: linear and nonlinear disambiguation optimization (LANDO)

Proceedings of the Royal Society A, **478**: 20210830, 2022.

6. M. Behzad, **B. Herrmann**, W. R. Calderón-Muñoz, J. M. Cardemil, and R. Barraza
Thermo-structural analysis of a honeycomb-type volumetric absorber for concentrated solar power applications
International Journal of Numerical Methods for Heat and Fluid Flow, **32**: 598-615, 2022.
7. **B. Herrmann**, P. Baddoo, R. Semaan, S. L. Brunton, and B. J. McKeon
Data-driven resolvent analysis
Journal of Fluid Mechanics **918**: A10, 2021.
8. **B. Herrmann**, P. Oswald, R. Semaan, and S. L. Brunton
Modeling synchronization in forced turbulent oscillator flows
Communications Physics, **3**: 195, 2020.
9. **B. Herrmann**, M. Behzad, J. M. Cardemil, W. R. Calderón-Muñoz, and R. M. Fernández
Conjugate heat transfer model for feedback control and state estimation in a volumetric solar receiver
Solar Energy, **198**: 343-354, 2020.
10. **B. Herrmann-Priesnitz**, W. R. Calderón-Muñoz, G. Diaz, and R. Soto
Heat transfer enhancement strategies in a swirl flow minichannel heat sink based on hydrodynamic receptivity
International Journal of Heat and Mass Transfer, **127**: 245-256, 2018.
11. **B. Herrmann-Priesnitz**, W. R. Calderón-Muñoz, and R. Soto
Stability and receptivity of boundary layers in a swirl flow channel
Acta Mechanica, **229**: 4005-4015, 2018.
12. **B. Herrmann-Priesnitz**, W. R. Calderón-Muñoz, A. Valencia, and R. Soto
Thermal design exploration of a swirl flow microchannel heat sink for high heat flux applications based on numerical simulations
Applied Thermal Engineering, **109**: 22-34, 2016.
13. **B. Herrmann-Priesnitz**, W. R. Calderón-Muñoz, E. A. Salas, A. Vargas, M. A. Duarte, and D. A. Torres
Hydrodynamic structure of the boundary layers in a rotating cylindrical cavity with radial inflow
Physics of Fluids, **28**: 033601, 2016.
14. **B. Herrmann-Priesnitz**, W. R. Calderón-Muñoz and R. LeBoeuf
Effects of urban configuration on the wind energy distribution over a building
Journal of Renewable and Sustainable Energy, **7**: 033106, 2015.

Conference Papers

1. C. Sarmiento, J. M. Cardemil, **B. Herrmann**, and W. R. Calderón-Muñoz
Heat Transfer Framework for Selecting the Structure of Open Volumetric Air Receivers
Proceedings of the ISES Solar World Congress and IEA SHC International Conference on Solar Heating and Cooling for Buildings and Industry 2019, SWC 2019.
2. M. Behzad, **B. Herrmann**, W. R. Calderón-Muñoz, and J. M. Cardemil
Thermo-structural analysis of a honeycomb type volumetric absorber for a concentrated solar power plant
Proceedings of the ISES Solar World Congress and IEA SHC International Conference on Solar Heating and Cooling for Buildings and Industry 2019, SWC 2019.
3. **B. Herrmann-Priesnitz** and W. R. Calderón-Muñoz
Effect of hydrodynamic boundary layer structure on the performance of a swirl flow microchannel heat sink for high heat flux applications
2nd Thermal and Fluids Engineering Conference, TFEC 2017.

Contributed Talks

1. **B. Herrmann**, P. J. Baddoo, S. T. M. Dawson, R. Semaan, S. L. Brunton, and B. J. McKeon
Interpolatory input and output projections for flow control
76th Annual Meeting of the APS Division of Fluid Dynamics, DFD 2023.
2. **B. Herrmann**
Modelamiento de sistemas dinámicos basado en datos: desafíos y oportunidades
Jornadas de Mecánica Computacional, JMC 2023.
3. **B. Herrmann**, P. J. Baddoo, S. T. M. Dawson, R. Semaan, S. L. Brunton, and B. J. McKeon
From resolvent to Gramians: forcing and response modes for control
22nd Computational Fluids Conference, CFC 2023.
4. **B. Herrmann**, P. J. Baddoo, S. T. M. Dawson, R. Semaan, S. L. Brunton, and B. J. McKeon
From resolvent to Gramians: forcing and response modes for control
75th Annual Meeting of the APS Division of Fluid Dynamics, DFD 2022.
5. **B. Herrmann**, P. J. Baddoo, S. L. Brunton, and B. J. McKeon
Nonlinearity-subtracted Dynamic mode decomposition
U.S. National Congress on Theoretical and Applied Mechanics, USNC/TAM 2022.
6. **B. Herrmann**
Physically meaningful dimensionality reduction of dynamical systems
CMM Pucón Symposium, 2022.
7. **B. Herrmann**
Dinámica, control y datos
I Congreso de Postgrado de la Facultad de Ciencias Físicas y Matemáticas U. de Chile, 2022.
8. **B. Herrmann**
Estructuras coherentes para control de flujos de fluido
Jornadas de Mecánica Computacional, JMC 2022.
9. **B. Herrmann**, P. J. Baddoo, S. L. Brunton, and B. J. McKeon
Linearized analyses of fluid flows from nonlinear simulation data
74th Annual Meeting of the APS Division of Fluid Dynamics, DFD 2021.
10. **B. Herrmann**, P. J. Baddoo, S. L. Brunton, and B. J. McKeon
Análisis lineal de flujos de fluido a partir de simulaciones no lineales
Jornadas de Mecánica Computacional, JMC 2021.
11. **B. Herrmann**, P. J. Baddoo, R. Semaan, S. L. Brunton, and B. J. McKeon
Data-driven analysis of non-normal systems (*Keynote talk*)
U.S. National Congress on Computational Mechanics, USNCCM 2021.
12. **B. Herrmann**, P. J. Baddoo, R. Semaan, S. L. Brunton, and B. J. McKeon
Data-driven resolvent analysis
SIAM Conference on Computational Science and Engineering, SIAM CSE 2021.
13. **B. Herrmann**, J. Pohl, S. L. Brunton, and R. Semaan
Experimental gust mitigation using model based feedforward and feedback control
73rd Annual Meeting of the APS Division of Fluid Dynamics, DFD 2020.
14. **B. Herrmann**, S. L. Brunton, and R. Semaan
Modeling synchronization in forced turbulent oscillator flows
Second Symposium on Machine Learning and Dynamical Systems, Fields Institute, MLDS 2020.
15. **B. Herrmann**, S. L. Brunton, and R. Semaan
Synchronization in periodically forced oscillator flows
72nd Annual Meeting of the APS Division of Fluid Dynamics, DFD 2019.
16. **B. Herrmann-Priesnitz**, W. R. Calderón-Muñoz, J. M. Cardemil, and M. R. Fernández
Catastrophic dynamics of volumetric solar receivers

71st Annual Meeting of the APS Division of Fluid Dynamics, DFD 2018.

17. **B. Herrmann-Priesnitz**, W. R. Calderón-Muñoz, G. Diaz, and R. Soto
Hydrodynamic stability in a swirl flow channel
7th International Symposium on Bifurcations and Instabilities in Fluid Dynamics, BIFD 2017.
18. **B. Herrmann-Priesnitz**, and W. R. Calderón-Muñoz
Effect of hydrodynamic boundary layer structure on the performance of a swirl flow microchannel heat sink for high heat flux applications
2nd Thermal and Fluids Engineering Conference, TFEC 2017.

Invited Talks

1. **B. Herrmann**
Hecho en Beaufort: Estudio Lightboard para clase invertida
Teaching seminar at FCFM U Chile, Encuentro de docencia 2022.
2. **B. Herrmann**
Modelamiento de sistemas dinámicos: relevancia y desafíos modernos
Seminar of the Dept. of Mechanical Eng. at U Chile, Ciencia de datos para sistemas dinámicos 2021.
3. **B. Herrmann**
Mecánica computacional y ciencia de datos
Undergraduate seminar at FCFM U Chile, Feria vocacional 2021.
4. **B. Herrmann**
Ciencia de datos para sistemas dinámicos
Seminar of the Department of Mechanical Engineering at U Chile, Semana mecánica 2021.
5. **B. Herrmann**, P. J. Baddoo, R. Semaan, S. L. Brunton, B. J. McKeon
Data-driven analysis of non-normal systems
R. Vinuesa's group seminar from the Department of Mechanics at KTH, 2021.
6. **B. Herrmann**
Deep learning en ciencia e ingeniería
Deep learning seminar at FCFM U Chile, 2021.
7. **B. Herrmann**
Machine learning informado por física para gemelos digitales
XIX Encuentro de gestión de activos físicos, EGAF 2021.
8. **B. Herrmann**
Learning what tickles your flow from data
Seminar of the Department of Mechanical Engineering at U Hawaii Manoa, 2021.
9. **B. Herrmann**, P. Oswald, S. L. Brunton, R. Semaan
Modeling drag reduction in forced turbulent oscillator flows
Seminar of the Institute of Fluid Mechanics at TU Braunschweig, 2020.
10. **B. Herrmann**, S. L. Brunton, R. Semaan
Modeling synchronization in forced turbulent oscillator flows
B. McKeon's group seminar from the Graduate Aerospace Laboratories at Caltech, 2020.

Supervised student projects

Co-advisor

1. Analysis of the interaction between a photovoltaic panel and a vertical axis wind turbine in an urban environment using CFD simulations, Vicente Saavedra, 2018.
2. Effect of the thermal interaction on the efficiency of an array of photovoltaic panels, Sebastián Hurtado, 2018.
3. Computational model of the insulation system for a magnetic induction heater, Joaquín Carrasco, 2018.
4. Three-dimensional thermal modeling of a photovoltaic panel, Viviana Olivares, 2018.

5. Thermal modeling of a photovoltaic solar farm from the perspective of cyber-physical systems, Rodrigo Cordero, 2018.

Member of committee

6. One-dimensional and unsteady thermal model of a bifacial photovoltaic cell, Carolina Bernuy, 2018.
7. Siting of urban wind turbines using CFD simulation and entropy generation analysis, Mariana Gallardo, 2018.
8. Design and modeling of a passive heat sink for temperature reduction and redistribution in photovoltaic panels, Daniel Espinosa, 2017.