Benjamin Herrmann

Assistant Professor
Department of Mechanical Engineering
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Research Interests

Data-driven modeling: *Physics informed ML, model discovery, modal decompositions, digital twins.*
Dynamics and control: *Koopman theory, model reduction, sensor/actuator placement, system identification.*
Fluid dynamics: *Hydrodynamic stability, resolvent analysis, unsteady aerodynamics, cardiovascular flows.*

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

Postdoctoral Positions

May 2019 – May 2021 University of Washington, USA.
Data-driven methods for analysis of large-scale dynamical systems.
Supervisor: Steven L. Brunton, sbrunton@uw.edu

Apr 2019 – Nov 2020 Technische Universität Braunschweig, Germany.
Data-driven modeling of aerodynamic systems for experimental feedback control.
Supervisor: Richard Semaan, r.semaan@tu-bs.edu

Jul 2018 – Jan 2019 University of Chile, Chile.
Modeling of conjugate heat transfer and fluid flow in a volumetric solar receiver.
Supervisor: José Miguel Cardemil, jmcardem@uc.cl

Awards and Honors

PRIME Fellowship – DAAD: Postdoctoral Researchers International Mobility Experience, 2019-2020
Beca Doctorado Nacional 2015 – CONICYT: Fellowship for Doctoral Studies, 2015-2018.

Funding

1. **FONDECYT 11220465,** *Methods for data-driven modeling of dynamical systems with applications to control, optimization and analysis of fluid flows*, PI, 2022–2024, ***$85M CLP***.

2. **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, ***$8M CLP***.

3. **PRIME Fellowship**, *Data-driven feedback control of a turbulent flow around a D-shaped body for drag reduction*, 2019–2020, ***$125k €.***

Journal Publications

264 Google Scholar citations; h-index 9; i10-index 9

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. **B. Herrmann**, E. Kracht, S. L. Brunton, and B. J. McKeon
Sparse sensor placement for turbulent flow field reconstruction based on mean-flow-linearized dynamics
Thirteenth International Symposium on Turbulence and Shear Flow Phenomena, TSFP 2024.
2. 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.
3. 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.
4. **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 resolvent analysis
    SIAM Conference on Computational Science and Engineering, SIAM CSE 2021.
12. **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.
13. **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.
14. **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.
15. **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.
16. **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.
17. **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 (BH Invited)

1. Aprendiendo dinámica a partir de datos espacio-temporales ***(Tutorial)***
   Escuela de Verano en Inteligencia Computacional, EVIC 2023.
2. Modelamiento de sistemas dinámicos: desafíos y oportunidades
   Lecture for PDEs course at FCFM U Chile, 2023.
3. Hecho en Beauchef: Estudio Lightboard para clase invertida
   Teaching seminar at FCFM U Chile, Encuentro de docencia 2022.
4. Data-driven analysis of non-normal systems ***(Minisymposium Keynote)***
   U.S. National Congress on Computational Mechanics, USNCCM 2021.
5. 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.
6. Mecánica computacional y ciencia de datos
   Undergraduate seminar at FCFM U Chile, Feria vocacional 2021.

7. Ciencia de datos para sistemas dinámicos
   Seminar of the Department of Mechanical Engineering at U Chile, Semana mecánica 2021.
8. Data-driven analysis of non-normal systems
   R. Vinuesa's group seminar from the Department of Mechanics at KTH, 2021.
9. Deep learning en ciencia e ingeniería
   Deep learning seminar at FCFM U Chile, 2021.
10. Machine learning informado por física para gemelos digitales
    XIXX Encuentro de gestión de activos físicos, EGAF 2021.
11. Learning what tickles your flow from data
    Seminar of the Department of Mechanical Engineering at U Hawaii Manoa, 2021.
12. Modeling drag reduction in forced turbulent oscillator flows
    Seminar of the Institute of Fluid Mechanics at TU Braunschweig, 2020.
13. Modeling synchronization in forced turbulent oscillator flows
    B. J. McKeon's group seminar from the Graduate Aerospace Laboratories at Caltech, 2020.

Other Talks

2023, Nov. APS DFD, Washington, DC (G-Hernandez, Herrmann, Cao, Colbrook, Brunton, McKeon)
2023 Oct. JMC, Santiago, Chile (Lemus, Herrmann)
2023 Oct. JMC, Santiago, Chile (Torres, Herrmann)
2023 Oct. JMC, Santiago, Chile (Delgado, Herrmann)
2023 Oct. JMC, Santiago, Chile (Magaña, Herrmann)
2022, Nov. APS DFD, Indianapolis, IN (McKeon, Herrmann, Baddoo, Brunton; **Keynote**)
2022 Oct. JMC, Valdivia, Chile (Lemus, Herrmann)
2022 Oct. JMC, Valdivia, Chile (Bahamondes, Herrmann)
2022 Oct. JMC, Valdivia, Chile (Magaña, Herrmann)
2021, Nov. APS DFD, Phoenix, AZ (Baddoo, Herrmann, McKeon, Kutz, Brunton)
2020, Nov. APS DFD, Virtual (Brunton, Baddoo, Herrmann, McKeon)

Service

Service at U Chile:
ME PhD Program Committee [2023–present].
ME Department Council [2022–present].

Scientific societies: *SIAM, APS, SCMC.*

Grant reviewer: *Fondecyt.*

Paper reviewer:
Nature Computational Science
SIAM Journal of Scientific Computing
Journal of Fluid Mechanics
Physical Review Fluids
AIAA Journal
Chaos: An Interdisciplinary Journal of Nonlinear Science
Physica D: Nonlinear Phenomena
International Journal of Mechanical Sciences
Mechanical Systems and Signal Processing
Expert Systems with Applications
International Journal of Heat and Mass Transfer
Journal of Applied and Computational Mechanics
Chemical Engineering Research and Design

Mentoring & Advising

Current (1 PhD, 3 Masters, 4 Undergraduates)

PhDs:
Erick Kracht [2023–present]. PhD UChile ME.

Masters:
Nicolás Torres [2023–present]. MSc UChile ME.
Diemen Delgado [2023–present]. MSc UChile ME.
Matías Bahamondes [2022–present]. MSc UChile ME.

Undergraduates:
Benjamin Reyes [2024–present]. Uchile ME.
Benjamin Reyes [2024–present]. Uchile ME.
Juan F. Salvo [2023–present]. Uchile ME.
Juan P. Caldera [2023–present]. Uchile ME.

Lab Alumni (1 Masters, 2 Undergraduates)

Masters:
Javier Lemus [2022–2023]. MSc UChile ME.

Undergraduates:
Efraín Magaña Reyes [2022–2023]. Uchile ME.
Ignacio Sanhueza Reyes [2021–2022]. Uchile ME.

Teaching

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.