

## Dervis C. Vural, Assistant Professor

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Department of Physics, **University of Notre Dame**

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**RESEARCH INTERESTS** Statistical Mechanics, Complex Networks, Evolutionary Ecology, Disordered Materials.

**PERSONAL STATEMENT** I specialize in the theoretical analysis of biological and physical many-body systems where interactions and disorder play an important role. My research is driven by three fundamental questions: (1) Universality: To what extent do microscopic laws determine macroscopic behavior? (2) Statistics: How should microscopic laws be transformed to give macroscopic ones? (3) Inversion: Can microscopic laws be uniquely determined from macroscopic observations? Topics of interest include complex networks, control theory, population genetics, aging and failure, swarms and active matter, inverse problems, synthetic biology and condensed matter systems. My background is in theoretical physics (U. Illinois), engineering and applied sciences (Harvard U.), and biological sciences (Yale U.). Transcending boundaries of science and engineering, pure and applied, or theoretical and practical, our group strives to be problem solvers first and foremost, viewing empirical relevance, conceptual advancement and mathematical rigor as an inseparable whole.

**EDUCATION** **University of Illinois at Urbana-Champaign**, Urbana-Champaign, IL, USA

Ph.D., Physics, 2011

- Thesis Topic: *Universal Sound Attenuation in Disordered Solids*
- Adviser: Professor Anthony J. Leggett
- Area of Study: Theoretical Condensed Matter

M.S., Physics, 2004

- Adviser: Professor Anthony J. Leggett
- Area of Study: Theoretical Condensed Matter Physics

**Middle East Technical University**, Ankara, Turkey

B.S., Physics, 2002

- Special (Honors) Program, *Magna cum Laude*.
- Undergraduate research on Carbon Nano Structures.

ACADEMIC APPOINTMENTS    **University of Notre Dame**, Assistant Professor  
 Department of Physics    2014-present

**Yale University**, Postdoctoral Researcher  
 Department of Molecular Cellular and Developmental Biology    2014

**Harvard University**, Postdoctoral Researcher  
 School of Engineering and Applied Sciences    2011-2014

**University of Illinois at Urbana-Champaign**, Postdoctoral Researcher  
 Department of Physics    2011-2012

**University of Illinois at Urbana-Champaign**, Research Assistant  
 Department of Physics    2002-2011

PUBLICATIONS    # Vural Group Students    \* Corresponding Author

- Ghonge S.#, **D.C. Vural\***, Temperature as a quantum observable. *Journal of Statistical Mechanics*, 073102 (2018)
- N. Rupprecht#, **D.C. Vural\***, Limits on Inferring the Past, *97.6* (2018): 062155
- Morsky B.#, **D.C. Vural\***, Cheater-altruist synergy in immunopathogenic ecological public goods games, *Journal of Theoretical Biology*, 454, 7: 231-239 (2018)
- X. Fu, S. Kato, J. Long, **D.C. Vural**, S.W. Zucker and T. Emonet\*, Spatial Self-Organization Resolves Conflicts Between Individuality and Collective Migration, *Nature Communications*, 9.1 (2018): 2177
- G. Uppal#, **D.C. Vural\***, Shearing in flow environment promotes evolution of social behavior in microbial populations. *eLife*. (2018) May 22;7:e34862.
- D. Suma, A. Acun, P. Zorlutuna, **D.C. Vural\***, Proceedings of the Royal Society, *Open Science*, 5.2 (2018):171395
- N. Rupprecht#, **D.C. Vural\***, Collective Motion of Predictive Swarms, *PLoS ONE*, 12(10) (2017), e0186785
- V. Nguyen#, **D.C. Vural\***, Morphological Inversion of Complex Diffusion, *Physical Review E*, 96.3 (2017): 032314
- G. Forte#, **D.C. Vural\***, Iterative Control Strategies for Nonlinear Systems, *Physical Review E*, 96.1 (2017): 012102

- S. Ghonge<sup>#</sup>, **D.C. Vural\***, Inferring Network Structure from Cascades, Physical Review E, 96.1 (2017): 012319
- A. Acun, **D.C. Vural**, P. Zorlutuna\*, A Tissue Engineered Model of Aging: Interdependence and Cooperative Effects in Failing Tissues, Scientific Reports, 7.1 (2017): 5051
- I.U. Can, N. Nagarajan, **D.C. Vural**, P. Zorlutuna\*. “Muscle-Cell-Based Living Diodes”, Advanced Biosystems, 1600035 (2017) [**Cover Article**]
- D.C. Vural\***, A. Isaakov, L. Mahadevan\*. “Organization and Control of Evolving Interdependent Populations”, Proceedings of the Royal Society Interface, 12: 20150044 (2015)
- D.C. Vural\***, G. Morrison, Mahadevan\*. “Aging in complex interdependency networks.” Physical Review E 89.2 : 022811 (2014).
- A.J. Leggett\*, **D.C. Vural\***, The “Tunnelling Two-Level Systems” Model of the Low-Temperature Properties of Glasses: Are “Smoking-Gun” Tests Possible?, The Journal of Physical Chemistry B, (2013).
- D.C. Vural**, A.J. Leggett\*, Universal sound absorption in amorphous solids: A Theory of Elastically Coupled Generic Blocks, Journal of Non-Crystalline Solids, 357(11), 3528-3537 (2011),
- D.C. Vural\***, When Models Interact with their Subjects: The Dynamics of Model-Aware Systems. PLoS ONE, 6(6): e20721 (2011)
- T. Achler, **D.C. Vural**, E. Amir\*. Counting Objects with Biologically Inspired Regulatory-Feedback Networks, Neural Networks IJCNN, IEEE, 5178976, pp. 36-40 (2009)
- S. Erkoç\*, **D.C Vural**, Molecular-Dynamics Simulations of Carbon Nanocage Structures: Nanoballs and Nanotoroids. International Journal of Modern Physics. 12(5) 685-690 (2001)

AWARDED  
FUNDING

- DARPA HR0011-16-C-0062 01/01/2016 - 12/31/2016  
Biological Technology Office \$338,682  
“Ecological & Biosocial Control: Directing Coevolving Networks”  
**Role:** Sole PI
- NSF PHY-1607643 6/15/2016 - 5/31/2017  
Physics of Living Systems \$31,442  
“Workshop on Aging and Failure in Biological, Physical and Engineered Systems”  
**Role:** Lead PI

- NSF CBET-203384 6/1/2018 - 5/31/2018  
Engineering of Biomedical Systems \$400,000  
“Tissue Engineered Model of Aging to Study the Role of Cellular Interdependence in Failing Tissues”  
**Role:** Co-PI
- ARMI / BioFab USA, 6/1/2018 - 5/31/2019  
Engineering of Biomedical Systems \$3,198,820  
“A Bioreactor for Large-Scale Culture of Anchorage-dependent Cells with Hollow Microcarriers”  
**Role:** Co-PI

#### INVITED TALKS

- “Universal Properties of Disordered Materials”, Workshop on Large Fluctuations and Collective Phenomena in Disordered Materials, May 16-19, 2011, University of Illinois at Urbana Champaign, IL
- “Evolution of Interdependence and Aging”, NSF Workshop: Biological and Physical Principles of Mammalian Aging, May 14-16, 2014, Arlington, VA
- “How things Fall Apart”, Colloquium: Indiana University-Purdue University at Indianapolis, November 5, 2015, Indianapolis, IN
- “Statistical Mechanics of Aging and Death”, Colloquium: Western Michigan University, December 7, 2015, Kalamazoo, MI
- “Beyond Cellular Aging: How Complex Structures Fail”, NSF Workshop: Physics of Wear, Tear, Aging and Failure in Living and Non-Living Systems, May 6-8, 2015, Living Systems, Tysons Corner, VA
- “Filling the Gap Between Cell Damage and Tissue Failure”, Aging and Failure in Biological, Physical and Engineered Systems, May 15-18, 2016
- “Evolutionary Control Theory”, DARPA, Biological Technology Office, Biological Control Program Kickoff, December 1, 2016, Booz Allen Hamilton One Preserve facility, Rockville, MD.
- Colloquium at Santa Fe Institute. “Rise and Fall of Evolutionary Sand Castles.” February 19, 2018
- Santa Fe Institute Workshop on Dynamic Multi-System Resilience in Human Aging, November 12-13, 2018
- Systems Biology Theory Seminar, Harvard Medical School, “Rise and fall of evolutionary sand castles”, March 8, 2019

#### SERVICE

- Organizer and Chair in NSF funded Workshop on Aging and Failure in Biological, Physical and Engineered Systems”, May 15-18, 2016
- Chair APS Prairie Section. “Biological and Complex Systems”.
- Organizer and Chair in Annual Midwest Quantitative Biology Symposium

sium at Notre Dame, April 8, 2017.

#### OUTREACH

- Science Fair Judge, Marian High School, South Bend, IN
- Public Lecture in “Our Universe Revealed” Series.
- Reviewer for Physical Review Letters, Physical Review B, Physical Review E, PLoS One, New Journal of Physics, Proceedings of the Royal Society Interface.
- Proposal Reviewer for Cariplo Foundation
- Demonstrated physics experiments to primary, secondary and high school students in the underdeveloped villages in Turkey with the organization ILKYAR.

#### AWARDS

Honorary Faculty Inductee of Physics Honor Society, Sigma Pi Sigma, for excellence in teaching.

#### SYNERGISTIC ACTIVITIES

- Graduated from the Piano Department at Bilkent University, Turkey. Number of awards from compositions and concerts involving algorithmic composing and wave design. Visual and acoustic experiments available at [www.dcvural.info](http://www.dcvural.info)