

# Stanford

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## Gunnar Carlsson

Ann and Bill Swindells Professor, Emeritus

Mathematics

 Curriculum Vitae available Online

### Bio

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#### BIO

Dr. Carlsson has been a professor of mathematics at Stanford University since 1991. In the last ten years, he has been involved in adapting topological techniques to data analysis, under NSF funding and as the lead PI on the DARPA “Topological Data Analysis” project from 2005 to 2010. He is the lead organizer of the ATMCS conferences, and serves as an editor of several Mathematics journals

#### ACADEMIC APPOINTMENTS

- Emeritus Faculty, Acad Council, Mathematics
- Member, Institute for Computational and Mathematical Engineering (ICME)

#### BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, Scientific Advisory Board, WASP initiative, Wallenberg Foundation, Sweden (2018 - present)

#### PROFESSIONAL EDUCATION

- Ph.D., Stanford University , Mathematics (1976)
- B.A., Harvard University , Mathematics (1973)

### Teaching

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#### STANFORD ADVISEES

##### Doctoral Dissertation Co-Advisor (NonAC)

Naomi Kraushar, Sophie Libkind, Wyatt Mackey

### Publications

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#### PUBLICATIONS

- **Topological data analysis reveals genotype-phenotype relationships in primary ciliary dyskinesia.** *The European respiratory journal*  
Shoemark, A. n., Rubbo, B. n., Legendre, M. n., Fassad, M. R., Haarman, E. G., Best, S. n., Bon, I. C., Brandsma, J. n., Burgel, P. R., Carlsson, G. n., Carr, S. B., Carroll, M. n., Edwards, et al  
2021
- **Topological methods for data modelling** *NATURE REVIEWS PHYSICS*  
Carlsson, G.  
2020
- **Fibers of Failure: Classifying Errors in Predictive Processes** *ALGORITHMS*

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- Carlsson, L. S., Vejdemo-Johansson, M., Carlsson, G., Jonsson, P. G.  
2020; 13 (6)
- **Excision in equivariant fibred G-theory** *ANNALS OF K-THEORY*  
Carlsson, G., Goldfarb, B.  
2020; 5 (4): 721–56
  - **A Topology Layer for Machine Learning**  
Bruel-Gabrielsson, R., Nelson, B. J., Dwaraknath, A., Skraba, P., Guibas, L. J., Carlsson, G., Chiappa, S., Calandra, R.  
ADDISON-WESLEY PUBL CO.2020: 1553–62
  - **Bounded G-theory with fibred control** *JOURNAL OF PURE AND APPLIED ALGEBRA*  
Carlsson, G., Goldfarb, B.  
2019; 223 (12): 5360–95
  - **Parametrized homology via zigzag persistence** *ALGEBRAIC AND GEOMETRIC TOPOLOGY*  
Carlsson, G., de Silva, V., Kalisnik, S., Morozov, D.  
2019; 19 (2): 657–700
  - **Towards a new approach to reveal dynamical organization of the brain using topological data analysis** *NATURE COMMUNICATIONS*  
Saggar, M., Sporns, O., Gonzalez-Castillo, J., Bandettini, P. A., Carlsson, G., Glover, G., Reiss, A. L.  
2018; 9: 1399
  - **Hierarchical clustering of asymmetric networks** *ADVANCES IN DATA ANALYSIS AND CLASSIFICATION*  
Carlsson, G., Memoli, F., Ribeiro, A., Segarra, S.  
2018; 12 (1): 65–105
  - **Admissible Hierarchical Clustering Methods and Algorithms for Asymmetric Networks** *IEEE TRANSACTIONS ON SIGNAL AND INFORMATION PROCESSING OVER NETWORKS*  
Carlsson, G., Memoli, F., Ribeiro, A., Segarra, S.  
2017; 3 (4): 711–27
  - **Uncovering precision phenotype-biomarker associations in traumatic brain injury using topological data analysis.** *PLoS ONE*  
Nielson, J. L., Cooper, S. R., Yue, J. K., Sorani, M. D., Inoue, T., Yuh, E. L., Mukherjee, P., Petrossian, T. C., Paquette, J., Lum, P. Y., Carlsson, G. E., Vassar, M. J., Lingsma, et al  
2017; 12 (3)
  - **Representable Hierarchical Clustering Methods for Asymmetric Networks**  
Carlsson, G., Memoli, F., Ribeiro, A., Segarra, S., Palumbo, F., Montanari, A., Vichi, M.  
SPRINGER INTERNATIONAL PUBLISHING AG.2017: 83–95
  - **Symmetric and r-symmetric tropical polynomials and rational functions** *JOURNAL OF PURE AND APPLIED ALGEBRA*  
Carlsson, G., Verovsek, S. K.  
2016; 220 (11): 3610-3627
  - **On modules over infinite group rings** *INTERNATIONAL JOURNAL OF ALGEBRA AND COMPUTATION*  
Carlsson, G., Goldfarb, B.  
2016; 26 (3): 451-466
  - **The ring of algebraic functions on persistence barcodes** *Homology, homotopy, and applications*  
Adcock, A., Carlsson, E., Carlsson, G.  
2016; 18 (1): 381-402
  - **Topological data analysis for discovery in preclinical spinal cord injury and traumatic brain injury** *NATURE COMMUNICATIONS*  
Nielson, J. L., Paquette, J., Liu, A. W., Guandique, C. F., Tovar, C. A., Inoue, T., Irvine, K., Gensel, J. C., Kloke, J., Petrossian, T. C., Lum, P. Y., Carlsson, G. E., Manley, et al  
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  - **NUDGED ELASTIC BAND IN TOPOLOGICAL DATA ANALYSIS** *TOPOLOGICAL METHODS IN NONLINEAR ANALYSIS*  
Adams, H., Atanasov, A., Carlsson, G.  
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- **Evasion paths in mobile sensor networks** *INTERNATIONAL JOURNAL OF ROBOTICS RESEARCH*  
Adams, H., Carlsson, G.  
2015; 34 (1): 90-104
- **Topological methods reveal high and low functioning neuro-phenotypes within fragile X syndrome.** *Human brain mapping*  
Romano, D., Nicolau, M., Quintin, E., Mazaika, P. K., Lightbody, A. A., Cody Hazlett, H., Piven, J., Carlsson, G., Reiss, A. L.  
2014; 35 (9): 4904-4915
- **Classification of hepatic lesions using the matching metric** *COMPUTER VISION AND IMAGE UNDERSTANDING*  
Adcock, A., Rubin, D., Carlsson, G.  
2014; 121: 36-42
- **A Klein-Bottle-Based Dictionary for Texture Representation** *INTERNATIONAL JOURNAL OF COMPUTER VISION*  
Perea, J. A., Carlsson, G.  
2014; 107 (1): 75-97
- **Topological pattern recognition for point cloud data** *ACTA NUMERICA*  
Carlsson, G.  
2014; 23: 289-368
- **Topology of viral evolution** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*  
Chan, J. M., Carlsson, G., Rabadan, R.  
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- **BIG-DATA VISUALIZATION FOR TRANSLATIONAL NEUROTRAUMA**  
Nielson, J., Inoue, T., Paquette, J., Lin, A., Sacramento, J., Liu, A. W., Guandique, C. F., Irvine, K., Gensel, J. C., Beattie, M. S., Bresnahan, J. C., Manley, G. T., Carlsson, et al  
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- **Persistent Topology and Metastable State in Conformational Dynamics** *PLOS ONE*  
Chang, H., Bacallado, S., Pande, V. S., Carlsson, G. E.  
2013; 8 (4)
- **Classifying Clustering Schemes** *FOUNDATIONS OF COMPUTATIONAL MATHEMATICS*  
Carlsson, G., Memoli, F.  
2013; 13 (2): 221-252
- **Extracting insights from the shape of complex data using topology** *SCIENTIFIC REPORTS*  
Lum, P. Y., Singh, G., Lehman, A., Ishkanov, T., Vejdemo-Johansson, M., Alagappan, M., Carlsson, J., Carlsson, G.  
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- **Building Markov state models with solvent dynamics** *11th Asia Pacific Bioinformatics Conference (APBC)*  
Gu, C., Chang, H., Maibaum, L., Pande, V. S., Carlsson, G. E., Guibas, L. J.  
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- **Persistent topology and metastable state in conformational dynamics.** *PloS one*  
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Carlsson, G., Memoli, F., Ribeiro, A., Segarra, S.  
IEEE.2013: 791–794
- **Hierarchical Clustering Methods and Algorithms for Asymmetric Networks** *47th Asilomar Conference on Signals, Systems and Computers*  
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- **AXIOMATIC CONSTRUCTION OF HIERARCHICAL CLUSTERING IN ASYMMETRIC NETWORKS** *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*

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- **A Topological Paradigm for Hippocampal Spatial Map Formation Using Persistent Homology** *PLOS COMPUTATIONAL BIOLOGY*  
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  - **Computational topology for configuration spaces of hard disks** *PHYSICAL REVIEW E*  
Carlsson, G., Gorham, J., Kahle, M., Mason, J.  
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  - **Topology based data analysis identifies a subgroup of breast cancers with a unique mutational profile and excellent survival** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*  
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  - **Higher topological cyclic homology and the Segal conjecture for tori** *ADVANCES IN MATHEMATICS*  
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  - **Derived representation theory and the algebraic K-theory of fields** *JOURNAL OF TOPOLOGY*  
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  - **CONTROLLED ALGEBRAIC G-THEORY, I** *JOURNAL OF HOMOTOPY AND RELATED STRUCTURES*  
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  - **Covering homology** *ADVANCES IN MATHEMATICS*  
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  - **Zigzag Persistence** *FOUNDATIONS OF COMPUTATIONAL MATHEMATICS*  
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  - **Characterization, Stability and Convergence of Hierarchical Clustering Methods** *JOURNAL OF MACHINE LEARNING RESEARCH*  
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  - **Statistical Topology via Morse Theory Persistence and Nonparametric Estimation** *AMS Special Session on Algebraic Methods in Statistics and Probability*  
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  - **Multiparameter Hierarchical Clustering Methods**  
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  - **COMPUTING MULTIDIMENSIONAL PERSISTENCE** *JOURNAL OF COMPUTATIONAL GEOMETRY*  
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  - **Constructing multi-resolution Markov State Models (MSMs) to elucidate RNA hairpin folding mechanisms.** *Pacific Symposium on Biocomputing. Pacific Symposium on Biocomputing*  
Huang, X., Yao, Y., Bowman, G. R., Sun, J., Guibas, L. J., Carlsson, G., Pande, V. S.  
2010: 228-239
  - **The Theory of Multidimensional Persistence** *23rd Annual Symposium on Computational Geometry*  
Carlsson, G., Zomorodian, A.  
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- **Zigzag Persistent Homology and Real-valued Functions** *25th Annual Symposium on Computational Geometry*  
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- **epsilon-entropy of piecewise polynomial functions and tree partitioning compression** *33rd IEEE International Conference on Acoustics, Speech and Signal Processing*  
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- **Localized homology** *9th International Conference on Shape Modeling and Applications*  
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- **The integral K-theoretic Novikov conjecture for groups with finite asymptotic dimension** *INVENTIONES MATHEMATICAE*  
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- **On homological coherence of discrete groups** *JOURNAL OF ALGEBRA*  
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- **CONTROLLED ALGEBRA AND THE NOVIKOV CONJECTURES FOR K-THEORY AND L-THEORY** *TOPOLOGY*  
Carlsson, G., Pedersen, E. K.  
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- **Bounded K-theory and the assembly map in algebraic K-theory** *Novikov conjectures, index theory, and rigidity*  
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- **On the K-theory of infinite product categories** *K-theory*  
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- **Equivariant stable homotopy and Sullivan's conjecture** *Inventiones Mathematicae*  
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- **THE CYCLIC GROUPS AND THE FREE LOOP SPACE** *COMMENTARII MATHEMATICI HELVETICI*  
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- **On the homology of finite free  $(\mathbb{Z}/2)^n$ -complexes** *Inventiones Mathematicae*  
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- **On the rank of abelian groups acting freely on  $(S^n)^k$**  *Inventiones Mathematicae*  
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1981; 64 (1): 171-174
- **Some restrictions on groups acting freely on  $(S^n)^k$**  *Transactions of the American Mathematical Society*  
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- **SOME EXACT SEQUENCES IN THE THEORY OF HERMITIAN FORMS** *JOURNAL OF PURE AND APPLIED ALGEBRA*  
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