

# Xavier Tricoche

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## Research Interests

- Visualization, scalable data analysis, data structures for visualization, geometric data processing
- Topological methods, structural analysis of multivariate fields, dynamical systems
- Applications: fluid dynamics, high-energy physics, granular materials, materials engineering, orbital mechanics, seismic research, medical imaging, bioengineering, machine learning

## Professional Experience

- *Associate Professor*, Department of Computer Science, Purdue University, West Lafayette, IN, August 2014–present.
- *Visiting Professor*, Institute for Mechanical Systems, ETH Zürich, January 2016–December 2016.
- *Assistant Professor*, Department of Computer Science, Purdue University, West Lafayette, IN, August 2007–August 2014.
- *Adjunct Assistant Professor*, School of Computing, University of Utah, Salt Lake City, UT, August 2007–present.
- *Research Assistant Professor*, School of Computing, University of Utah, Salt Lake City, UT, June 2006–August 2007.
- *Postdoctoral Fellow*, SCI Institute, University of Utah, Salt Lake City, UT, February 2004–June 2006.
- *Postdoctoral Researcher*, Computer Science Department, University of Kaiserslautern, Germany, July 2002–January 2004.

## Education

- Ph.D., Computer Science, University of Kaiserslautern, Germany, 2002  
Dissertation: *Vector and Tensor Field Topology Simplification, Tracking, and Visualization*. Advisor: H. Hagen
- M.S., Applied Mathematics, University Joseph Fourier, Grenoble, France, 1998
- Engineer's Degree, Computer Science, ENSIMAG, Grenoble, France, 1998

## Awards and Honors

- Best Paper Award, AAS/AIAA Astrodynamics Specialist 2013 Conference/Space Flight Mechanics Meeting, Kauai, HI.
- Honorable Mention (2nd best paper), IEEE Visualization 2013, Seattle, WA.
- CAREER Award, National Science Foundation, July 2012.
- Interdisciplinary Award, College of Science, Purdue University, 2009.
- Engagement Award, College of Science, Purdue University, 2008.

## Publications

### Journal Articles

1. D. El-Rushaidat<sup>‡1</sup>, R. Yeh<sup>‡</sup>, and X. Tricoche Accurate parallel reconstruction of unstructured datasets on rectilinear grids *Journal of Visualization* 24, 787–806, 2021.
2. X. Tricoche, W. Schlei<sup>‡</sup>, and K. Howell Extraction and Visualization of Poincaré Map Topology for Spacecraft Trajectory Design *IEEE Transactions on Visualization and Computer Graphics* 27(2), 765–774, Feb. 2021. (Proceedings of IEEE Visualization 2020).
3. R. Yeh<sup>‡</sup>, Y. Nashed, T. Peterka, X. Tricoche Fast Automatic Knot Placement Method for Accurate B-spline Curve Fitting *Computer Aided Design* 128, 102905, November 2020.
4. W. Schlei<sup>‡</sup>, K. Howell, X. Tricoche and C. Garth Enhanced Visualization and Autonomous Extraction of Poincaré Map Topology *The Journal of Astronomical Science*, July 2015, 1–28, doi=10.1007/s40295-015-0042-4.
5. D. Blackmore, A. Rosato, X. Tricoche, K. Urban, and L. Zuo Analysis, Simulation and Visualization of 1D Tapping via Reduced Dynamical Models *Physica D. Nonlinear phenomena*, 273-274, 14–27, 2014.
6. S. Barakat<sup>‡</sup> and X. Tricoche Sparse Adaptive Sampling for Scalable Flow Map Computation *IEEE Transactions on Visualization and Computer Graphics* 19(12), 2753–2762, 2013. (Proceedings of IEEE Visualization 2013 (Acceptance rate: 31/126 = 25%).
7. S. B. Lee, T. S. Key, Z. Liang, R. E. Garcia, S. Wang, X. Tricoche, G. S. Rohrer, Y. Saito, C. Ito, and T. Tani Microstructure Design of Lead-Free Piezoelectric Ceramics. *Journal of the European Ceramic Society*, 33(2), 313–326, 2013.
8. S. Barakat<sup>‡</sup>, C. Garth, and X. Tricoche Interactive computation and rendering of finite-time Lyapunov exponent fields. *IEEE Transactions on Visualization and Computer Graphics*, 18(8), 1368–1380, 2012.
9. S. Barakat<sup>‡</sup>, M. Rütten, and X. Tricoche Surface-Based Structure Analysis and Visualization for Multifield Time-Varying Datasets. *IEEE Transactions on Visualization and Computer Graphics*, 18(12), 2392–2401, 2012. Proceedings of IEEE Visualization 2012 (Acceptance rate: 42/154 = 27%).
10. Z. Ding<sup>‡</sup>, X. Zhang, W. Chen, X. Tricoche, D. Peng, and Q. Peng Coherent streamline generation for 2-D vector fields. *Tsinghua Science and Technology*, 17(4), 463–470, 2012.
11. V. Ratnaswamy, A. Rosato, D. Blackmore, X. Tricoche, N. Ching, and L. Zuo Evolution of solids fraction surfaces in tapping: simulation and dynamical systems analysis. *Granular Matter*, 14(2), 163–168, 2012.
12. S. Barakat<sup>‡</sup>, N. Andryscio<sup>‡</sup>, and X. Tricoche Efficient Extraction of High-quality Crease Surfaces for Visual Analysis. *Computer Graphics Forum*, 30(3), 961–970, 2011. Proceedings of Eurographics/IEEE Symposium on Visualization (EuroVis 2012) (Acceptance rate: 54/187 = 29%).
13. D. Blackmore, A. Rosato, X. Tricoche, K. Urban, and V. Ratnaswamy Tapping dynamics for a column of particles and beyond. *Journal of Mechanics of Materials and Structures*, 6(1-4), 71–86, 2011.
14. X. Tricoche, C. Garth, and A. Sanderson Visualization of Topological Structures in Area-Preserving Maps. *IEEE Transactions on Visualization and Computer Graphics*, 17(12), 1765–1774, 2011. Proceedings of IEEE Visualization 2011 (Acceptance rate: 49/194 = 25%).
15. N. Andryscio<sup>‡</sup> and X. Tricoche Matrix trees. *Computer Graphics Forum*, 29(3), 963–972, 2010. Proceedings of Eurographics/IEEE Symposium on Visualization (EuroVis 2010) (Acceptance rate: 48/164 = 29%).

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<sup>‡1</sup> ‡ designates Tricoche's PhD students

16. S. Barakat<sup>‡</sup> and X. Tricoche An image-based approach to interactive crease extraction and rendering. *Procedia Computer Science*, 1(1), 1709–1718, 2010.
17. M. Hlawitschka, C. Garth, X. Tricoche, G. Kindlmann, G. Scheuermann, K. Joy, and B. Hamann Direct visualization of fiber information by coherence. *International Journal of Computer Assisted Radiology and Surgery*, 5(2), 125–131, 2010.
18. V. Popescu, P. Rosen, L. Arns, X. Tricoche, C. Wyman, and C. Hoffmann The general pinhole camera: Effective and efficient nonuniform sampling for visualization. *IEEE Transactions on Visualization and Computer Graphics*, 16(5), 777–790, 2010.
19. A. Sanderson, G. Chen, X. Tricoche, D. Pugmire, S. Kruger, and J. Breslau Analysis of Recurrent Patterns in Toroidal Magnetic Fields. *IEEE Transactions on Visualization and Computer Graphics*, 16(6), 1431–1440, 2010. Proceedings of IEEE Visualization 2010 (Acceptance rate: 49/185 = 26%).
20. C. Garth, H. Krishnan, X. Tricoche, and K. Joy Generation of Accurate Integral Surfaces in Time-Dependent Vector Fields. *IEEE Transactions on Visualization and Computer Graphics*, 14(6), 1404–1411, 2008. Proceedings of IEEE Visualization 2008 (Acceptance rate: 50/197 = 25%).
21. X. Tricoche, G. Kindlmann, and C.-F. Westin Invariant Crease Lines for Topological and Structural Analysis of Tensor Fields. *IEEE Transactions on Visualization and Computer Graphics*, 14(6), 1627–1634, 2008. Proceedings of IEEE Visualization 2008 (Acceptance rate: 50/197 = 25%).
22. C. Garth, A. Wiebel, X. Tricoche, H. Hagen, and K. Joy Lagrangian Visualization of Flow Embedded Structures. *Computer Graphics Forum*, 27(3), 1007–1014, 2008. Proceedings of Eurographics/IEEE Symposium on Visualization (EuroVis 2008) (Acceptance rate: 45/143 = 31%).
23. H. Jänicke, M. Böttinger, X. Tricoche, and G. Scheuermann Automatic Detection and Visualization of Distinctive Structures in 3D Unsteady Multi-fields. *Computer Graphics Forum*, 27(3), 767–774, 2008. Proceedings of Eurographics/IEEE Symposium on Visualization (EuroVis 2008) (Acceptance rate: 45/143 = 31%).
24. G.-S. Li<sup>\*2</sup>, X. Tricoche, and C. Hansen. Physically-based dye advection for flow visualization. *Computer Graphics Forum*, 27(3), 727–734, 2008. Proceedings of Eurographics/IEEE Symposium on Visualization (EuroVis 2008) (Acceptance rate: 45/143 = 31%).
25. R. Laramee, G. Erlbacher, C. Garth, H. Theisel, X. Tricoche, T. Weinkauff, and D. Weiskopf Applications of Texture-based Flow Visualization. *Engineering Applications of Computational Fluid Mechanics*, 2(3), 264–274, 2008.
26. G.-S. Li<sup>\*</sup>, X. Tricoche, D. Weiskopf, and C. Hansen Flow Charts: Visualization of Vector Fields on Arbitrary Surfaces. *IEEE Transactions on Visualization and Computer Graphics*, 14(5), 1067–1080, 2008.
27. G. Kindlmann, X. Tricoche, and C.-F. Westin Delineating white matter structure in diffusion tensor MRI with anisotropy creases. *Medical Image Analysis*, 11(5), 492–502, 2007.
28. C. Garth, F. Gerhardt, X. Tricoche, and H. Hagen Efficient Computation and Visualization of Coherent Structures in Fluid Flow Applications. *IEEE Transactions on Visualization and Computer Graphics*, 13(6), 1464–1471, 2007. Proceedings of IEEE Visualization 2007 (Acceptance rate: 56/216 = 26%).
29. A. Wiebel, X. Tricoche, D. Schneider, H. Jänicke, and G. Scheuermann Generalized Streak Lines: Analysis and Visualization of Boundary Induced Vortices. *IEEE Transactions on Visualization and Computer Graphics*, 13(6), 1735–1742, 2007. Proceedings of IEEE Visualization 2007 (Acceptance rate: 56/216 = 26%).

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<sup>2</sup>\* designates students co-advised by Tricoche.

30. C. Wolters, A. Anwander, X. Tricoche, D. Weinstein, and R. MacLeod Influence of Tissue Conductivity Anisotropy on EEG/MEG Field and Return Current Computation in a Realistic Head Model: A Simulation and Visualization Study Using High-Resolution Finite Element Modeling. *NeuroImage*, 30(3), 813–826, 2006.
31. B. Taccardi, B. Punske, F. Sachse, X. Tricoche, P. Colli-Franzone, L. Pavarino, and C. Zambawa Intramural activation and repolarization sequences in canine ventricles. Experimental and simulation studies. *Journal of Electrophysiology*, 38(4), 131–137, 2005.
32. C. Wolters, A. Anwander, X. Tricoche, S. Lew, and C. Johnson Influence of Local and Remote White Matter Conductivity Anisotropy for a Thalamic Source on EEG/MEG Field and Return Current Computation. *International Journal of Bioelectromagnetism*, 7(1), 203–206, 2005.
33. X. Tricoche, T. Wischgoll, G. Scheuermann, and H. Hagen Topology Tracking for the Visualization of Time-Dependent Two-Dimensional Flows. *Computers & Graphics*, 26(2), 249 – 257, 2002.
34. X. Tricoche, G. Scheuermann, and H. Hagen Tensor Topology Tracking: A Visualization Method for Time-Dependent 2D Symmetric Tensor Fields. *Computer Graphics Forum*, 20(3), 461–470, 2001. Proceedings of Eurographics 2001 (Acceptance rate: 54/174 = 31%).

### Articles Refereed in Conference Proceedings

35. D. El-Rushaidat, R. Yeh, X. Tricoche Boundary-Aware Rectilinear Grid: Accurate Approximation of Unstructured Dataset into Rectilinear Grid with Solid Boundary Handling Capabilities To appear in *Proceedings of IEEE Pacific Visualization 2022*. (Acceptance rate: N/A)
36. R. Yeh<sup>‡</sup>, K. Weiss, A. Capps, X. Tricoche MultiMat: An API for Managing Multimaterial Simulation Data (full paper) In *Proceedings of the 29th International Meshing Roundtable*, Stony Brook, NY, 14 pages, June 2021 (Acceptance rate: N/A)
37. A. Sanderson, X. Tricoche. Exploration of Periodic Flow Fields. In *Proceedings of the 18th International Symposium on Flow Visualization*, 2018. (Acceptance rate: N/A)
38. T. Peterka, Y. Nashed, I. Grindeanu, V. Mahadevan, R. Yeh, X. Tricoche. Foundations of Multivariate Functional Approximation for Scientific Data (full paper). In *Proceedings of IEEE Symposium on Large Data Analysis and Visualization (LDAV 2018)*, 2018. (Acceptance rate: 40%)
39. A. Rosato, D. Blackmore, X. Tricoche, K. Urban, and L. Zuo. Dynamical Systems Model and Discrete Element Simulations of a Tapped Granular Column (full paper). In *Proceedings of Powder & Grains 2013*, 2013. (Acceptance rate: N/A)
40. W. Schlei<sup>‡</sup>, K. Howell, C. Garth, and X. Tricoche. Enhanced Visualization and Autonomous Extraction of Poincaré Map Topology (full paper). **Best Paper**. In *Proceedings of AAS/AIAA Astrodynamics Specialist Conference*, 2013. (Acceptance rate: N/A)
41. N. Kotava, A. Knoll, M. Schott, C. Garth, X. Tricoche, C. Kessler, E. Cohen, C. Hansen, M. Papka, and H. Hagen. Volume rendering with multidimensional peak finding. In *Pacific Visualization Symposium (PacificVis), 2012 IEEE*, pp. 161–168, February 2012. (Acceptance rate: 30/89 = 34%)
42. N. Andrysc<sup>‡</sup> and X. Tricoche. Implicit and dynamic trees for high performance rendering. In *Proceedings of Graphics Interface 2011*, pp. 143–150, May 2011. (Acceptance rate: 29/74 = 39%)
43. C. Short\*, K. Howell, and X. Tricoche. Lagrangian coherent structures in the restricted three-body problem. In *Proceedings of 21st AAS/AIAA Space Flight Mechanics Meeting*, Paper No. AAS 11-250 (16 pages), February 2011. (Acceptance rate: N/A)

44. G. Kindlmann, X. Tricoche, and C.-F. Westin. Anisotropy Creases Delineate White Matter Structure in Diffusion Tensor MRI. In *MICCAI 2006*, 9(Pt 1):126-33 (8 pages), October 2006. (Acceptance rate: 39/578 = 6.75% for oral presentation)
45. G.-S.Li\*, X. Tricoche, and C. Hansen. GPUFLIC: Interactive and Dense Visualization of Unsteady Flows. In *Data Analysis 2006: Proceedings of Eurographics/IEEE Symposium on Visualization (EuroVis)*, May 2006. (Acceptance rate: 43/98 = 44%)
46. F. Sachse, M. Cole, R. M. Kirby, X. Tricoche, and C. Johnson. Advanced Modeling and Visualization of Cardiothoracic Electrical Fields. In *Medicine Meets Virtual Reality 2005*, February 2005. (Acceptance rate: N/A)
47. C. Garth, X. Tricoche, and G. Scheuermann. Tracking of Vector Field Singularities in Unstructured 3D Time-Dependent Data Sets. In *Proceedings of IEEE Visualization 2004*, pp. 329–336, October 2004. (Acceptance rate: 46/167 = 28%)
48. Y. Livnat and X. Tricoche. Interactive point-based isosurface extraction. In *Proceedings of IEEE Visualization 2004*, pp. 457–464, October 2004. (Acceptance rate: 46/167 = 28%)
49. X. Tricoche, C. Garth, G. Kindlmann, E. Deines, G. Scheuermann, M. Rütten, and C. Hansen. Visualization of Intricate Flow Structures for Vortex Breakdown Analysis. In *Proceeding of IEEE Visualization 2004*, pp. 187–194, October 2004. (Acceptance rate: 46/167 = 28%)
50. C. Garth, X. Tricoche, T. Salzbrunn, and G. Scheuermann. Surface Techniques for Vortex Visualization. In *Proceedings Eurographics/IEEE Symposium on Visualization (EuroVis)*, pp. 155–164, May 2004. (Acceptance rate: 39/82 = 48%)
51. X. Tricoche, C. Garth, T. Bobach, G. Scheuermann, and M. Rütten. Accurate and Efficient Visualization of Flow Structures in a Delta Wing Simulation. In *Proceedings of 34th AIAA Fluid Dynamics Conference and Exhibit*, AIAA Paper 2004-2153 (13 pages), June 2004. (Acceptance rate: N/A)
52. M. Bertram, X. Tricoche, and H. Hagen. Adaptive smooth scattered-data approximation for large-scale terrain visualization. In *VISSYM '03: Proceedings of Eurographics/IEEE Symposium on Visualization 2003*, pp. 177–184, May 2003. (Acceptance rate: 30/62 = 48%)
53. M. Langbein, G. Scheuermann, and X. Tricoche. An Efficient Point Location Method for Visualization in Large Unstructured Grids. In *Proceedings of Vision, Modeling, Visualization*, 2003. (Acceptance rate: N/A)
54. X. Tricoche, G. Scheuermann, and H. Hagen. Continuous Topology Simplification of Planar Vector Fields. In *Proceedings of IEEE Visualization 2001*, pp. 159–166, October 2001. (Acceptance rate: 51/152 = 34%)
55. X. Tricoche, G. Scheuermann, and H. Hagen. Vector and Tensor Topology Simplification on Irregular Grids. In *Data Visualization 2001 (Proceedings of Eurographics/IEEE Symposium on Visualization (VisSym 2001))*, pp. 101–116, May 2001. (Acceptance rate: 33/68 = 49%)
56. X. Tricoche, G. Scheuermann, and H. Hagen. Topology-based visualization of time-dependent 2D vector fields. In *Data Visualization 2001 (Proceedings of Eurographics/IEEE Symposium on Visualization (VisSym 2001))*, pp. 117–126, May 2001. (Acceptance rate: 33/68 = 49%)
57. X. Tricoche, G. Scheuermann, and H. Hagen. A Topology Simplification Method for 2D Vector Fields. In *Proceedings of IEEE Visualization 2000*, pp. 359–366, October 2000. (Acceptance rate: 52/151 = 34%)
58. X. Tricoche, G. Scheuermann, and H. Hagen. Higher-Order Singularities in Piecewise Linear Vector Fields. In *The Mathematics of Surfaces IX*, September 2000. (Acceptance rate: N/A)
59. G. Scheuermann, X. Tricoche, and H. Hagen. C1 Interpolation for Vector Field Topology Visualization. In *Proceedings of IEEE Visualization 1999*, pp. 271–278, October 1999. (Acceptance rate: 47/129 = 36%)

## Refereed Workshop Papers

59. Z. Ding, Y. Gur, and X. Tricoche. Edge Detection in Diffusion Weighted MRI using a Tangent Curve Similarity Metric. To appear in “Modeling, Analysis, and Visualization of Anisotropy”, Springer 2017.
60. A. Sanderson, G. Chen, X. Tricoche, and E. Cohen. Understanding quasi-periodic fieldlines and their topology in toroidal magnetic fields. In “Topological Methods in Data Analysis and Visualization”, pp. 125–140, Springer, 2012.
61. X. Tricoche, M. Hlawitschka, S. Barakat<sup>‡</sup>, and C. Garth. Beyond Topology: A Lagrangian Metaphor to Visualize the Structure of 3D Tensor Fields. In “New Developments in the Visualization and Processing of Tensor Fields”, pp. 93–109, Springer, 2012.
62. X. Tricoche, C. Garth, A. Sanderson, and K. Joy. Visualizing invariant manifolds in area-preserving maps. In “Topological Methods in Data Analysis and Visualization II”, pp. 109–124, Springer, 2012.
63. X. Tricoche, R. MacLeod, and C. Johnson. Visual Analysis of Bioelectric Fields. In “Visualization in Medicine and Life Sciences”, pp. 205–220, Springer, 2008.
64. A. Wiebel, X. Tricoche, and G. Scheuermann. Extraction of separation manifolds using topological structures in flow cross sections. In “Topology-Based Methods in Visualization II”, pp. 31–43, Springer, 2009.
65. C. Garth, G.-S.Li\*, X. Tricoche, C. Hansen, and H. Hagen. Visualization of coherent structures in transient 2d flows. In “Topology-Based Methods in Visualization II”, pp. 1–13, Springer, 2009.
66. X. Tricoche and C. Garth. Topological methods for visualizing vortical flows. In “Mathematical Foundations of Scientific Visualization, Computer Graphics, and Massive Data Exploration”, pp. 89–107, Springer, 2009.
67. C. Garth, X. Tricoche, and A. Wiebel. On the Role of Domain Specific Knowledge in the Visualization of Technical Flows. In “Proceedings of the 19th Simulation and Visualization Conference”, pp. 107–120, Springer, 2008.
68. C. Garth, R. Laramee, X. Tricoche, J. Schneider, and H. Hagen. Extraction and Visualization of Swirl and Tumble Motion from Engine Simulation Data. In “Proceedings of The Topology-Based Methods in Visualization Workshop”, pp. 121–135, Springer, 2007.
69. X. Zheng, X. Tricoche, and A. Pang. Degenerate 3D Tensors. In “Visualization and Processing of Tensor Fields”, pp. 241–256, Springer, 2006.
70. X. Tricoche, X. Zheng, and A. Pang. Visualizing the Topology of Symmetric, Second-Order, Time-varying Two-Dimensional Tensor Fields. In “Visualization and Processing of Tensor Fields”, pp. 225–240, Springer, 2006.
71. C. Garth and X. Tricoche. Topology- and Feature-based Flow Visualization: Methods and Applications. In “SIAM Conference on Geometric Design and Computing”, (21 pages, online publication), 2005.
72. X. Tricoche, C. Garth, and G. Scheuermann. Fast and Robust Extraction of Separation Line Features. In “Scientific Visualization: The Visual Extraction of Knowledge from Data”, pp. 245–263, Mathematics + Visualization, Springer, 2005.

## Books and Book Chapters

73. V. Pascucci, X. Tricoche, H. Hagen, and J. Tierny (Editors). “Topological Methods in Data Analysis and Visualization. Theory, Algorithms, and Applications”, 268 pages, Springer, 2011.
74. C. Johnson and X. Tricoche. Biomedical Visualization. In “Advances in Biomedical Engineering”, pp. 209-272, Elsevier, 2008.
75. G. Scheuermann and X. Tricoche. Topological Methods in Flow Visualization. In “Visualization Handbook”, pp. 341–356, Academic Press, 2004.

76. X. Tricoche and G. Scheuermann. Topology Simplification of Symmetric, Second Order 2D Tensor Fields. In “Geometric Modeling Methods in Scientific Visualization”, pp. 275-292, Springer, 2003.
77. G. Scheuermann, W. Kollmann, X. Tricoche, and T. Wischgoll. Evolution of Topology in Axi-Symmetric and 3-D Viscous Flows. In “Numerical Simulations of Incompressible Flows”, pp. 622–643, World Scientific Publishing, 2003.
78. X. Tricoche, G. Scheuermann, and H. Hagen. Scaling the Topology of Symmetric Second Order Tensor Fields. In “Hierarchical and Geometrical Methods in Scientific Visualization”, pp. 171-184, Springer, 2002.

### Invited Papers

79. W. Bethel, C. Johnson, C. Hansen, C. Silva, S. Parker, A. Sanderson, L. Myers, M. Cole, X. Tricoche, S. Ahern, G. Ostrouchov, D. Pugmire, J. Daniel, J. Meredith, V. Pascucci, H. Childs, P.-T. Bremer, A. Mascarenhas, K. Joy, B. Hamann, C. Garth, C. Aragon, G. Weber, and Prabhat Seeing the Unseeable. *SciDAC Review*, 8:24-33, 2008.
80. X. Tricoche Topology Simplification for Turbulent Flow Visualization. *Grafiktag 2002*, 2002

### Technical Reports

81. R. Yeh<sup>‡</sup>, X. Tricoche, M. de Hoop, “Learning-based Temporal Pattern Matching for Robust Wavefront Reconstruction”. Technical report, Geomathematical Imaging Group, Purdue University, 2015.
82. R. Yeh<sup>‡</sup>, X. Tricoche, M. de Hoop, S. Mallat, “A Multistage Scattering Transform Enables the Hierarchical Classification of Seismic Waves”. Technical report, Geomathematical Imaging Group, Purdue University, 2014.
83. Y. Livnat and X. Tricoche, “Shadows for Incomplete Point-based Isosurfaces”. Technical report UUSCI-2005-001, University of Utah, 2005.

### Under Revision

84. R. Yeh<sup>‡</sup>, T. Peterka, X. Tricoche, Feature-guided Fast Knot Placement for Accurate Multivariate B-spline Approximation.

### Posters

86. A. Rosato, O. Dybenko, V. Ratnaswamy, D. Hornthrop, N. Andryscio<sup>‡</sup>X. Tricoche, and L. Kondic, “Density Relaxation of Granular Matter” in Gordon Research Conference on Granular and Granular-Fluid Flow, 2010 (refereed)
87. A. Sanderson, X. Tricoche, C. Garth, Scott Kruger, C. Sovinec, E. Held and J. Breslau, “A Geometric Approach to Visualizing Patterns in the Poincaré Plot of a Magnetic Field” in IEEE Visualization 2010, October 2010 (refereed).

### Invited Presentations

#### National and International Meetings

1. Hybrid Lagrangian-Eulerian Model. *TopoInVis 2017*, Tokyo, Japan, February 2017.
2. Tractography-based edge detection for DW-MRI analysis. *Seminar on Modelling, Processing and Visualization of Anisotropy*, Schloß Dagstuhl, Germany, April 2016.
3. Visualization of Reduced Dynamical Systems (minisymposium presentation). *SIAM Applications of Dynamical Systems*, Snowbird, UT, May 2015.

4. Granular Flows from a Dynamical Systems Perspective (minisymposium co-organization and presentation). *SIAM Applications of Dynamical Systems*, Snowbird, UT, May 2013.
5. Theory and Computation of Lagrangian Coherent Structures (minisymposium co-organization and presentation). *SIAM Applications of Dynamical Systems*, Snowbird, UT, May 2011.
6. Large Vector Field Visualization: Theory and Practice (tutorial co-organization and presentation). *IEEE Visualization*, Salt Lake City, UT, October 2010.
7. Tensors in Visualization (tutorial presentation). *IEEE Visualization*, Salt Lake City, UT, October 2010.
8. Visual Analysis of Lagrangian Coherent Structures in Large-Scale Computational Fluid Dynamics Simulations. *8th AIMS Conference on Dynamical Systems, Differential Equations, and Applications*, Dresden, Germany, May 2010.
9. Visualizing the Structure of 3D Tensor Fields: Topology, Invariant Creases, and Lagrangian Metaphor. *Seminar on Visualization and Processing of Tensor Fields*, Schloss Dagstuhl, Germany, July 2009.
10. Lagrangian Coherent Structures: Challenges and Opportunities for Visualization. *Seminar on Scientific Visualization*, Schloss Dagstuhl, Germany, June 2009.
11. Dynamics of Vortical Flows (minisymposium). *SIAM Applications of Dynamical Systems*, Snowbird, UT, May 2009.
12. Geometric Assessment of Structural Coherence in Diffusion Tensor Imaging. *Seminar on Visualization and Processing of Tensor Fields*, Schloss Dagstuhl, Germany, January 2007.
13. What is the right way to deal with the topology of time-dependent flow fields? (panel). *Workshop on Topology-based Methods in Visualization*, Budmerice, Slovakia, September 2005.
14. Critical Problems and Promising Research Directions in Topology-Based Flow Visualization (panel). *Workshop on Topology-based Methods in Visualization*, Budmerice, Slovakia, September 2005.
15. Flow Visualization of Bioelectric Activity in Human Body. *Seminar on Scientific Visualization*, Schloss Dagstuhl, Germany, June 2005.
16. Feature-Oriented Methods in Flow Visualization (tutorial presentation). *IEEE Visualization*, Austin, TX, October 2004.
17. Vector Field Topology: Basic Notions and Applications in Flow Visualization. *Mathematical Foundations of Visualization, Computer Graphics, and Massive Data Exploration*, Banff International Research Station, Canada, May 2004.
18. Topology-based Visualization of Tensor Fields. *Visualization and Image Processing of Tensor Fields*, Schloss Dagstuhl, Germany, April 2004.
19. Fast and Robust Extraction of Separation Line Features. *Seminar on Scientific Visualization*, Schloss Dagstuhl, Germany, June 2003.
20. Clifford Algebra, Clifford Analysis, and their Applications in Physics and Visualization (tutorial presentation). *Eurographics*, Manchester, UK, September 2001.

### **Universities and Other Institutions**

21. Scientific Visualization, Purdue/JPL CS Workshop, NASA Jet Propulsion Lab, Pasadena, CA, May 2018.
22. Structural Analysis and Visualization in Fluid Dynamics and Orbital Mechanics, NASA Jet Propulsion Lab, Pasadena, CA, April 2017.
23. Advanced Flow Visualization, Seminar Series, Department of Mechanical and Process Engineering, ETH Zürich, May-July 2016 (5 lectures).



24. Visualization of topological structures in Poincaré maps and applications to orbital mechanics. *ETH Zürich*, Institute for Mechanical Systems, February 2016.
25. A Unifying Formalism to Analyze the Structure of Physical Systems. *University of Utah*, Salt Lake City, UT, May 2011.
26. GPU-Friendly Data Structures and Algorithms for Advanced Visualization. *Argonne National Laboratory*, Argonne, IL, March 2011.
27. From Structure to Picture: Effective Visualization of Vector and Tensor Fields. *IUPUI*, Indianapolis, September 2010.
28. Structural Analysis of Vector and Tensor Fields for Effective Visualization. *Argonne National Laboratory*, Argonne, IL, October 2009.
29. Invariant Crease Lines for Topological and Structural Analysis of Tensor Fields. *University of Kaiserslautern*, Kaiserslautern, Germany, May 2008.
30. Extraction of Salient Structures for Analysis and Visualization of Scientific Data. *University of Connecticut*, Storrs, December 2007.
31. Structure Extraction for Flow Visualization. *First Annual IRTG Workshop*, Schloss Dagstuhl, Germany, June 2006.
32. Visualizing Salient Structures in Biomedical Data. *University of Leipzig*, Leipzig, Germany, June 2006.
33. Visualizing Structures in Vector and Tensor Data. *NIH NCRR CIBC Workshop*, Salt Lake City, UT, April 2006.
34. Toward an Automatic Extraction of Magnetic Structures in Tokamak Simulations. *Princeton Plasma Physics Laboratory*, Princeton, NJ, January 2006.
35. A Structural Approach to Flow Visualization. *University of California*, Davis, CA, June 2004.
36. Topology-based Visualization of Tensor Fields. *University of Kaiserslautern*, Germany, 2004.
37. Topology-based Visualization. *INRIA Rhône-Alpes*, Grenoble, France, April 2003.

## Presented Papers

37. Adaptive Refinement of the Flow Map Using Sparse Samples. *IEEE Visualization 2013*, Seattle, WA, October 2013.
38. Topological Analysis of Area-Preserving Maps. *IEEE Visualization 2011*, Providence, RI, October 2011.
39. Invariant Crease Lines for Topological and Structural Analysis of Tensor Fields. *IEEE Visualization 2008*, Columbus, OH, October 2008.
40. Feature-Based Flow Visualization. *SIAM Conference on Geometric Design and Computing*, Phoenix, AZ, November 2005.
41. Visualization of Intricate Flow Structures for Vortex Breakdown Analysis. *IEEE Visualization 2004*, Austin, TX, October 2004.
42. Accurate and Efficient Visualization of Flow Structures in a Delta Wing Simulation. *34th AIAA Fluid Dynamics Conference and Exhibit*, Portland, OR, June 2004.
43. Tensor Topology Tracking: A Visualization Method for Time-Dependent 2D Symmetric Tensor Fields. *Eurographics 2001*, Manchester, UK, September 2001.
44. Topology-based Visualization of Time-Dependent 2D Vector Fields. *Eurographics/IEEE Symposium on Visualization (VisSym 2001)*, Ascona, Switzerland, May 2001.

45. Vector and Tensor Topology Scaling on Irregular Grids. *Eurographics/IEEE Symposium on Visualization (VisSym 2001)*, Ascona, Switzerland, May 2001.
46. A Topology Simplification Method for 2D Vector Fields. *IEEE Visualization 2000*, Salt Lake City, UT, October 2000.
47. C1-Interpolation for Vector Field Topology Visualization. *IEEE Visualization 1999*, San Francisco, CA, October 1999.

## Courses Taught

Semester & Year	Course Number	Title of Course	Number of Students	Student Classification
SS 2022	CS59200-IVZ	Information Visualization Seminar	18	Graduate
FS 2021	CS49000-VIZ	Introduction to Data Visualization	28	Undergrad
SS 2021	CS53000	Introduction to Scientific Visualization	16 (all online)	Graduate
FS 2020	CS49000-VIZ	Introduction to Data Visualization	15 (5 online)	Undergraduate
SS 2020	CS53000	Introduction to Scientific Visualization	34 (6 online)	Graduate
FS 2019	CS49000/CS59000 IDV	Introduction to Data Visualization	6 + 14	Undergrad / Gr
SS 2019	CS53000	Introduction to Scientific Visualization	26	Graduate
FS 2018	CS49000/CS59000 IDV	Introduction to Data Visualization	8 + 13	Undergrad / Gr
SS 2018	CS53000	Introduction to Scientific Visualization	21 (7 online)	Graduate
FS 2017	CS25100	Data Structures and Algorithms	140	Undergraduate
SS 2017	CS25100	Data Structures and Algorithms	257	Undergraduate
FS 2016	151-0517-00L	Scientific Visualization for Engineering Applications (ETH)	15	Graduate
FS 2015	CS53000	Introduction to Scientific Visualization	6	Graduate
SS 2015	CS43400	Advanced Computer Graphics	11	Undergraduate
FS 2014	CS53000	Introduction to Scientific Visualization	22	Graduate
SS 2014	CS25100-LE2	Data Structures and Algorithms	51	Undergraduate
FS 2013	CS53000	Introduction to Scientific Visualization	15	Graduate
SS 2013	CS53000	Introduction to Scientific Visualization	35	Graduate
FS 2012	CS25100	Data Structures and Algorithms	152	Undergraduate
SS 2012	CS25100	Data Structures and Algorithms	51	Undergraduate
FS 2011	CS53000	Introduction to Scientific Visualization	19	Graduate
SS 2011	CS25100	Data Structures and Algorithms	50	Undergraduate
FS 2010	CS53000	Introduction to Scientific Visualization	28	Graduate
SS 2010	CS69003	Advanced Visual Data Analysis	6	Graduate
FS 2009	CS53000	Introduction to Scientific Visualization	15	Graduate
SS 2009	CS59000	Advanced Visual Data Analysis	5	Graduate
FS 2008	CS53000	Introduction to Scientific Visualization	14	Graduate
SS 2008	CS53000	Introduction to Scientific Visualization	12	Graduate
FS 2007	CS59000	Flow Visualization	4	Graduate

## Students

### Graduated M.S. and Ph.D. Students

- Raine Yeh, Ph.D., December 2020, Computer Science, Purdue.  
Thesis: *Efficient Knot Optimization for Accurate B-spline-based Data Approximation*. Now at Google, New York City, NY.
- Wayne Schlei, Ph.D., April 2017, Aeronautics and Astronautics (co-advised with K. Howell), Purdue.  
Thesis: *Interactive Spacecraft Trajectory Design Strategies Featuring Poincaré map Topology*. Now at The Johns Hopkins University Applied Physics Laboratory.
- Ziang Ding, Ph.D. December 2016, Computer Science, Purdue.

Thesis: *Lagrangian Analysis of Vector and Tensor Fields: Algorithmic Foundations and Applications in Medical Imaging and Computational Fluid Dynamics*. Now at Walmart Corp.

- Samer Barakat, Ph.D., June 2013, Computer Science, Purdue.  
Thesis: *High-performance Structure Extraction and Analysis for Visualization*. Now at Intel.
- Shezhad Afzal, M.S., June 2013, Computer Science, Purdue. Now in ECE PhD program.
- Santhosh Shanmugham, M.S., June 2012, Computer Science, Purdue. Now at Amazon.
- Erick Martin del Campo, M.S., June 2011, Computer Science, Purdue. Now self-employed.
- Amanda Day, M.S., June 2011, Computer Science, Purdue. Now at Harris Corporation.
- Nathan Andryscio Ph.D., June 2010, Computer Science, Purdue.  
Thesis: *Data Structures for Efficient Analysis of Large Scale Unstructured Datasets*. Now at Intel.
- Cheng Wang, M.S., June 2009, Computer Science, Purdue. Now at Baidu.
- Guo-Shi Li, Ph.D., June 2008, School of Computing, University of Utah.  
Thesis: *Interactive Texture Based Flow Visualization*. (co-advised with C. Hansen). Now at ExxonMobil.

### **Current PhD Students**

1. Dana El-Rushaidat, Computer Science, Purdue, 2016-present.  
Support: Teaching Assistant  
Research: *High-Quality Structured Data Reconstruction*

## Research Grants and Awards Received

### Funded Research Projects:

- *Intel Gift*  
Agency: Intel  
Amount: \$25,000 (100% of total)  
Dates: 02/05/2013 – open  
Role: PI
- *CAREER: Efficient Structural Analysis of Multivariate Fields for Scalable Visualization*  
Agency: NSF/ACI  
Amount: \$513,789 (100% of total)  
Dates: 07/01/2012 – 09/30/2017  
Role: PI
- *High-Performance Visualization and Geometric Analysis on Parallel Architectures*  
Agency: Intel  
Amount: \$38,000 (76% of total)  
Dates: 10/11/2011 – open  
Role: PI
- *Collaborative Research: A Unified Dynamical Systems-Simulation-Visualization Approach to Modeling and Analyzing Granular Flow Phenomena*  
Agency: NSF/CMMI  
Amount: \$229,000 (43% of total)  
Dates: 09/01/2010 – 08/31/2013  
Role: PI
- *Novel Advanced Visualization Techniques for the Study of Granular Materials*  
Agency: Purdue Research Foundation  
Amount: \$8,000 (100% of total)  
Dates: 06/01/2008 – 07/31/2008  
Role: PI
- *Real-time Image Processing and Field Coherence*  
Agency: Intel  
Amount: \$22,500 (50% of total)  
Dates: 09/01/2008 – open  
Role: CO-PI

### Funding Received for Student Support

- *Image-based Analysis of Area-Preserving Maps*  
Agency: Purdue Research Foundation  
Amount: \$30,657  
Dates: 06/01/2019 - 05/31/2020  
Student: Lu Xing
- *Intel PhD Fellowship*  
Agency: Intel  
Amount: \$25,000  
Dates: 08/01/2010 - 05/31/2011  
Student: Samer Barakat

## Service

### Academic

#### Committees, University, Purdue

- Graduate Council 2018/2019, 2019/2020.

#### Committees, College of Science, Purdue

- Faculty Council 2020/2021, 2021/2022

#### Committees, Computer Science Department, Purdue

- Undergraduate Committee 2008/2009, 2019/2020
- Undergraduate Data Science Committee 2019/2020, 2020/2021, 2021/2022
- Graduate Admission Committee 2007/2008, 2011/2012, 2012/2013, 2018/2019
- Graduate Study 2009/2010, 2014/2015
- Secretary to the Faculty 2009/2010, 2010/2011, 2013/2014
- Hiring Committee, Spring 2017, 2017/2018

#### Qual 2 Committees

- Jian Cui, IUPUI
- Ilke Demir
- Ruwan Gamage, IUPUI
- Ignacio Garcia Dorado
- Jason McLaughlin, IUPUI

#### Msc Thesis Committees

- Apurva Nagarajan, Computer Graphics Technology, Purdue

#### PhD Committees

- Hongyuan Cai, Department of Computer Science, IUPUI
- Fiangxiang Jao, Department of Physics, University of Utah
- Mark Kim, School of Computing, University of Utah
- Ying Liu, Department of Computer Science, IUPUI
- Cody Short, Department of Aeronautics and Aerospace, Purdue University
- Carlos Vanegas, Department of Computer Science, Purdue University
- Jing Wan, Department of Computer Science, IUPUI
- Juan Esquivel, Department of Computer Science, Purdue

- Yangyan Hou, Department of Computer Science, Purdue
- Nabeel Butt, Department of Computer Science, Purdue
- Ilke Demir, Department of Computer Science, Purdue
- Meng-Lin Wu, Department of Computer Science, Purdue
- Chengyuan Lin, Department of Computer Science, Purdue
- Daniel Andersen, Department of Computer Science, Purdue
- Zheyuan Wang, Department of Computer Science, IUPUI

### **Presentations**

- SURF Program: Summer 2014
- CS197 - Honors Seminar for Freshmen: Spring 2010
- CS291 - Sophomore Development Seminar: Fall 2008
- CS314 - Numerical Methods: Fall 2010
- CS397 - Honors Seminar: Fall 2012
- CS434 - Advanced Computer Graphics: Spring 2013
- CS501 - Computing for Science and Engineering: Spring 2013
- CS531 - Computational Geometry: Spring 2009
- CS535 - Interactive Computer Graphics: Spring 2009
- CS591 - Graduate Student Seminar: Fall 2009, Fall 2010

### **Miscellaneous**

- Faculty advisor on two projects for Purdue Data Mine
- Coordination of the JPL visit by CS Faculty to initiate collaborations
- Contributions to outreach activities of the CS Department through presentations about graphics and visualization to K-12 students and teachers (July 2010, July 2011).
- GradDay 2009: Coordinator for Computer Graphics and Visualization lab
- Employee Appreciation Social 2008: introduced new faculty to the department

### **Professional**

#### **Editorial Duties**

- Associate Editor, IEEE Transactions on Visualization and Computer Graphics, 2017-2021.

#### **Conference Organization**

- Topological Methods in Visualization (TopoInVis) 2009: workshop co-chair member of steering committee since 2005.
- IEEE Visualization (Vis) 2008/09: exhibits chair

### **Program Committees**

- IEEE VIS (SciVis), 2021
- Large Data Analysis and Visualization (LDAV), 2021
- Eurographics/IEEE Symposium on Visualization (EuroVis): 2021
- IEEE VIS (SciVis), 2020
- Large Data Analysis and Visualization (LDAV), 2020
- Eurographics/IEEE Symposium on Visualization (EuroVis): 2020
- IEEE VIS (SciVis), 2019
- Large Data Analysis and Visualization (LDAV), 2019
- IEEE Pacific Visualization (PacificVis): 2019
- IEEE VIS (SciVis), 2018
- IEEE Pacific Visualization (PacificVis): 2017
- Eurographics/IEEE Symposium on Visualization (EuroVis): 2016
- IEEE Pacific Visualization (PacificVis): 2016
- IEEE Pacific Visualization (PacificVis): 2015
- IEEE Visualization (Vis): 2013
- IEEE Pacific Visualization (PacificVis): 2013
- IEEE Visualization (Vis): 2012
- IEEE Pacific Visualization (PacificVis): 2012
- IEEE Visualization (Vis): 2011
- Eurographics/IEEE Symposium on Visualization (EuroVis): 2011
- IEEE Pacific Visualization (PacificVis): 2011
- Eurographics/IEEE Symposium on Visualization (EuroVis): 2010
- Eurographics/IEEE Symposium on Visualization (EuroVis): 2009
- International Symposium on Visual Computing: 2008–present
- IEEE Visualization (Vis): 2008
- Knowledge-Assisted Visualization: 2008
- Eurographics/IEEE Symposium on Visualization (EuroVis): 2008
- IEEE Visualization (Vis): 2007
- Knowledge-Assisted Visualization: 2007
- IEEE Visualization (Vis): 2006



### **Journal Reviewer**

- Chaos, Solitons & Fractals
- Computer Aided Geometric Design
- Computer and Graphics
- Computer Graphics Forum
- Experiments in Fluids
- IEEE Transactions on Medical Imaging
- IEEE Transactions on Parallel and Distributed Systems
- IEEE Transactions on Visualization and Computer Graphics
- International Journal of Geographical Information Science
- Journal of Applied Meteorology and Climatology
- Optik - International Journal for Light and Electron Optics
- Parallel Computing
- Journal of Visualization

### **Grant Funding Panels**

- NIH/NIAID 2021
- NSF Information & Intelligent Systems 2020
- NSF Information & Intelligent Systems 2019
- NSF Information & Intelligent Systems 2015
- NSF Information & Intelligent Systems 2013
- NSF Information & Intelligent Systems 2012
- DOE Office of Advanced Scientific Computing Research 2011
- NSF Cyber Discovery & Innovation 2010