

Curriculum vitae of Leo Dorst

1 Education

Ph.D. Technical Sciences, Technical University Delft, June 10, 1986.

Ir-degree (M.Sc.) in Applied Physics, Technical University Delft, January 26, 1982.

Teaching degree in Physics and Mathematics (University and Senior High School level), January 26, 1982.

Honors:

Finalist for UvA lecturer of the year 2008.

‘2005 Inventor of the Year’, New York Intellectual Property Law Association (with co-inventor Karen Trovato).

Cum laude Ph.D., 1986.

Cum laude M.Sc. in Applied Physics, 1982.

2 Employment

- **Faculty of Sciences, University of Amsterdam, The Netherlands, 4/1992-1/2025.**

Title: universitair docent (tenured assistant professor)

Research in goal-directed behavior, from geometrical considerations of state spaces. Development of mathematics of differential contact of bodies and quantitative mathematical morphology. Application of Clifford’s geometric algebra in the computer sciences. Interested in accurate 3D reconstruction. Teaching of classes in robotics, autonomous systems, computer vision and linear algebra.

- **Industrial Research Limited, Auckland, New Zealand, 1/2010-5/2010**

Sabbatical with Robert Valkenburg on 3D reconstruction with geometric algebra.

- **Arizona State University, Phoenix, AZ, USA, 11/1998-4/1999.**

Sabbatical with David Hestenes on geometric algebra in computer science.

- **Philips Laboratories, Briarcliff Manor, NY, USA, 9/1986-3/1992.**

Title: senior member research staff.

Initially developed a robot path planner based on distance transforms. Extended this to a general path planning method for autonomous devices and successfully demonstrated the theoretical and practical equivalence of robot path planning, car maneuvering, and solving Rubik’s Cube like puzzles. The method led to 11 patent applications (and consequently only a few public papers). Implementation (in C and C++) of the method on a PUMA robot and a radio-controlled car that parks itself from any position (with others). Scientific and management responsibility for a group of 13 researchers (M.Sc. and Ph.D) in the programs ”Sensory Integrated Robotics” and ”Autonomous Systems”. Work on theory of integration of sensing and motion for goal-directed systems.

- **FOM (Fundamental Research of Matter), Utrecht, The Netherlands, 3/1982-7/1986.**
 Title: research scientist. Work performed at Technical University Delft.
 Designing, building and implementing a system for the computer-guided automated analysis of interferograms. Detailed experience with commercial VME-based image processing modules. Responsible for acquiring the FOM (Dutch NSF) funding of this project. At the same time, research on the accuracy of measurements in digital images, leading to a Ph.D. thesis on digitized straight lines. Teaching of courses in signal processing and image analysis.
- **THDelft (Technical University Delft), Delft, The Netherlands, 2/1981-2/1982.**
 Title: teaching assistant.
 Designing and implementing a self-guided undergraduate course in digital image processing. Teaching of courses in signal processing and image analysis.
- **CERN (European Center for Nuclear Research), Geneva, Switzerland, 7/1980-9/1980.**
 Title: summer student.
 Designing a coordinate system for the ‘Crystal Ball’ photon detector, to speed-up analysis of experiments.

3 Papers in Refereed Journals

1. R. Groenendijk, L. Dorst, Th. Gevers, *A Geometric Back-Propagation in Morphological Neural Networks*, IEEE PAMI, pp. 1–8, June 2023, <https://doi.org/10.1109/TPAMI.2023.3290615>
2. H. ElNaghy, L. Dorst, *Pairwise Alignment of Archaeological Fragments through Morphological Characterization of Fracture Surfaces*, International Journal of Computer Vision, vol. 130, July 2022, pp. 2184-2204, doi: 10.1007/s11263-022-01635-3, <https://link.springer.com/content/pdf/10.1007/s11263-022-01635-3.pdf>
3. J. Hrdina, A. Návrát, P. Vašík, L. Dorst, *Projective Geometric Algebra as a Subalgebra of Conformal Geometric Algebra*, Adv. Appl. Clifford Algebras, 31:18, 14 pages, 2021.
4. H. ElNaghy, L. Dorst, *Boundary Morphology for Hierarchical Simplification of Complementary Archaeological Fragments*, Mathematical Morphology - Theory and Applications, volume 4, pp. 46-63, 2020. Available at <https://www.degruyter.com/view/journals/mathm/4/1/article-p46.xml>.
5. L. Dorst, *Boolean Combination of Circular Arcs using Orthogonal Spheres*, Adv. Appl. Clifford Algebras, vol.29, no.3:41, 2019. DOI: 10.1007/s00006-019-0959-y.
6. L. Dorst, *Conformal Villarceau Rotors*, Adv. Appl. Clifford Algebras, vol.29, no.3:44, 2019. 2019, DOI: 10.1007/s00006-019-0960-5.
7. L. Dorst, *3D Oriented Projective Geometry through Versors of $\mathbb{R}^{3,3}$* , Adv. Appl. Clifford Algebras, vol.26, no.4, pp.1137-1172, 2016. Open access (2015): DOI 10.1007/s00006-015-0625-y, <http://link.springer.com/article/10.1007/s00006-015-0625-y>.

8. L. Dorst, *The Construction of 3D Conformal Motions*, Mathematics in Computer Science, vol.10, no.1, pp.97-113, 2016, Open access: DOI 10.1007/s11786-016-0250-8, <http://dx.doi.org/10.1007/s11786-016-0250-8>.
9. L. Dorst, *Total Least Squares Fitting of k -Spheres in n -D Euclidean Space Using an $(n + 2)$ -D Isometric Representation*, J of Mathematical Imaging and Vision, 2014, pp.1-21, DOI 10.1007/s10851-014-0495-2.
10. L. Dorst, *First Order Error Propagation of the Procrustes method for 3-D attitude estimation*, IEEE-PAMI, vol.27, no.2, 2005, pp. 221-229.
11. M.D. Zaharia, L. Dorst, *Modeling and Visualization of 3D Polygonal Mesh Surfaces using Geometric Algebra*, Computers & Graphics 28, 2004, pp. 519-526.
12. D. Fontijne, L. Dorst, *Modelling 3D Euclidean Geometry*, IEEE CGA, vol. 23, no. 2, March/April 2003, pp. 68-78.
13. L. Dorst and N. Ahmed, *Reduction of Placement Problems using Minkowski Decomposition*, IEEE SMC-B, 2003, vol.33, no.1, pp. 133-137.
14. K.I. Trovato and L. Dorst, *Differential A**, IEEE Knowledge and Data Engineering, vol.14, no.6, November/December 2002, pp.1218-1229.
15. S. Mann and L. Dorst, *Geometric algebra: a computational framework for geometrical applications (part II: applications)*, IEEE Computer Graphics and Applications, vol.22 no.4, July/August 2002, pp.58-67.
16. L. Dorst and S. Mann, *Geometric algebra: a computational framework for geometrical applications (part I: algebra)*, IEEE Computer Graphics and Applications, vol.22. no.3, May/June 2002, pp.24-31.
17. Bouma, T.A., Dorst, L. and Pijls, H.G.J., *Geometric Algebra for Subspace Operations*, Acta Mathematicae Applicandae, vol. 73, pp. 285-300, 2002, available on-line at series <http://xxx.lanl.gov/abs/math.LA/0104102>.
18. L. Dorst and R. van den Boomgaard, *The Support Cone: a representational tool for the analysis of boundaries and their interactions*, IEEE PAMI, vol.22, no.2, 2000, pp.174-178.
19. L. Dorst, *Analyzing the behaviors of a car: a study in abstraction of goal-directed motions*, IEEE Systems Man and Cybernetics A, vol. 28, no. 6, 1998, pp. 811-822.
20. L. Dorst, A. Hoekstra, J.M. van den Akker, J. Breeman, F.C.A. Groen, J. Lagerberg, A. Visser, H. Yakali, L.O. Hertzberger, *Evaluating Automatic Debiting Systems by modelling and simulation of virtual sensors*, IEEE Instrumentation and Measurement Magazine, June 1998, vol.1, no.2, pp. 18-25.
21. Dorst, L. and Boomgaard, R. van den, *Morphological Signal Processing and the Slope Transform*, invited paper for Signal Processing, vol. 38, 1994, pp. 79-98.
22. Dorst, L., *Towards Formal Theories of Autonomous Goal-Directed Behavior*, Guest Editorial for Special Issue of Robotics and Autonomous Systems, Elsevier, vol.9, no.2&3, 1992.

23. Dorst, L. and Wu, H.-L., *The Geometry of Knowledge Acquisition through Motion and sensing*, Robotics and Autonomous Systems, Elsevier, vol.9, no.2&3, 1992, pp. 75-104.
24. Benjamin, D.P., Cameron, A.J., Dorst, L., Rosar, M., Wu, H.-L., *Integrating Perception with Problem Solving*, SIGART, ACM Press, vol.2, no.4, 1991, pp.41-45.
25. Dorst, L. , Mandhyan, I., Trovato, K.I., *The Geometrical Representation of Path Planning Problems*, invited paper in: Robotics and Autonomous Systems, Elsevier, vol.7, 1991, pp.181-195.
26. Dorst, L. and Smeulders, A.W.M., *Length Estimators for Digitized Contours*, Invited paper in: Computer Vision, Graphics and Image Processing, 1987, vol. 40, pg. 311–333.
27. Dorst, L. and Smeulders, A.W.M., *Best Linear Unbiased Estimators for Properties of Digitized Straight Lines*, IEEE Pattern Analysis and Machine Intelligence, 1986, vol. PAMI-8, no. 2, pg. 276–282, (See printer’s correction in PAMI-8(5):676, 1986).
28. Smeulders, A.W.M. and Dorst, L., *Measurement Issues in Morphometry*, Journal of Analytical and Quantitative Cytology, 1985, vol. 7, no. 4, pg. 242–249.
29. Dorst, L. and Duin, R.P.W., *Spirograph Theory: a Framework for Calculations on Digitized Straight Lines*, IEEE Pattern Analysis and Machine Intelligence, 1984, vol. PAMI-6, no. 5, pg. 632–639.
30. Dorst, L. and Smeulders, A.W.M., *Discrete Representation of Straight Lines*, IEEE Pattern Analysis and Machine Intelligence, 1984, vol. PAMI-6, no. 4, pg. 450–463.

4 Papers in Conference Proceedings; Contributions to Books

1. L. Dorst, *Paraxial Geometric Optics in 3D through Point-based Geometric Algebra*, B. SHeng et al. (Eds.): CGI 2023, LNCS 14498, pp. 1-15, 2024. https://doi.org/10.1007/978-3-031-50078-7_27
2. L. Dorst and S. De Keninck, *Physical Geometry by Plane-based Geometric Algebra*, accepted for PROMS proceedings of ICACGA 2022, Springer, July 2023.
3. L. Dorst, *Projective Duality Encodes Complementary Orientations in Geometric Algebras*, Math. Meth. Appl. Sci., 2023, pp. 1-17, DOI 10.1002/mma.9754.
4. L. Dorst, *Complementary Orientations in Geometric Algebras*, LNCS 13862 (Chapter 5, 978-3-031-30922-9), Springer, 2023.
5. R. Groenendijk, L. Dorst, Th. Gevers, *MorphPool: Efficient Non-linear Pooling & Unpooling in CNNs* BMVC 2022, London. <https://bmvc2022.mpi-inf.mpg.de/56/>
6. L. Dorst, *Optimal Combination of Orientation Measurements Under Angle, Axis and Chord Metrics*, in: Systems, patterns and data engineering with geometric calculi, ICIAM2019 SEMA SIMAI Springer Series, editor S. Xambó-Descamps, pp. 47-88, 2021. ISBN: 978-3-030-74485-4

7. S. De Keninck and L. Dorst, *Hyperwedge*, N. Magnenat-Thalmann et al. eds., in: Advances in Computer Graphics, 37th Computer Graphics International Conference CGI 2020, LNCS 12221, Springer, pp. 549–554, 2020.
8. H. ElNaghy, L. Dorst, *Complementarity-Preserving Fracture Morphology for Archaeological Fragments*, in LNCS 11564, Mathematical Morphology and Its Applications to Signal and Image Processing, Proceedings of 14th Int. Symp. Mathematical Morphology, Saarbrücken, 2019; Springer, pp.403-414.
9. S. de Keninck, L. Dorst, *Geometric Algebra Levenberg-Marquardt* Advances in Computer Graphics, eds. LNCS 11542, Gavrilova, Chang, Thalmann, Ishikawa, Springer, pp.511-522, 2019. (ENGAGE CGI 2019, Calgary 2019)
10. L. Dorst, H. ElNaghy, M. Mortara, C. Pizzi, A. Scalas, M. Spagnuolo, *Geometric Ingestion in GRAVITATE: Resampling, Faceting and Annotation Transfer*, abstract and presentation for GRAVITATE workshop in Visual Heritage, Vienna, 2018.
11. H. ElNaghy, L. Dorst, *Using Mathematical Morphology to Simplify Archaeological Fracture Surfaces*, Eurographics Symposium on Geometry Processing, eds T.Ju and A.Vaxman, 2018, DOI 10.2312/sgp.20181179.
12. H. ElNaghy, L. Dorst, *Geometry Based Faceting of 3D Digitized Archaeological Fragments*, ICCV e-Heritage Workshop, Venice, 2017, pp. 2934-2942, DOI 10.1109/ICCVW.2017.346.
13. Phillips, Stephen C. and Walland, Paul W. and Modafferi, Stefano and Dorst, Leo and Spagnuolo, Michela and Catalano, Chiara Eva and Oldman, Dominic and Tal, Ayellet and Shimshoni, Ilan and Hermon, Sorin, *GRAVITATE: Geometric and Semantic Matching for Cultural Heritage Artefacts*, Eurographics Workshop on Graphics and Cultural Heritage, Chiara Eva Catalano and Livio De Luca, eds., The Eurographics Association, 2016, pp. 2312-6124, ISBN 978-3-03868-011-6, DOI 10.2312/gch.20161407.
14. L. Dorst, *Geometric Algebra*, entry in: Computer Vision, A Reference Guide, Katsushi Ikeuchi, editor, Springer Verlag, 2014, pp. 329-333.
link: <http://www.springerreference.com/docs/html/chapterdbid/333832.html>
15. G. Dubbelman, L. Dorst, H.G.J. Pijls, *Manifold Statistics for Essential Matrices* A. Fitzgibbon et al. (eds) ECCV 2012, Part II, LNCS 7573, pp. 531-544, 2012.
16. L. Dorst, *Tutorial Appendix: Structure Preserving Representation of Euclidean Motions Through Conformal Geometric Algebra*, in: L.Dorst, J. Lasenby, eds., Guide to Geometric Algebra in Practice, Springer, 2011, Chapter 21, pp. 435-452. (Slightly modified version of [22]).
17. R.J. Valkenburg, L. Dorst, *Estimating Motors from a Variety of Geometric Data in 3D Conformal Geometric Algebra*, in: L.Dorst, J. Lasenby, eds., Guide to Geometric Algebra in Practice, Springer, 2011, Chapter 5, pp. 81-104.
18. D. Fontijne, L. Dorst, *Reconstructing Rotations and Rigid Body Motions from Exact Point Correspondences through Reflections*, in: L.Dorst, J. Lasenby, eds., Guide to Geometric Algebra in Practice, Springer, 2011, Chapter 4, pp. 63-78.

19. L. Dorst, R.J. Valkenburg, *Square Root And Logarithm of Rotors in 3D CGA Using Polar Decomposition*, in: L.Dorst, J. Lasenby, eds., *Guide to Geometric Algebra in Practice*, Springer, 2011, Chapter 2, pp. 25-46.
20. I. Esteban, L. Dorst, J. Dijk, *Closed Form Solution for the Scale Ambiguity Problem in Monocular Visual Odometry*, in: *Intelligent Robotics and Applications*, H. Liu, H. Ding, Z. Xiong, X. Zhu (editors), Springer LNCS 6424 (2010), pp. 665-679.
21. D. Fontijne, L. Dorst, *Efficient Algorithms for Factorization and Join of Blades*, in: *Geometric Algebra Computing for Engineering and Computer Science*, eds: E.Bayro-Corrochano, G.Scheuermann, Springer 2010, pp.457-476.
22. L. Dorst, *Tutorial: Structure Preserving Representation of Euclidean Motions through Conformal Geometric Algebra*, in: *Geometric Algebra Computing for Engineering and Computer Science*, eds: E.Bayro-Corrochano, G.Scheuermann, Springer 2010, pp. 35-52.
23. L. Dorst, *Conformal Geometric Algebra by Extended Vahlen Matrices*, GraVisMa 2009 Workshop Proceedings, V. Skala, D. Hildenbrandt, eds., pp.72-79; submitted to WSCG.
24. L. Dorst, *Determining a Versor in n-D Geometric Algebra from the Known Transformation of n Vectors*, GraVisMa 2009 Workshop Proceedings, V. Skala, D. Hildenbrandt, eds., pp.66-71; submitted to WSCG.
25. C. Cibura, L. Dorst, *From Exact Correspondence Data to Conformal Transformations in Closed Form Using Vahlen Matrices*, GraVisMa 2009 Workshop Proceedings, V. Skala, D. Hildenbrandt, eds., pp.58-65; submitted to WSCG.
26. N. Ohnishi, Y. Kameda, A. Imiya, L. Dorst, R. Klette, *Dynamic Multiresolution Optical Flow Computation*, (RobVision 2008, Auckland, NZ), in: *Robot Vision 2008*, LNCS 4931, G.Sommer and R.Klette (eds.), Springer, pp.1-15, 2008.
27. L.Dorst, *The Representation of Rigid Body Motions in the Conformal Model of Geometric Algebra*, in: *Human Motion – Understanding, Modeling, Capture and Animation*, Series: Computational Imaging and Vision, Vol. 36, Springer, 2008, pp. 507-529.
28. D. Fontijne, L. Dorst, *Geometric Algebra: a new foundation for geometric programming*, poster in: Scientific ICT Research Event Netherlands SIREN2006, Utrecht, October 12, 2006, pg. 63.
29. D. Hildenbrand, D. Fontijne, Y. Wang, M. Alexa and L. Dorst, *Competitive runtime performance for inverse kinematics algorithms using conformal geometric algebra* In: Fellner, Dieter W. (Ed.) u.a.; European Association for Computer Graphics (Eurographics), Aire-la-Ville, pp. 5-9, 2006.
30. D. Fontijne, L. Dorst, *Geometric Algebra: a new foundation for geometric programming*, poster in: Scientific ICT Research Event Netherlands SIREN2005, Eindhoven, October 6, 2005, pg. 34.
31. L. Dorst, D. Fontijne, *An Algebraic Foundation for Object-Oriented Euclidean Geometry*, proceedings of ITM/ga 2003, RIMS Kokyuroku, vol. 1378, Kyoto, Japan, 2004. pp. 138-153.

32. W. van der Mark, D. Fontijne, L. Dorst, F.C.A. Groen, *Vehicle Ego-Motion Estimation with Geometric Algebra*, Proceedings IEEE Intelligent Vehicle Symposium, Versailles, France, June 17-21, 2002, pp. 58-63.
33. L. Dorst, *The Inner Products of Geometric Algebra*, in: *Applications of Geometric Algebra in Computer Science and Engineering*, L. Dorst, C. Doran, J. Lasenby (eds.), Birkhäuser, Boston, pp. 35-46, 2002
34. N. Massios, L. Dorst, F. Voorbraak, *A strategy for robot surveillance using the hierarchical structure of the environment*, in: IJCAI'01 workshop on Reasoning with Uncertainty, Seattle, USA, August 2001, pp. 43-50.
35. L. Dorst *Objects in contact: boundary collisions as geometric wave propagation*, in: *Geometric Algebra with Applications in Science and Engineering* E. Bayro-Corrochano, G. Sobczyk, eds, Birkhäuser, ISBN 0-8176-4199-8, 2001, Chapter 17, pp. 349-370.
36. S. Mann, L. Dorst, T. Bouma, *The making of GABLE: a Geometric Algebra Learning Environment in Matlab*, in: *Geometric Algebra with Applications in Science and Engineering* E. Bayro-Corrochano, G. Sobczyk, eds, Birkhäuser, ISBN 0-8176-4199-8, 2001, Chapter 24, pp. 491-511.
37. L. Dorst *Honing geometric algebra for its use in the computer sciences*, in: G. Sommer ed.: *Geometric Computing with Clifford Algebras: Theoretical Foundations and Applications in Vision and Robotics*, Springer ISBN 3-540-41198-4, Chapter 6, 2001, pp. 127-152.
38. L. Dorst and R. van den Boomgaard, *The systems theory of contact*, in: *Algebraic Frames for the Perception-Action Cycle*, G. Sommer, Y.Y Zeevi, eds., Lecture Notes in Computer Science 1888, Springer, 2000, pp. 22-47.
39. Corten, E. and Dorst, L. and Kröse B., *The design of OASIS: Open Architecture for Simulations with Intelligent Systems*. In Proc ESM'98, Manchester June 16-19 1998, SCS Publication, ISBN 1- 56555-148-6, Zobel, R. and Möller, D (editors), pp. 455-459, 1998.
40. E. Corten, L. Dorst, B. Kröse, *OASIS. Open Architecture for Simulations with Intelligent Systems*, Proc IAS-5, Y. Kakazu, M. Wada, T. Sato, eds, IOS press ISBN 90 51993986, Sapporo June 2-4 1998, pp. 6-12.
41. A. W. M. Smeulders, L. Dorst, M. Worring, *Measurement and characterisation in vision geometry*, in: *SPIE Vision Geometry*, eds. R. Melter, L. Latechi, SPIE, 1997, 2 - 20.
42. Yakali, H.H. and Kröse, B.J.A. and Dorst, L., *Vision-based 6-dof robot end-effector positioning using neural networks*, Proceedings 1997 RWC Symposium, RWC Technical Report TR - 96001, 1997, pp. 191-198.
43. L. Dorst, *Bottom-up Derivation of the Qualitatively Different Behaviors of a Car across Varying Spatio-Temporal Scales: a Study in Abstraction of Goal-Directed Motion*, In: *Algebraic Frames for the Perception-Action Cycle*, Kiel 1997, eds. G. Sommer and J.J. Koenderink, Lecture Notes in Computer Science 1315, Springer, 1997, pp.344-355.

44. L. Dorst, F.C.A. Groen, J.M. van den Akker, J. Breeman, A. Hoekstra, J. Lagerberg, A. Visser, H. Yakali, L.O. Hertzberger, *The virtual sensor concept applied to simulation: the evaluation of Automatic Debiting Systems*, 1997 Workshop on Emergent Technologies & Virtual Systems for Instrumentation and Measurements, Niagara Falls, Ontario, Canada, May 15-17, 1997, pp. 118-124.
45. A.G. Hoekstra, L. Dorst, M. Bergman, J. Lagerberg, A. Visser, H. Yakali, F. Groen, L.O. Hertzberger, *High Performance Discrete Event Simulations to evaluate Complex Industrial Systems, The case of Automatic Debiting Systems for Electronic Toll Collection on Motor Highways*, High Performance Computing and Networking, Eds. Bob Hertzberger and Peter Sloot, Lecture Notes in Computer Science 1225 (Springer), pp. 41-50, 1997.
46. A.G. Hoekstra, L. Dorst, M. Bergman, J. Lagerberg, A. Visser, H. Yakali, F.C.A. Groen and L.O.Hertzberger, *Modelling and simulation of automatic debiting systemes for electronic toll collection on motor highways*, Proceedings IASTED Int. Conf. Appl. Modelling and Simulation, ed. M.H. Hamzam, pp. 104-108, 1997.
47. R. van den Boomgaard, L. Dorst, *The Morphological Equivalent of Gaussian Scale-Space*, in: Gaussian Scale-Space Theory, J. Sporring, M. Nielsen, L. Florack and P. Johansen, eds, Kluwer, 1997, pp. 203-220.
48. R. van den Boomgaard, L. Dorst, S. Makram-Ebeid, J. Schavemaker, *Quadratic structuring functions in mathematical morphology*, in: Mathematical Morphology and its Applications to Image and Signal Processing, eds. P. Maragos, R. Shafer, Butt, Kluwer 1996, pp. 147-154..
49. L. Dorst, R. van den Boomgaard, *Orientation-based representations for mathematical morphology*, invited paper for: International Workshop on Syntactic and Structural Pattern Recognition, Nahariya, Israel, October 1994. in: Shape, Structure and Pattern Recognition, D. Dori, A. Bruckstein, eds., World Scientific, 1995, pp. 13-22. (almost identical to 4:51).
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51. L. Dorst, R. van den Boomgaard, *Orientation-based representations for mathematical morphology*, invited paper for: 4th Discrete Geometry for Computer Imagery, Grenoble, September 1994.
52. L. Dorst, R. van den Boomgaard, *Two dual representations of mathematical morphology based on the parallel normal transport property*, in: Mathematical morphology and its Application to Signal Processing 2, Kluwer Dordrecht, pp. 161-170, 1994. (same as 4:53).
53. L. Dorst, R. van den Boomgaard, *Two dual representations of mathematical morphology based on the parallel normal transport property*, (International Workshop on Visual Form, Capri, Italy, June 1994), in: Aspects of Visual Form Processing, C. Arcelli, L.P. Cordella, G. Sanniti di Baja, eds., World Scientific, Singapore, 1994, pp. 178-187.

54. L. Dorst, R. van den Boomgaard, *An Analytical Theory of Mathematical Morphology*, in: *Mathematical Morphology and its Applications to Signal Processing*, J. Serra, P. Salembier, eds., Universitat Politecnica de Catalunya, Barcelona, Spain, May 1993, pp. 245-250.
55. Benjamin, D.P., Cameron, A.J., Dorst, L., Rosar, M., Wu, H.-L., *Integrating Perception with Problem Solving*, in: *Proceedings of AAAI-91 workshop on Intelligent Integrated Systems*, AAAI, Berkeley, CA, March 1991. Also published as [3:24].
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57. Dorst, L., Mandhyan, I., Trovato, K., *The Geometrical Structure of Path Planning Problems*, in: *Intelligent Autonomous Systems 2*, Amsterdam, 12/1989, pg. 155-167. (same as 3:25).
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59. Trovato, K. and Dorst, L., *Autonomous Planning of Vehicle Maneuvers*, in: *Intelligent Autonomous Systems 2*, Amsterdam, 12/1989, pg. 981-983.
60. Dorst, L., *Discretized Straight Lines: Parameters, Primitives and Properties*, in: *Mathematical Research vol.51*, *Proceedings of GEOBILD 89*, Georgental, GDR, Akademie-Verlag Berlin, 3/89, pg. 11-18.
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64. Dorst, L. and Verbeek, P.W., *The Constrained Distance Transformation: A Pseudo-Euclidean, Recursive Implementation of the Lee Algorithm*, in: *Signal Processing III: Theories and Applications*, editors Young, I.T. and others, EURASIP, North-Holland, Amsterdam, 1986, pg. 917-920.
65. Beckers, A.L.D, Dorst, L., Young, I.T., *The Choice of Filter Parameters for Non-Linear Grey-Value Image Processing*, in: *Proceedings of the 2nd International Symposium on Optical and Electro-Optical Applied Science and Engineering*, Cannes, France, SPIE 596, SPIE, 12/1985, pg. 120-128.
66. Dorst, L. and Groen, F.H., *A System for the Quantitative Analysis of Interferograms*, in: *Proceedings of the 2nd International Symposium on Optical and Electro-Optical Applied Science and Engineering*, Cannes, France, SPIE 599, SPIE, 12/1985, pg. 155-159.

67. Young, I.T. , Beckers, A.L.D. , Dorst, L. , Boerman, A.E., *Choosing Filter Parameters for Non-Linear Image Filtering*, in: Pattern Recognition in Practice II, Amsterdam, The Netherlands, North-Holland, Amsterdam, 6/1985, pg. 5–15.
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69. Dorst, L. and Smeulders, A.W.M., *Length Estimators Compared*, in: Pattern Recognition in Practice II, Amsterdam, The Netherlands, North–Holland, Amsterdam, 6/1985, pg. 73–80.
70. Dorst, L., *The Accuracy of the Digital Representation of a Straight Line*, in: Fundamental Algorithms for Computer Graphics, NATO ASI series F, vol.17, Proceedings of the NATO Advanced Study Institute held at Ilkley, Yorkshire, Great Britain, Earnshaw, R.A. editor, NATO ASI, Springer Verlag, Berlin, 4/1985, pg. 141–152.
71. Dorst, L., *Quantitative Analysis of Interferograms Using Image Processing Techniques*, in: Proceedings of 13th Conf. of the ICO, Sapporo, Japan, SPIE 398, SPIE, 8/1984, pg. 476–477.
72. Dorst, L., *A Local Contrast Enhancement Filter*, in: Proceedings of 6th ICPR, Munich, Germany, IEEE, 10/1982, pg. 604–606.
73. Dorst, L. and Smeulders, A.W.M., *The Estimation of Parameters of Digitized Straight Line Segments*, in: Proceedings of 6th ICPR, Munich, Germany, IEEE, 10/1982, pg. 601–603.

5 Patents

1. Trovato, K.I., Dorst, L., *Differential Budding: method and apparatus for path planning with moving obstacles and goals*, U.S. Patent 6,728,581, April 27, 2004.
2. Dorst, L., and Trovato, K.I., *Method and Apparatus for Path Planning*, U.S. Patent 6,604,005, Aug. 5, 2003.
3. Trovato, K.I., and Dorst, L., *Method and apparatus for controlling the maneuvers of a vehicle*, U.S. Patent 5,870,303, Feb. 9, 1999.
4. Dorst, L., and Trovato, K.I., *Animation of Path Planning*, U.S. Patent 5,808,887, Sept. 15, 1998.
5. Cameron, A.J., and Dorst, L., *Path Planning in an Uncertain Environment*, U.S. Patent 5,764,510, June 9, 1998.
6. Cameron, A.J., and Dorst, L., *Path Planning in an Uncertain Environment*, U.S. Patent 5,751,573, May 12, 1998.
7. Trovato, K.I., Dorst, L., *Computer animation of planned path in changing space* U.S. patent 5,696,674, December 9, 1997

8. Trovato, K.I., Dorst, L., *Method and apparatus for smooth control of a vehicle with automatic recovery from interference*, U.S. patent 5,663,879, September 2, 1997
9. Rosar, M.E., Trovato, K.I., Dorst, L., Warmerdam, T.P.H., *Electron Microscope Having a Goniometer Controlled from the Image Frame of Reference*, U.S. patent 5,481,111, January 2, 1996
10. Trovato, K.I. and Dorst, L., *Path planning with transition changes*, US Patent 5,083,256, January 21, 1992.
11. Trovato, K. and Dorst, L., *Differential Budding: Method and Apparatus for Path Planning with Moving Obstacles and Goals*, U.S. Patent 4,949,277, August 14, 1990.

6 Theses, Books

1. L.Dorst, ed., *Liber Amicorum Prof.dr.ir.F.C.A. Groen*, 1 juni 2012.
2. L. Dorst, J. Lasenby, editors, *Guide to Geometric Algebra in Practice*, Springer, ISBN 978-0-85729-810-2, xxiv+458 pages, 2011.
3. L. Dorst, D. Fontijne, S. Mann, *Geometric Algebra for Computer Science: An Object-Oriented Approach to Geometry*, Morgan-Kaufmann Publishers, ISBN-10: 0123749425, ISBN-13: 978-0123749420, xxxvi+626 pages, Revised First Edition April 2009.
4. L. Dorst, D. Fontijne, S. Mann, *Geometric Algebra for Computer Science: An Object-Oriented Approach to Geometry*, Morgan-Kaufmann Publishers, ISBN 0-12-369465-5, xxxvi+626 pages, April 2007.
5. L. Dorst, C. Doran, J. Lasenby (editors), *Applications of Geometric Algebra in Computer Science and Engineering*, Birkhäuser, Boston, ISBN 0-8176-4267-6, xii+478 pages, 2002.
6. Dorst, L. and Lambalgen, M. van and Voorbraak, F., eds., *Reasoning with Uncertainty in Robotics*, International Workshop RUR'95, Amsterdam, The Netherlands, Lecture Notes in Artificial Intelligence 1093, Springer, 392 pages, 1996.
7. Dorst, L., *Discrete Straight Line Segments: Parameters, Primitives and Properties*, Ph.D. Thesis, Technical University Delft, 192 pages, June 10, 1986.
8. Leo '84 , *Frensj*, published by Leo Dorst, 1985 (a book of cartoons on the Pattern Recognition Group).
9. Dorst, L., *On Digitized Straight Line Segments*, M.Sc. thesis, Technical University Delft, 1/1982.

7 Reports, Contributions to Periodicals, Press etc.

1. *Constructing Conformal Motions*, in: Amsterdam Science, issue 8, November 2018, pg. 16-17.

2. Quoted in article on AlphaGo Zero in Volkskrant, October 19, 2017: <https://www.volkskrant.nl/tech/google-ontwerpt-nieuwe-go-computer-die-het-spel-zelf-kan-leren-en-zijn-voorganger-zo-verpulvert-a4522508/>
3. *De mathematische morfologie van Go*, in Bulletin 9 van de Nederlandse Go Bond, december 2014, pg. 5.
4. *Maak je eigen huis van Lego*, in: Maak indruk op je kinderen, Uitgeverij Snor, 2007, pg.92-93.
5. *Rekenen met bollen, cirkels en lijnen; Het gebruik van geometrische algebra in de informatica*, interview with Leo Dorst, Daniel Fontijne, and Stephen Mann on the occasion of the appearance of our textbook, I/O InformaticaOnderzoek, jaargang 4, nummer 3, juli 2007, IPN/NWO, pg. 4–6.
6. L. Dorst, *Computer leert connectiviteit van Go-expert*, De Connectie (Het AI-blad voor studenten en andere geïnteresseerden), jaargang 2, nr. 4, April 2007, pp. 5-7. Technische versie van [7:8,7].
7. L. Dorst, *Computer leert connectiviteit van Go-expert: deel 2*, Go (Tijdschrift van de Nederlandse Go-bond), 44:2, 2007, pp. 41–42.
8. L. Dorst, *Computer leert connectiviteit van Go-expert: deel 1*, Go (Tijdschrift van de Nederlandse Go-bond), 44:1, 2007, pp. 45-47.
9. *Stinkkaas inspireert uitvinder*, about the Inventor of the Year award, VPRO Noorderlog June 6, 2005.
10. L. Dorst and R. van den Boomgaard, *The Support Cone: a representational tool for the analysis of boundaries and their interactions*, ISIS Internal Report, UvA, number to be announced, 2000 (full version of paper 3:18).
11. L. Dorst, *Two Ph.D. theses on robot path planning using navigation functions*, in: Nieuwsbrief NVKI (Newsletter of Dutch Association for AI), vol. 14-1, 1997, pp.13-15.
12. L. Dorst, J.M. van den Akker, J. Breeman, F.C.A. Groen, A. Hoekstra, J. Lagerberg, A. Visser, L.O. Hertzberger, *The virtual sensor concept applied to the performance evaluation of Automatic Debiting Systems*, internal report, RekeningRijden, 1997.
13. Dorst, L., Erkamp, H. *Generating effective exploration from a sensor space representation of robot perception*, RWCP Internal Report, 24 pages, 1997.
14. Ahmed, N., Dorst, L., *Reduction of path planning problems to prototypical motions of prototypical shapes using Minkowski decomposition, with application to path planning for a box in 2D*, 1997, submitted to IEEE Systems Man and Cybernetics, June 1997.
15. Dorst, L., *Bottom-Up Derivation of the Qualitatively Different Behaviors of a Car across Varying Spatio-Temporal Scales as a Study in Abstraction of Goal-Directed Motions*, RWCP Internal Report, 24 pages, 1997.
16. Yakali, H., Dorst, L., Kröse, B., *Pose characterization by independent moment-based image features of planar objects*, RWCP Internal Report, 1997.

17. H. Yakali, L. Dorst, *Vendor proposals from a virtual sensor point of view*, Evaluation Report RekeningRijden, November 1996.
18. L. Dorst, *Generic sensor modelling for Rekening Rijden*, Internal Report RekeningRijden, November 1996.
19. L. Dorst, H. Yakali, *The geometry engine*, Internal Report RekeningRijden, August 1996.
20. L. Dorst, H. Yakali, *Sensory interpretation issues*, Evaluation Report RekeningRijden, April 1996.
21. L. Dorst, H. Yakali, *The geometry engine*, Internal Report RekeningRijden, August 1996.
22. Dorst, L. and Wu, H.-L., *The Geometry of Knowledge Acquisition through Motion and Sensing, Part 2: A Model in (Mostly) Linear Algebra*, Philips Laboratories Internal Report, TR-92-001, MS-92-005, 1992.
23. Wu, H.-L., and Dorst, L., *Knowledge Acquisition through Measurement and Motion; Part 1: A Model in Sets with Probabilities*, Philips Internal Report, 1991.
24. Dorst, L., *Towards Compu-Eucentric Motion*, Philips Internal Report, 1991
25. Dorst, L. and Wu, H.-L., *The Geometry of Knowledge Acquisition through Motion, Sensing and Reasoning*, Philips Internal Report, TN-91-066, MS-91-065, 1991.
26. Smeulders, A.W.M., and Dorst, L., *Decomposition of Discrete Curves into Piece-wise Straight Segments in Linear Time*, In: Vision Geometry, R.Melter, P.Bhattacharya, A.Rosenfeld, eds., series Contemporary Mathematics vol.119, American Mathematical Society, 1991, pp.169-195.
27. Dorst, L., and Smeulders, A.W.M., *Discrete Straight Line Segments: Parameters, Primitives and Properties*, In: Vision Geometry, R.Melter, P.Bhattacharya, A.Rosenfeld, eds., series Contemporary Mathematics vol.119, American Mathematical Society, 1991, pp.45-62. Also in: GEOBILD '89, eds. Hübler et al, Mathematical Research vol. 51, Akademie-Verlag Berlin 1989.
28. Cameron, A., and Dorst, L., *Planning Paths Using Distance Functions in an Uncertain Environment*, Philips Laboratories Internal Report, no. TN-90-062, 1990.
29. Dorst, L., *Implementation of a Path Planner for the PUMA-562 Robot Using Bubble-Based Wave Propagation*, Philips Laboratories Internal Report, no. TN-90-060, 1990.
30. Dorst, L., Rosar, M.E., Mandhyan, I., *Submetrics and Vector Fields: A Comparison of Formalisms for Wave Propagation Based Path Planning*, Philips Laboratories Internal Report, no. TN-90-040, 1990.
31. Dorst, L., *Representations and Algorithms for the $2x2x2$ Rubik's cube with Half Turns*, Philips Laboratories Internal Report, no. TN-89-041, 1989.
32. Trovato, K. and Dorst, L., *Optimal Path Planning (summary)*, Philips Laboratories Internal Report, no. TN-88-1146, 2/1989.

33. Dorst, L., *Optimal Path Planning by Cost Wave Propagation: 1- Basic Framework and Procedures*, Philips Laboratories Internal Report, no. TN-88-120, 1988 (proprietary).
34. Dorst, L., *The Accuracy of the Digital Representation of a Straight Line*, in: First Quinquennial Review of the NVPHBV (Dutch society for Pattern Recognition and Image Processing), DEB Publishers, Pijnacker, The Netherlands, 1986, pg. 183–199.
35. Duin, R.P.W. and Dorst, L., *On the Optimal Grid Configuration for Straight Line Position Measurement*, in: First Quinquennial Review of the NVPHBV (Dutch society for Pattern Recognition and Image Processing), DEB Publishers, Pijnacker, The Netherlands, 1986, pg. 203–217.
36. Dorst, L. and den Haan, J.R., *TIPS Introductie Cursus Beeldbewerking* (manual for an introductory course in Image Processing Techniques for the clients of the Center for Image Processing Delft and users of the TIPS software package), TPD, Delft, Holland, 1986, (48 pages).
37. Dorst, L. and Smeulders, A.W.M., *Discrete Representation of Straight Lines*, Zentralblatt für Mathematik und Ihre Grenzgebiete, 7/1985, vol. 545, pg. 347, Abstract no.545.68097.
38. Dorst, L. and Duin, R.P.W., *Spirograph Theory: a Framework for Calculations on Digitized Straight Lines*, Zentralblatt für Mathematik und Ihre Grenzgebiete, 7/1985, vol. 545, pg. 347, Abstract no.545.68098.
39. Dorst, L., *Image Analysis and CAD/CAM*, 1/1985, TV interview for course on CAD/CAM produced for TELEAC by R. Le Gué, Cinecentrum, Hilversum.
40. Dorst, L., van Munster, R.J., Smeulders, A.W.M., *Digitale bewerking van beelden (introductory text in general image processing)*, Nederlands Tijdschrift voor Fotonica, 1984, no. 2, pg. 18–40.
41. Dorst, L., van Munster, R.J., Smeulders, A.W.M., *Digitale Beeldbewerking: technieken en toepassingen (introductory text in general image processing)*, in: Technische Toepassingen van Beeldbewerking, Symposium on Technical Applications of Image Processing, DEB Publishers, Pijnacker, The Netherlands, 1984, pg. 41–78.
42. Dorst, L., *Handleiding voor het ST-introductiepraktikum Beeldbewerking (manual for an introductory course on Image Processing Techniques)*, Technical University Delft, 4/1982.
43. Le Gué, R. , Young, I.T. , Dorst, L. , Duin, R.P.W. , Groen, F.C.A., *Het Eind = Zoek*, Collaborative television program with NOS and Cinecentrum, Hilversum, 10/1981.
44. Dorst, L., *A Coordinate System for the Crystal Ball (report on the work as summer student at CERN, Geneva, Switzerland)*, Technical University Delft, 4/1981.

8 Teaching

8.1 Courses

- A Guided Tour to Plane-based Geometric Algebra, online, <https://bivector.net/PGA4CS.html> and https://www.geometricalgebra.net/new_material.html, July 2020.
- UvA Matching: Linear Algebra for AI, for high-school students enrolling in the AI programme. (2017-2020, now online)
- Math classes to assist Master AI course on Machine Learning by Max Welling and Ted Meeds; later Patrick Forré; later Rianne van den Berg. (2014-2019).
- *Geometric Algebra for Computer Science*, 6 EC, based on my book, for Bachelor Honours and Master AI students. (2011-2015).
- *Linear Algebra*, 6 EC, for 1st year AI (and 2011-2023 also 1st year CS). Beginnings up to SVD. (2004-2024)
- *Computer Vision (Beeldverwerken)*, 6 EC, Bachelor (2nd year) AI (prepared with Rein van den Boomgaard). Geometric transformations, color, local structure, scale spaces, Hough transform, appearance modeling, projective geometry, reconstruction, stereo vision, optic flow, (2004-2021)
- Lectures in Project Course *Zoeken Sturen en Bewegen* 1 EC, 1st year AI: rigid body motion, kinematics, path planning. (2004-2017)
- Coordination Bachelor graduation projects 2012.
- PhD student reading club on Kanatani, *Statistical Optimization for Geometric Computation*, 2009; counts as ASCI course.
- PhD student reading club on Hartley and Zisserman, *Multiple View Geometry*, 2008; counts as ASCI course (with J.M. Geusebroek).
- Reactive Behavior in Machines, for 1st year AI. (2002-2006)
- Computational Geometry, week-long Ph.D. level course with Mark de Berg, Marc van Kreveld, Remco Veltkamp, (ASCI course a20), 2-day contribution on geometrical algebra, 2001, 2003, 2007.
- Geometric algebra, contribution to SIGGRAPH course 31 (2000), 53 (2001).
- Computer Vision, for 3rd year AI and INF, from 2001 (with Rein van den Boogaard). Projective geometry, reconstruction, stereo vision, optic flow, appearance modeling. (2001-2003)
- Machine Perception, for 2nd year AI and INF, from 2001 (with Rein van den Boogaard). Geometric transformations, color, local structure, scale spaces, Hough transform. (2000-2003)
- *Organisation and design of autonomous systems*, with Lagerberg, Groen, Hertzberger. (1995-2003) Representation and modeling, principles of control theory.

- *Robotics*, for 2nd year AI (later 1st year AI) (1992-2003). Path planning, kinematics.
- Lectures in the course ‘*Machine Vision for Industrial Applications*’, Philips Laboratories, 1987,1988, ‘Feature Extraction’.
- Lectures in the course ‘*Image Processing and Pattern Recognition*’, for undergraduates in Physics, Mathematics, Computer Science and Electrical Engineering (given by Prof.dr.I.T. Young and ir.J.J. Gerbrands), TUDelft, 1985: human visual perception and image enhancement.
- Lectures in the course ‘*Systems and Signals I*’, for sophomore students in Applied Physics, Mathematics and Computer Science (given by I.T. Young and based on the book ”Signals and Systems” by Oppenheim, Willsky and Young), TUDelft 1983, 1984,1985,1986: discrete and continuous Fourier transforms, modulation techniques, convolution, singularity functions, FFT, 2-D FFT, AM, FM, PCM, sampling, aliasing.
- Lectures in the course ‘*Image Processing for Industrial Applications*’, given for Dutch Universities and Industries, TUDelft, 1982, 1983, 1984: ‘*Image Enhancement*’, ‘*Processing Binary Images*’, also involved in organisation of hands-on laboratory work.
- Development and implementation of a self-guided under-graduate laboratory course on low-level digital image processing, notably 2-D FFT, linear- and non-linear filtering, cellular binary operations, mathematical morphology. TUDelft, 1982, manual in 7:42, 7:36.

8.2 Ph.D. students

- Rick Groenendijk, *Going into Depth: Learning Morphological Aspects in Data Modalities using Neural Networks*, University of Amsterdam, October 25, 2023.
- Hanan ElNaghy, *Pairwise Alignment of Archaeological Fragments through Morphological Characterization of Fracture Surfaces*, University of Amsterdam, September 2021, ISBN 978-94-6419-287-2.
- Isaac Esteban-Lopez, *Large Scale Semantic 3D Modeling of the Urban Landscape*, University of Amsterdam, December 4, 2012.
- Carsten Cibura, *Fitting Model Parameters in Conformal Geometric Algebra to Euclidean Observation Data*, University of Amsterdam, February 1, 2012.
- Gijs Dubbelman, *Intrinsic Statistical Techniques for Robust Pose Estimation*, University of Amsterdam, September 6, 2011.
- Wajid Ali, *Discovery of Articulated Structures in Image Sequences*, 2007 NWO, University of Amsterdam; cancelled after 6 months.
- Daniel Fontijne, *Efficient Implementation of Geometric Algebra*, 2004-2007 NWO, University of Amsterdam, October 16, 2007. With Dick Grune of the Free University of Amsterdam.
- Tim A. Bouma, *on geometric algebra*, 2000 (unfinished), University of Amsterdam, with Mathematics Institute.

- Nikos Massios, *Decision-Theoretic Robotic Surveillance*, University of Amsterdam, January 25, 2002. With ILLC, Amsterdam.
- Karen I. Trovato, *A* Planning in Discrete Configuration Spaces of Autonomous Systems*, University of Amsterdam, September 9, 1996. With Philips Laboratories, Briarcliff, NY, USA.

8.3 Ph.D. Committees

- Taco Cohen, *Equivariant Convolutional Networks*, University of Amsterdam, June 2021.
- Martin Roelfs, *State of the Art Spectroscopy of (Un)Physical Gauge Degrees of Freedom using Numerical Experiments*, KU Leuven, April 2021.
- Stephane Breuil, *Algorithmic Structure for Geometric Algebra operators and application to quadric surfaces*, Laboratoire d'Informatique Gaspard-Monge, ESIEE, Paris, France, December 2018.
- Lars Tingelstad, *Automatic Differentiation and Optimization of Multivectors: Estimating Motors in Conformal Geometric Algebra*, NTNU, Trondheim, Norway, June 2017.
- Fatemeh Panahi, *Geometric Algorithms for Part Orienting and Probing*, Universiteit Utrecht, December 2015.
- Martijn Liem, *Multi-Person Localization and Orientation Estimation in Volumetric Scene Reconstructions*, UvA, Amsterdam, October 2014.
- Dang Trung Kien, *Semi-Interactive Construction of 3D Event Logs for Scene Investigation*, UvA, Amsterdam, May 2013.
- Olaf Booij, *View Based Mapping for Wheeled Robots* UvA, Amsterdam, November 2011.
- S. Charneau, *Etude et application des algèbres géométriques par le calcul de la visibilité globale dans un espace projectif de dimension $n \geq 2$* , Poitiers, December 2007.
- Wannes van der Mark, *Stereo and Colour Vision Techniques for Autonomous Vehicle Guidance*, UvA, Amsterdam, June 2007.
- Bernd Rieger, *Structure from Motion in nD Image Analysis*, TUDelft, February 2004.
- Bodo Rosenhahn, *Pose Estimation Revisited*, Christian Albrachts Universität zu Kiel, 2003.
- Sahan Gamage, *Theoretical and Experimental Analysis of Articulated Rigid Body Motion using Geometric Algebra*, Cambridge University, July 2002.
- Christian Perwass, *Multiple View Tensors*, Cambridge University, 2000.
- Paraskevas Dunias, *Autonomous Robots using Artificial Potential Fields*, TU Eindhoven, December 1996.
- Carol Orange, *Supervised Boundary Formation*, TUDelft, October 1994.

- Marcel Worring, *Shape Analysis of Digital Curves*, UvA, Amsterdam, June 1993.
- Frank Tuijnman, *The Artificial Steersman*, UvA, Amsterdam, September 1992.

8.4 M.Sc. students

- D. Laszlo, *Equivariant PGA Network with Applications (working title)*, 2024.
- N. Reints, *Comparing ALgebraic Data Representations for Predicting Dynamic Behavior*, UvA 2023.
- R. van Erkelens, *Detection of shipping containers in video for 3D model reconstruction*, UvA 2020.
- E. di Leo, *Individual Tree Crown Detection and Counting in UAV Remote Sensed Rainforest RGB Images through Mathematical Morphology*, UvA 2017.
- K. Potti, *Watching Humans for Measuring Spaces*, VU 2014, (with T. Kostelijk, Vicar Vision).
- T. Hijzen, *Reconstruction of Wall Geometry for Augmented Reality*, 2013 (with P. Jonker, TUDelft).
- A. Halma, *Using geometric algebra for surface interpolation*, 2009.
- R. van de Bogaard, *Using linear filters for real-time smoothing of rotational data in virtual reality applications*, 2004.
- R.J. Bankras, *Using 5D Conformal Geometric Algebra to Compute Collisions of 3D Polyhedral Objects*, 2003.
- B. Koopen, *Contact of Bodies in 2D-space, Implementing the Discrete Legendre Transform*, 2002.
- D. van Schaijk, *Aircraft Recognition from Tracks of Radar Range Profiles*, 2000.
- J. Fekkes, *Confident estimation of optic flow for collision avoidance*, 1998.
- G. Venekamp, *Training Autonomous Agents by Genetic Algorithms*, 1999.
- N. Veerman, *Botsingsdetectie en botsingsrespons in een virtuele wereld*, 1997 (with E. Corten)
- E. Rondema, *Evolution of foraging behaviour*, 1997.
- S.J. de Haan, *Arcy (Artificial Cyclops)*, 1996 (with E. Corten).
- N.J.M. Hagen, *Arcy (Artificial Cyclops)*, 1996 (with E. Corten).
- H. Erkamp, *A representation in sensor values of an unknown environment through exploration of a mobile robot*, 1996
- L. Bergsma, *Projectie-invariante vlakvormherkenning*, 1995 (with R. van den Boomgaard).
- H.-P. Keuning, *2D shape from touching*, 1995.
- V. O. Solorzano Barboza, *A ladder through a maze*, 1995.
- M. Mol, *Het gebruik van TCL/TK voor verbeterde interfaces voor realtime computersystemen*, 1995.
- S. Carmiggelt, *Padplanning voor een mobiele robot*, 1994
- P.R. Laan, *Gericht ronddolen*, 1994.
- M. Zaanen, *(on seismic image interpretation)*, Delft University of Technology, 1986.
- A. Beckers, *(on morphological size histograms in images)*, Delft University of Technology, 1986.

8.5 B.Sc. students

- Z. Seljee, *Robots Seeing Geometric Planes*, 2022.
- J. Greven, , *Motor Estimation from Lines using Plane-based Geometric Algebra*, 2022 (with Steven De Keninck).
- P. Veenhuis, *Incorporating Plane-based Geometric Algebra in the Ioquake3 game engine*, 2022 (with Steven De Keninck).
- T. Sluis, *Vertex Skinning using Plane-based Geometric Algebra*, 2022 (with Steven De Keninck).

- P. van der Klei, *REvising Tangent Frames using Plane-based Geometric Algebra*, 2021 (with Steven De Keninck).
- L. Knigge, *Learning Character Motion using Plane-based Geometric Algebra*, 2021 (with Steven De Keninck).
- N.A.J. Peters Grau, *A True Coverage Anti-Alised Rasterizer*, 2021 (with Steven De Keninck).
- C. Üyük, *Fast Marching Implementation of 2D Grid Morphology*, 2017, 6 EC (summer intern, with Hanan ElNaghy).
- Y. Galama, *Using curvature and roughness of an artifact to classify facets being fractures*, 2016, 18 EC (with Hanan ElNaghy).
- M. de Jonge, *Projective Geometric Algebra*, 2013, 18 EC.
- A. Visser, *Retrieving Images Based on a Specific Place in a Living Room*, 2013, 18 EC.
- P. de Kok, *Visualization of Projective Line Geometry for Geometric Algebra*, 2012, 18 EC.
- W. Josemans, H. van der Molen, *Visualization of path planning methods (honours)*, 2007.
- G. Molenaar, J. van Velzen, C. Walraven, *Go viewer (2nd yr)*, 2007.
- H. Buisman, A. Ethembabaoglu, A. Schuth, *Gesture recognition (2nd yr)*, 2006.
- P. de Oude, *Space carving*, 2005.
- S. Kerkstra, S. Preeker, *Pull of the Unknown*, 2005.

9 Miscellaneous Scientific Activities

9.1 Invited talks

1. L. Dorst, S. De Keninck, *Geometric Dynamics: Classical Mechanics in PGA*, ICRA 23 workshop Geometric Representations, London, UK, June 2023.
2. L. Dorst, S. De Keninck, *Geometric Dynamics: Classical Mechanics in PGA*, GAME 2023, Kortrijk, Belgium, April 2023.
3. L. Dorst, S. De Keninck, *They Do It With Mirrors: Classical Mechanics in PGA*, ICACGA 22, workshop, Denver, CO, October 2022.
4. L. Dorst. *Teaching and Preaching Geometric Algebra*, AGACSE 2021, Brno, Czechia, September 2021.
5. L. Dorst. *PGA: Plane-Based Geometric Algebra: a Complete Framework for Euclidean Geometry*, CGI 2020 ENGAGE online workshop.
6. L. Dorst, semi-plenary talk: *GET REAL: How Geometric Algebra subsumes/extends/invigorates Linear Algebra*, GAME2020 workshop, Kortrijk.
7. L. Dorst, semi-plenary talk: *GET REAL: How Geometric Algebra subsumes/extends/invigorates Linear Algebra* plus 3-part course in Geometric Algebra: *One Algebra for All Geometry?* plus *Boolean Combination of Circular Arcs using Orthogonal Spheres*, at CMAC 2019, Uberlândia, Brasil, September 2019.
8. L. Dorst, 3-part course in geometric algebra, plus *Structure Preserving Representation of Euclidean Motions through Conformal Geometric Algebra*, Louvain-la-Neuve, October 2018.

9. L. Dorst, *Structure Preserving Representation of Euclidean Motions through Conformal Geometric Algebra* and *CGA in Practice 1: Least Squares Fitting of Spatial Circles* and *CGA in Practice 2: The Construction of 3D Conformal Motions*, 3 tutorials in: AGACSE 2018, Campinas, Brazil, August 2018.
10. L. Dorst, *AlphaGo's AI*, screening of AlphaGo documentary, Nederlandse Go Bond, December 16, 2017, EGC Amstelveen. Reported in MGoB bulletin 38 'Go op een hoger plan' by William Wandel.
11. L. Dorst, *AlphaGo: the Game Changer*, screening of AlphaGo documentary, Amsterdam Data Science, November 28, 2017, UvA Amsterdam.
12. L. Dorst, *The Match*, in: 'Go en Machinale Intelligentie', KNAW (Royal Dutch Academy of Sciences), October 11, 2016, Amsterdam.
13. L. Dorst, *Structure Preserving Representation of Euclidean Motions through Conformal Geometric Algebra* and *Quaternions, Rotors, Versors (1): Orthogonal Transformations as Vector Multiplication or Bivector Exponentials* and *(2): Rotors, Logarithms and Interpolation* and *Total Least Square Fitting of Hyperspheres and Hypercircles using Conformal Geometric Algebra*, 4 tutorials in: Summer School on Geometric Algebra, Santander, Spain, August 22-26, 2016.
14. L. Dorst, *Go-Professional's Evaluation of AlphaGo's Strengths and Weaknesses*, in: Let It Go, Amsterdam Data Science, March 10, 2016, Amsterdam.
15. L. Dorst, *3D Projective Transformations as Versors of $\mathbb{R}^{3,3}$* , AGACSE 2015, Barcelona, July 2015.
16. L. Dorst, *How Rounds Can be Fit by Squaring the Circle*, Workshop Geometric Computation for Computer Vision, at GCCV 2013, Guanajuato, Mexico, October 2013.
17. L. Dorst, *Motions from Point Data: Using the Multiple Reflection Representation*, DGCV2010, ESIEE, France, September 23, 2010.
18. *Geometric Algebra: Programming Oriented Objects*, TU Eindhoven, Eindhoven, October 9, 2007.
19. *Geometric Algebra: Programming Oriented Objects*, Philips Natlab, Eindhoven, October 3, 2007.
20. *Geometric Algebra: An Operational Model for Euclidean Geometry*, Journées Algèbres Géométriques et Applications, Marseille, France, November 2005
21. *Pad plannen en Lego*, Radio Interview for Hoe?Zo! radio, September 30, 2005. (see <http://www.science.uva.nl/~leo/lego/hoezo.html>).
22. Acceptance speech for '2005 Inventor of the Year' award, NYIPLA annual meeting, Yale Club, New York, May 25, 2005, with Karen Trovato.
23. *An Algebra for Euclidean Geometry* GTMG (Groupe de Travail en Modélisation Géométrique) workshop, Poitiers, France, March 2005.

24. *Estimating Rigid Body Motions of Point Clouds*, in: Geometric Properties from Incomplete Data, Dagstuhl, Germany, March 2004.
25. *An Algebraic Approach to Programming Geometry*, Philips NatLab, Eindhoven, February 2003. Also at CWI, Amsterdam, March 2003.
26. *Geometric Algebra*, contribution to course #53 at SIGGRAPH 2001, Los Angeles (with S. Mann).
27. *Geometric Algebra*, contribution to course #31 at SIGGRAPH 2000, New Orleans (with S. Mann).
28. *The systems theory of contact*, 2nd International Workshop Algebraic Frames for the Perception-Action Cycle, Kiel Germany, September 2000
29. Invited plenary speaker at the 5th International Conference on Clifford Algebras and their Applications, Ixtapa, Mexico, June 27 - July 4, 1999.
30. *Geometric (Clifford) algebra: a practical tool for efficient geometric representation*, at Mathematics Dept., U. of Amsterdam, March 1998, at Physics Dept., TUDelft, August 1998; at FEL/TNO May 1999.
31. *The shape of growing objects and propagating waves*, Nederlandse Vereniging voor Patroonherkennen en Beeldverwerking, (Dutch Society for Pattern Recognition and Image Processing), Shell, Amsterdam, November 29, 1996.
32. *Orientation-based representations for mathematical morphology*, International Workshop on Syntactic and Structural Pattern Recognition, Nahariya, Israel, October 1994.
33. *Orientation-based representations for mathematical morphology*, 4th Discrete Geometry for Computer Imagery, Grenoble, September 1994.
34. *Discretized Straight Lines: Parameters, Primitives and Properties*, Invited Talk American Mathematical Society, Hoboken, NJ, 10/1989.
35. *Representations and Algorithms for Finite Groups*, Presentation at workshop 'Category Theory in Artificial Intelligence and Robotics', Briarcliff, NY, 5/1989.
36. *Optimal Path Planning*, Electrical, Computer and Systems Engineering Seminar Series, Rensselaer Polytechnic Institute, Troy, NY, March 1988 (with K.Trovato).
37. *Interview for TELEAC (Dutch Television Academy) course on CAD/CAM*, produced by "Beeldenstorm", R. LeGué, January 22,26, 1985.
38. *Kwantitatieve evaluatie van interferogrammen*, Symposium on Technical Applications of Image Processing, Aula, TUDelft, April 16, 1984.
39. *The Estimation of Parameters of Digitized Straight Line Segments*, Nederlandse Vereniging voor Patroonherkennen en Beeldverwerking, (Dutch Society for Pattern Recognition and Image Processing), THDelft, October 6, 1982.

40. *De meetnauwkeurigheid van rechte grenzen op twee-dimensionale rasters*, Stichting Meet- en Besturingstechnologie, Werkgemeenschap Meten, (Dutch Foundation for Technology of Measurement and Control, Section Measurement), Utrecht, May 11, 1982.

9.2 Editorial boards, memberships

1. Editorial board of *Advances in Applied Clifford Algebras*, Birkhäuser, since vol.21, no.1, 2011.
2. Corresponding member of CAIROS (Clifford Algebra International Research Open Studies), founded by Pierre Anglès, Institut de Mathématiques E. Picard, of the University Paul Sabatier, Toulouse, France, since 2007.

9.3 Reviewer

Journal of Mathematical Imaging and Vision
Image and Vision Computing
National Science Foundation (USA)
IEEE Pattern Analysis and Machine Intelligence
Int. Journal Document Analysis and Recognition
Computer Vision, Graphics and Image Processing
IEEE Robotics and Automation
Robotics and Autonomous Systems
ACM Transactions on Graphics
Pattern Recognition
Pattern Recognition Letters
SIGGRAPH
Algorithmica
Advances in Applied Clifford Algebras Thin Solid Films

9.4 Project Leaderships

1. WP3 Research Workpackage leader H2020 project GRAVITATE, June 2015-May 2018.
2. DASIS (*Discovery of Articulated Structures in Image Sequences*), NWO project 612.065.517, 1 AIO+ 1 PD, 2007-2012.
3. *Geometric Algebra, a New Foundation for Geometric Programming*, NWO project 612.012.006, 1 SP (later 1 AIO)+ 1 PD, 2000-2006.
4. *Mathematical Foundations of Geometric Algebra*, UvA FNWI collaboration project IvI/KdV Institutes, 1 AIO, 2000-2003.

9.5 Conference Committees

Organizing AGACSE 2024, Amsterdam, Netherlands, August 2024.
Scientific Committee ICCA 2023, Holon, Israel, June 2023.
Scientific Committee ICACGA 2022, Denver, USA, October 2022.

Scientific Committee AGACSE 2021, Brno, Chechia, October 2021.
 Scientific Committee ICCA12, Heifei, China, August 2020.
 Scientific Committee, AGACSE 2018, Campinas, Brazil, July 2018.
 Scientific Committee ICCA11, Ghent, Belgium, August 2017.
 Programme Committee 3DOR: Eurographics Workshop on 3D Object Retrieval, October 2016.
 Scientific Committee, 33rd Annual Conference on Computer Graphics International (CGI 2016),
 GACSE workshop, Heraklion, Greece, July 2016.
 Scientific Committee, AGACSE 2015, Barcelona, Spain, July 2015.
 Subreviewer DGCI 2014, Sienca, September 2014.
 Adivsory Committee ICCA-2014, Tartu, Lithuania, August 2014.
 Programme Committee Workshop Geometric Computation for Computer Vision, at GCCV 2013,
 Guanajuato, Mexico, October 2013.
 Programme Committee ASCI.OPEN, November 2013.
 Subreviewer Computational Kinematics CK2013, Barcelona, May 2013.
 Programme Committee AGACSE 2012 (Applications of Geometric Algebras in Computer Science
 and Engineering), La Rochelle, July 2012.
 Organization AGACSE 2010 (Applications of Geometric Algebras in Computer Science and Engi-
 neering), Amsterdam, June 2010 (with Joan Lasenby).
 International Advisory Board AGACSE 2008 (Applications of Geometric Algebras in Computer
 Science and Engineering), Leipzig, August 2008.
 Progamme Committee Robot Vision 2008, Auckland, New Zealand, February 2008.
 Steering Committee *IMA conference on Geometric Algebra* Trinity College, Cambridge UK, Septem-
 ber 5-6, 2002.
 With C.Doran and J.Lasenby: Co-organizer *Applications of Geometrical Algebras in Computer
 Science and Engineering*, Cambridge, UK, July 9-13, 2001.
 Program Committee *Second International Workshop on Algebraic Frames for the Perception Ac-
 tion Cycle*, Kiel, Germany, 2000.
 Scientific Committee *3rd Intern. Workshop on Visual Form*, Capri, 1997.
 Progam Committee *6th Discrete Geometry for Computer Imagery*, Strassbourg, 1996.
 Co-organiser of workshop *Reasoning with uncertainty in robotics*, Amsterdam, 1995.
 Program committee, *5th Conference on Discrete Geometry for Computer Imagery*, Clermont-
 Ferrand, 1995.
 Chair and technical committee, *2nd Intern. Workshop on Visual Form*, Capri, Italy 1994.
 Chair, Intelligent Autonomous Systems 2, Amsterdam 1989.
 Editor Special Issue on Path Planning for: Robotics and Autonomous Systems, Elsevier North-
 Holland Publications, 1990.

10 Universiteitsmanagementtaken

Lid toelatingscommissie bachelor Kunstmatige Intelligentie, 2020-**heden**.
 Voorbereiding zelfstudie accreditatie Bachelor AI 2019.
 Vice-voorzitter facultaire commissie toetsbeleid, 2018-2022.
 Vice-voorzitter examencommissie Kunstmatige Intelligentie, 2016-2022.
 Voorbereiding zelfstudie accreditatie Bachelor AI 2013.
 Voorbereiding en medeverantwoordelijk zelfstudie accreditatie AI 2007.

Honoursprogrammacoördinator Ba AI 2007-2009.
Voorzitter examencommissie Kunstmatige Intelligentie, 2002-2016.
Lid docententeam Bachelor AI, 2002-**heden**.
Onderwijscommissie AI, lid 1995-2001, en voorzitter 1996-2001.
Vorbereiding en medeverantwoordelijk zelfstudie onderwijsvisitatie AI 2002.
Commissie wiskundeonderwijs in de informaticas, lid vanaf 1997.
Afstudeercoördinator specialisatie Autonome Systemen AI, vanaf 1997.
Vorbereiding zelfstudie onderwijsvisitatie AI 1997.
Editor IAS jaarverslagen voor faculteit en ASCI, 1995-2014.
Lid faculteitsraad 1992-1993.