

# Manos Kamarianakis

COMPUTATIONAL GEOMETRY · ALGORITHM DESIGN · GEOMETRIC ALGEBRA · COMPUTER GRAPHICS · HCI

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*"A single idea, if it is right, saves us the labor of an infinity of experiences." - Jacques Maritain*

## Summary

Manos is a mathematician researcher that specializes in Computational Geometry and its applications for Computer Graphics. He got his PhD in applied mathematics from University of Crete (UoC), where he studied the Voronoi Diagrams of 3D spheres. He holds a M.Sc. (Honors) in mathematics, as well as 2 bachelor degrees, both in pure and applied mathematics.

Since July 2019, he is a member of Foundation for Research and Technology Hellas - Institute of Computer Science (FORTH-ICS) spinoff startup ORamaVR. As a research director, he oversees the design of innovative, geometric-based algorithms, suitable for Augmented, Virtual and Mixed Reality. He is the deputy PI of several EU Projects regarding advanced medical HCI applications in 5G edge cloud computing environments. His paper, "Never 'Drop the ball'", received the Best Paper & Presentation Award from the CGI2021 Conference (ENGAGE Workshop).

Manos is currently a visiting researcher of FORTH-ICS and specifically the Human-Computer Interaction Lab. From September 2022, he is an adjunct professor at Computer Science Department at UoC. Furthermore, from July 2019 until July 2022, he was a post-doctoral researcher in the Department of Mathematics, UoC, working on logic & diophantine problems.

## Professional Experience

### Visiting Researcher

FORTH - INSTITUTE OF COMPUTER SCIENCE

- Lab Director: Constantine Stefanidis
- Supervisor: George Papagiannakis
- Human-Computer Interaction Lab

Oct. 2021 - Today

Heraklion, Greece

### Post-Doctoral Researcher and R&D Director

ORAMA VR COMPANY

- Team Leader: Prof. George Papagiannakis
- Applications of Clifford Algebra and Conformal Geometric Algebra (CGA) in Computer Graphics
- Animation, deformation, cutting and tearing skinned models via CGA
- Computer graphics systems for human computer interaction in mixed reality
- Participation in proposals & papers write-up

July 2019 - Today

Heraklion, Greece

### Adjunct Professor

UNIVERSITY OF CRETE

- Teaching Computer Graphics - Graduate & Undergraduate level
- Supervision/Co-supervision of undergraduate, graduate and PhD thesis

Sept. 2022 - Today

Heraklion, Greece

### Post-Doctoral Researcher

UNIVERSITY OF CRETE

- Team Leader: Prof. Athanasios Pheidas
- Diophantine Problems in Logic and Number Theory (ESPA Project)
- Research regarding abc-conjecture and related problems
- Decidability and Undecidability over certain languages and rings

July 2019 - July 2022

Heraklion, Greece

### Researcher

UNIVERSITY OF ATHENS

- Team Leader: Prof. Ioannis Emiris
- Thales Project: Advanced Geometric Computing and Critical Applications (ESPA Project)
- Study of Apollonius diagrams of 3D spheres.
- Predicate design for Voronoi diagrams.

Feb. 2016 - Sept. 2016

Athens, Greece

# Education

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## University of Crete, Department of Mathematics & Applied Mathematics

PH.D. IN APPLIED MATHEMATICS

- Thesis: «Predicates for the 3D Apollonius Diagram», Supervisor: Menelaos Karavelas

January 2019

Heraklion, Greece

## University of Crete, Department of Applied Mathematics

B.S. IN APPLIED MATHEMATICS

- Specialization: Mathematical Methods and Software Development
- Honors, 8.78

September 2014

Heraklion, Greece

## University of Crete, Department of Mathematics & Department of Applied Mathematics

M.S. IN MATHEMATICS

- Interdepartmental Program: «Foundations of Computer Science»
- Honors
- Thesis: «Predicates for Euclidean Voronoi diagram of axis-aligned and ortho-45 line segments», Supervisor: Menelaos Karavelas

July 2011

Heraklion, Greece

## University of Crete, Department of Mathematics

B.S. IN PURE MATHEMATICS

- Honors, 8.51
- Thesis: «Deterministic Primality Testing: The theorem of Agrawal, Kayal and Saxena», Supervisor: Yannis Antoniadis

September 2008

Heraklion, Greece

# Teaching Experience

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I was a teaching assistant in the Department of Mathematics, University of Crete from 2005 to 2014. After 2014, I have been a private tutor for students of the same department.

Among the courses I have taught, both as a teaching assistant and a private tutor, are: Algebra, Number Theory, Logic, Probabilities, Analysis and Design of Algorithms, Discrete Mathematics, Numerical Analysis, Numerical Solution of ODEs, Cryptology, Linear Algebra, Analytic Geometry, Group Theory, Galois Theory, Analysis and Foundation of Mathematics. I have also helped students with programming in various languages/frameworks such as Python, C/C++, Maple, Matlab, Latex/Xetex/Bibtex and Ipe (graphics editor). Finally, I trained students for GRE-general and GRE-mathematics tests.

## University of Crete, Department of Computer Science

UNDERGRADUATE

- CS-358: Computer Graphics

Winter 2023(CoTeaching), Winter 2022, Winter 2021 (CoTeaching)

Heraklion, Greece

## University of Crete, Department of Computer Science

GRADUATE

- CS-553: Interactive Computer Graphics

Spring 2024 (CoTeaching), Spring 2023, Spring 2022 (CoTeaching)

Heraklion, Greece

## Thesis Co-Supervision

BSC THESIS

- Lefteris Toupis - Rendering interface implementation using WebGPU in Elements framework
- Constantinos Georgiou - Implementation of node editor and gizmos for entities inside the Elements framework
- Tasos Akoumianakis - The differences between Godot and Unity's environments during the process of development
- Manos Platakis - Physio-Fitness in AR: A New Dimension for Health Improvement
- Elias Vlachos - GPU-enabled Algorithms on the Entity-Component-System (ECS) Model for Textured 3D Object Animation
- Paul Ziotas - Transformation visual controllers for interactive scene manipulation in virtual reality
- Nick Hliakis - Modeling the Spatiotemporal Spread of COVID-19 in Closed Transportation Environments in a Virtual Reality Setting
- John Petropoulos - An integrated algorithm for geometric cut, tear and drill of skinned meshes in VR
- Manos Karidis - Automatic Lipsync/Expressions based on skeleton

MSC THESIS

- George Kokiadis - ImmerseDataXR: Advancing Data Comprehension with Immersive Visualizations
- John Petropoulos - pyGANDALF: a Geometric, Animation, Neural, Directed, Algorithmic, Learning Framework for computer graphics
- Michael Tamiolakis - High-realism Real-Time Cutting, Tearing & Drilling of 3D Deformable Models in XR environments

PHD THESIS

- George Kokiadis - Improving the performance of games through the Dissection of a game engine using 5G infrastructure
- Stratos Geronikolakis - An intelligent XR transition framework, allowing automatic interoperability and adaptability of the same computer graphics application across the different realities of the XR spectrum
- Nick Lydatakis - A novel Application Partitioning Framework for High-Fidelity Edge-Cloud Collaboration in Extended Reality with Soft Mesh Deformations

## Book Chapters

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- B1. **Kamarianakis, M.**, Papagiannakis, G. “Deform, Cut and Tear a skinned model using Conformal Geometric Algebra”, presented also in CGI 2020 conference (ENGAGE workshop), Springer LNCS proceedings, 2020
- B2. **Kamarianakis, M.**, Lydatakis, N., Papagiannakis, G. “Never ‘Drop the Ball’ in the Operating Room: An efficient hand-based VR HMD controller interpolation algorithm, for collaborative, networked virtual environments”, presented also in CGI 2021 conference (ENGAGE workshop), Springer LNCS proceedings, 2021 (**Best Paper Award**)

## Conference Papers

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- C1. **Kamarianakis, M.**, & Karavelas, M. I. “Analysis of the Incircle predicate for the Euclidean Voronoi diagram of axes-aligned line segments”. In W. Didimo & G. Liotta (Eds.), Proceedings of the 28th European Workshop on Computational Geometry (EuroCG 2012) (pp. 117–120). March 2012.
- C2. **Kamarianakis, M.**. The EdgeConflict “Predicate in the 3D Apollonius Diagram”. In Proceedings of the 6th International Conference on Analytic Number Theory and Spatial Tessellations. September 2018.
- C3. Papagiannakis, G., Zikas, P., Lydatakis, N., Kateros, S., Kentros, M., Geronikolakis, E., **Kamarianakis, M.**, Kartsonaki, I., Evangelou, G. “MAGES 3.0: Tying the knot of medical VR”. ACM SIGGRAPH 2020 Immersive Pavilion, Article 6, 1–2. August 2020.
- C4. **Kamarianakis, M.**, Papagiannakis, G. “Deform, Cut and Tear a skinned model using Conformal Geometric Algebra”. CGI20. October 2021.
- C5. Zikas, P., **Kamarianakis, M.**, Kartsonaki, I., Lydatakis, N., Kateros, S., Kentros, M., Geronikolakis, E., Evangelou, G., Apostolou, A., Catilo, P. A. A., Papagiannakis, G. “Covid-19 - VR Strikes Back: Innovative medical VR training”. ACM SIGGRAPH 2021 Immersive Pavilion. August 2021.
- C6. **Kamarianakis, M.**, Lydatakis, N., Papagiannakis, G. “Never “Drop the Ball” in the Operating Room: An efficient hand-based VR HMD controller interpolation algorithm, for collaborative, networked virtual environments”. CGI21 ENGAGE Workshop - Best Paper Award. September 2021.
- C7. Chompitaki, D., **Kamarianakis, M.**, Pheidas, T. “Decidability of the theory of addition and the Frobenius map in fields of rational functions”. Panhellenic Logic Symposium. August 2021.
- C8. Makris A., Boudi A., Coppola M., Cordeiro L., Corsini M., Dazzi P., Andilla F.D., Rozas Y.G., **Kamarianakis M.**, Pateraki M., Pham T.L., Protopsaltis A., Raman A., Romussi A., Rosa L., Spatafora E., Taleb T., Theodoropoulos T., Tserpes K., Zschau E., Herzog U. “Cloud for Holography and Augmented Reality”. 2021 IEEE 10th International Conference on Cloud Networking. Nov. 2021
- C9. **Kamarianakis M.** , Chrysovergis I., Kentros M., Papagiannakis G. “Recording and replaying psychomotor user actions in VR”. Siggraph ’22 Poster Session, August 2022.
- C10. **Kamarianakis, M.**, Protopsaltis, A., Papagiannakis, G. . AR-Assisted Surgical Care via 5G networks for First Aid Responders. arXiv, Presented in the IEEE International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD). August 2022.
- C11. **Kamarianakis, M.**, Protopsaltis, A., Angelis, D., Tamiolakis, M., Papagiannakis, G. (2022). “Progressive tearing and cutting of soft-bodies in high-performance virtual reality”. In ICAT-EGVE 2022—International conference on artificial reality and telexistence and eurographics symposium on virtual environments. The Eurographics Association. Dec 2022.
- C12. Papagiannakis, G., **Kamarianakis, M.**, Protopsaltis, A., Angelis, D., Zikas, P. “Project elements: A computational entity-component-system in a scene-graph pythonic framework, for a neural, geometric computer graphics curriculum”. In Eurographics 2023—Education papers. The Eurographics Association. May 2023.
- C13. Hitzer E., **Kamarianakis M.**, Papagiannakis G., Vasik P. “Survey of New Applications of Geometric Algebra”. In Mathematical Methods in the Applied Sciences, 1–17. 2023.
- C14. Filippidis, A., Marmaras, N., Maravgakis, M., Plexousaki, A., **Kamarianakis, M.**, Papagiannakis, G. “VR Isle Academy: A VR Digital Twin Approach for Robotic Surgical Skill Development”. CGI 2024 (To appear). Feb 2024.
- C15. **Kamarianakis, M.**, Lydatakis N., Papagiannakis, G. “GA-Unity: A Production-Ready Unity Package for Seamless Integration of Geometric Algebra in Networked Collaborative Applications”. CGI 2024 (To appear). Feb 2024.

## Journal Papers

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- J1. **Kamarianakis, M.**, Papagiannakis, G. “An All-in-One Geometric Algorithm for Cutting, Tearing, and Drilling Deformable Models”. Advances in Applied Clifford Algebras, 31(3), 58. May 2021.
- J2. Chompitaki, D., **Kamarianakis, M.**, Pheidas, T. “Notes on the decidability of Addition and the Frobenius map for polynomials and rational functions”. Reports on Mathematical Logic, Issue 57. March 2022.
- J3. Papagiannakis, G., **Kamarianakis, M.**, Sauter, T. C., Chalmers, A., Lasenby, J., Di Lernia, D., Greenleaf, W. “Editorial: New Virtual Reality and Spatial Computing Applications to Empower, Upskill and Reskill Medical Professionals in a Post-Pandemic Era”. Frontiers in Virtual Reality, Vol 3, March 2022.
- J4. Zikas P., Kateros S., Lydatakis N., Kentros M., Geronikolakis E., **Kamarianakis M.**, Evangelou G., Kartsonaki I., Apostolou A., Birrenbach T., Exadaktylos A. K., Sauter T. C., Papagiannakis G. “Virtual reality medical training for Covid-19 swab testing and proper handling of personal protective equipment: development and usability”. Frontiers in Virtual Reality, Vol. 2, Feb 2022.

- J5. Theodoropoulos T., Makris A., Boudi A., Taleb T., Herzog U., Rosa L., Cordeiro L., Tserpes K., Spatafora E., Romussi A., Zschau E., **Kamarianakis M.**, Protopsaltis A., Papagiannakis G., Dazzi P. “Cloud-based XR Services: A Survey on Relevant Challenges and Enabling Technologies”. Journal of Networking and Network Applications, Vol. 2, Issue 1, Feb 2022.
- J6. **Kamarianakis, M.**, Chrysovergis I., Lydatakis, N., Kentros M., Papagiannakis, G. “Less Is More: Efficient Networked VR Transformation Handling Using Geometric Algebra”. Advances in Applied Clifford Algebras, vol 33 (1), 6. 2022.
- J7. Zikas, P., Protopsaltis, A., Lydatakis, N., Kentros, M., Geronikolakis, S., Kateros, S., **Kamarianakis, M.**, Evangelou, G., Filippidis, A., Grigoriou, E., Angelis, D., Tamiolakis, M., Dodis, M., Kokiadis, G., Petropoulos, J., Pateraki, M., Papagiannakis, G. “MAGES 4.0: Accelerating the World’s Transition to VR Training and Democratizing the Authoring of the Medical Metaverse”. IEEE Computer Graphics and Applications, 43(2), 43–56. March 2023.
- J8. Apostolakis, K., Valera-Muros, B., di Pietro, N., Garrido, P., del Teso, D., **Kamarianakis, M.**, R. Tomas, P., Khalili, H., Panizo, L., Díaz Zayas, A., Protopsaltis, A., Margetis, G., Mangues-Bafalluy, J., Requena-Esteso, M., S. Gomes, A., Cordeiro, L., Papagiannakis, G., Stephanidis, C. “A Network Application approach towards 5G and beyond critical communications use cases”. Frontiers in Communications and Networks. February 2024.

## Works in Progress

- P1. Kolyvakis P., Angelis D., **Kamarianakis, M.**, Papagiannakis, G. “Geometric Algebra Meets Large Language Models: Instruction-Based Transformations of Separate Meshes in 3D, Interactive and Controllable Scenes”. Submitted to Siggraph Asia ’24 Technical Paper Session. May 2024.
- P2. Papagiannakis G., Greenleaf W., Cole M., Zhang M., Datta R., Delahaye M., Grigoriou E., **Kamarianakis, M.**, Protopsaltis A., Bijlenga P., Magnetat Thalmann N., Tsiridis E., Kenanidis E., Vamvakidis K., Koutelidakis I., Kannape O. “A Computational Medical XR Discipline”. Submitted to CGI 2024. May 2024.

## Papers Without Peer Review

- W1. Chompitaki, D., **Kamarianakis, M.**, Pheidas, T. “Decidability of the theory of addition and the Frobenius map in rings of rational functions”. ArXiv:2107.11266 [Math]. July 2021.
- W2. **Kamarianakis, M.**, Lydatakis, N., Protopsaltis, A., Petropoulos, J., Tamiolakis, M., Zikas, P., Papagiannakis, G.. ““Deep Cut”: An all-in-one Geometric Algorithm for Unconstrained Cut, Tear and Drill of Soft-bodies in Mobile VR”. arXiv:2108.05281 [Graphics] May 2022.
- W3. Chrysovergis I., **Kamarianakis M.**, Kentros M., Angelis D., Protopsaltis A., Papagiannakis G. “Assessing unconstrained surgical cuttings in VR using CNNs”. arXiv:2205.00934 [Computer Vision] April 2022.
- W4. **Kamarianakis M.**, Chrysovergis I., Papagiannakis G. “Realistic soft-body tearing under 10ms in VR”. arXiv:2205.00914 [Graphics] April 2022.
- W5. Zikas P, Kentros M, Angelis D, Protopsaltis A., **Kamarianakis M.**, Papagiannakis G. “UniSG: Unifying entity-component-systems, 3D & learning scenegraphs with GNNs for generative AI”. Authorea Preprints. May 2023.
- W6. **Kamarianakis, M.**, Protopsaltis, A., Angelis, D., Zikas, P., Kentros, M., Papagiannakis, G. “UniSG $\wedge$ GA: A 3D scenegraph powered by Geometric Algebra unifying geometry, behavior and GNNs towards generative AI”. arXiv. June 2023.
- W7. **Kamarianakis, M.**, Kokiadis G. M., Falalakis N., Bazopoulou D., Papagiannakis G. “ImmerseDataXR: Immersive Data Visualization in XR with Advanced Outlier Detection for Biology Analytics”. February 2024.
- W8. Protopsaltis, A., Kokiadis, G., Pateraki, M., **Kamarianakis, M.**, Morfiadakis, M., Papagiannakis, G. “Dissection of XR Physics Engine into a Cloud-native Service”. February 2024.
- W9. Kentros, M., Filippidis, A., Petropoulos, J., Cole, M., Popov, V., **Kamarianakis, M.**, Papagiannakis, G. “iREACT: Pure Collaborative Non-linear VR simulation for Cardiac Arrest Resuscitation training”. March 2024.
- W10. Kentros, M., Filippidis, A., Petropoulos, J., Cole, M., Popov, V., **Kamarianakis, M.**, Harmer B., Papagiannakis, G. “Enhancing Crew Resource Management in VR Medical Training: Tools for analyzing advanced, collaborative group training in the metaverse”. March 2024.

## Honors & Awards

### SCHOLARSHIPS

2011	<b>Scholarship</b> , to obtain a Ph.D., 4 years duration	<i>Onassis Foundation</i>
2011	<b>Scholarship</b> , to obtain a Ph.D., declined due to Onassis Scholarship mutual exclusiveness	<i>ELKE</i>
2009	<b>Scholarship «Maria Manasaki»</b> , for performance excellency in graduate studies	<i>University of Crete</i>
2004	<b>State Scholarship</b> , for performance excellency in undergraduate studies	<i>IKY</i>
2004	<b>State Scholarship</b> , for performance excellency in undergraduate studies	<i>IKY</i>

## European Projects

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### FIDAL

1/1/2023-31/12/2025

DEPUTY PRINCIPAL INVESTIGATOR

- HorizonEurope HORIZON-JU-SNS-2022-STREAM-D-01-01 101096146
- EU/SERI Contribution: 414,7500.00 EUR

### CHARITY

1/1/2021-31/12/2024

DEPUTY PRINCIPAL INVESTIGATOR

- Horizon2020 ICT-40-2020-RIA 101016509
- EU Contribution: 350,000.00 EUR

### 5G-EPICENTRE

1/1/2021-31/12/2024

DEPUTY PRINCIPAL INVESTIGATOR

- Horizon2020 ICT-41-2020-IA 101016521
- EU Contribution: 308,437.50 EUR

### OMEN-E

01/05/2023-30/04/2025

PARTICIPATION IN PROPOSAL WRITE-UP

- Innosuisse Swiss Accelerator, PFSA-22-240
- Innosuisse Contribution: 2,304,260 CHF

## Reviewing Services

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- RS1. Frontiers Topic (Special Issue): “New Virtual Reality and Spatial Computing Applications to Empower, Upskill and Reskill Medical Professionals in a Post-Pandemic Era”, Co-Editor
- RS2. ERCIM (Issue 137) Special Theme: “Extended Reality”, Guest Editor
- RS3. CGI ENGAGE Workshop, Organizing Committee
- RS4. CGI, Reviewer
- RS5. International Journal of Digital Earth, Reviewer
- RS6. Frontiers, Reviewer
- RS7. Mathematical Methods in the Applied Sciences, Reviewer
- RS8. Advances in Applied Clifford Algebras, Reviewer
- RS9. Nature Scientific Reports, Reviewer

## Extracurricular Information

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### Computer Skills

ALL OS (WINDOWS,MACOS, UNIX/LINUX), PYTHON, JUPYTER ,C/C++, GPU PROGRAMMING, OPENGL, MAPLE, MATLAB, LATEX/LUALATEX/BIBTEX, IPE, GIT, SVN, OFFICE

### Languages

GREEK: NATIVE, ENGLISH: FLUENT, FRENCH: FAIR

### Military Obligations Fulfilled

May 2017 - Feb. 2018

### President of Heraklion Bridge Club

June 2016 - Dec 2022

### Local Ambassador - Promoter of Bridge in Crete

May 2021 - Present

### Eleana's Husband, Valeria's Father