# 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 Kamarianakis was born in Chania, Crete, Greece, on 22 March 1986. He 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 Apollonius Diagram of 3D spheres. He holds a M.Sc. (Honors) in mathematics with specialization in applied mathematics, mainly concerning the design and analysis of algorithms for problems involving mathematics. He also holds 2 bachelor degrees, both in pure (Honors) and applied mathematics (Honors).

Since July 2019, he is a member of Foundation for Research and Technology Hellas - Institute of Computer Science (FORTH-ICS) spinoff startup ORamaVR. His role in ORamaVR as the R&D director involves the design of innovative, geometric-based algorithms, suitable for Augmented, Virtual and Mixed Reality. He leads the research behind the Cut/Tear/Drill (CTD) module, which consists a major step towards revolutionizing VR medical training, and he is actively involved in the incorporation of generative/predictive AI techniques with Computer Graphics. As the deputy ORamaVR coordinator in the 5G-Epicentre and CHARITY Horizon2020 EU projects, he is working in advanced medical HCI applications in 5G edge cloud computing environments. His vision in the Human-Computer Interaction field is to utilize the effectiveness of GPU programming and the benefits of various mathematical tools, such as Clifford (and higher-dimension) algebras and/or machine learning, as building blocks for optimized algorithms that will effectively tackle problems in computer graphics, robotics or adjacent research fields. He has published multiple articles on these topics and recently, 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 until July 2023, he was an adjunct professor at Computer Science Department at UoC, whereas, from July 2019 until July 2022, he was a post-doctoral researcher in the Department of Mathematics & Applied Mathematics, UoC.

## Professional Experience

### Visiting Researcher

*Oct. 2021 - Today*

FORTH - Institute of Computer Science

*Heraklion, Greece*

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

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

*July 2019 - Today*

ORamaVR Company

*Heraklion, Greece*

- 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

### Adjunct Professor

*Sept. 2022 - July 2023*

University of Crete

*Heraklion, Greece*

- Teaching Computer Graphics - Graduate & Undergraduate level
- Supervision of 3 undergraduate thesis, 1 graduate thesis - Ongoing
- Co-supervision of 2 undergraduate thesis, 1 PhD thesis- Ongoing

### Post-Doctoral Researcher

*July 2019 - July 2022*

University of Crete

*Heraklion, Greece*

- 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

### Researcher

*Feb. 2016 - Sept. 2016*

University of Athens

*Athens, Greece*

- 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.

## Book Chapters

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

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 Symbosium. 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". Authorea Preprints (Accepted in Mathematical Methods in the Applied Sciences). February, 2023.

## Journal Papers

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., Papapagiannakis 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.

## Papers Under Review

R1. 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.

R2. **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.

R3. 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] (Submitted to the Siggraph '22 Poster Session) April 2022.

R4. **Kamarianakis M.** , Chrysovergis I., Papagiannakis G. "Realistic soft-body tearing under 10ms in VR". arXiv:2205.00914 [Graphics] (Submitted to the Siggraph '22 Poster Session) April 2022.

R5. 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.

R6. **Kamarianakis, M.**, Protopsaltis, A., Angelis, D., Zikas, P., Kentros, M., Papagiannakis, G. "UniSGĜA: A 3D scenegraph powered by Geometric Algebra unifying geometry, behavior and GNNs towards generative AI". arXiv. June 2023.

## Honors & Awards

### Scholarships

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

## Education

**University of Crete, Department of Mathematics & Applied Mathematics** — *January 2019*

Ph.D. in Applied Mathematics — *Heraklion, Greece*

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

**University of Crete, Department of Applied Mathematics** — *September 2014*

B.S. in Applied Mathematics — *Heraklion, Greece*

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

**University of Crete, Department of Mathematics & Department of Applied Mathematics** — *July 2011*

M.S. in Mathematics — *Heraklion, Greece*

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

**University of Crete, Department of Mathematics** — *September 2008*

B.S. in Pure Mathematics — *Heraklion, Greece*

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

## Teaching Experience

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.

From September 2022 until July 2023, as an Adjunct Professor at Computer Science Departhment, I taught Computer Graphics for graduate and undergraduate students. I also supervised or co-supervised 7 undergraduate, 1 graduate and 1 PhD thesis.

## Extracurricular Information

### Computer Skills

All OS (Windows,MacOS, Unix/Linux), Python, Jupyter ,C/C++, GPU programming, OpenGL, Maple, Matlab, Latex/XeLatex/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*