

UNIVERSITY OF MARYLAND

COLLEGE PARK, MARYLAND

20742

DEPARTMENT OF COMPUTER SCIENCE

Telephone (301) 405-1755

January 9, 2022

Professor Paolo Atzeni
Universita Roma Tre
Dipartimento di Ingegneria
Sezione di Informatica e Automazione
Via della Vasca Navale 79
00146 Roma
ITALY

Dear Paolo,

I am writing in response to your request for a letter supporting granting Prof. Alberto Paoluzzi the title of Emeritus Professor at your University. This is an easy case to make once you look at his CV which contains 120 publications. This is an impressive number. In this letter I describe in greater detail a number of his publications by pointing out the problem being addressed as well as existing solutions when known and his solution with a focus on its novelty. This should provide you insight into the significance of his research which lies in solid modeling.

1. CAD'89, Boolean algebra over Linear Polyhedra (Minerva design)

The CAD'89 paper describes the invention of a novel data structure (winged-triangle) for modeling the geometry and topology of triangulated surfaces. It is extendable to higher dimensions (Simplicial d-complexes), and to be used for both a boundary representation and cellular decomposition of solids. This representation yields the simplest Boolean algorithms (based on union and complementation) in the literature, and provided a more efficient data structure for linear approximation of curved solids.

This paper forms the basis of the development of the first fully fledged solid modeler (called Minerva), including rendering, integration of polynomials, primitive and scripted surfaces) on PC class machines, at a time when solid modelers were only developed on Lisp machines. Thus this paper forms a critical step forward in stimulating the growth of the solid modeling research and realization aspects.

2. ACM ToG'94 (PLaSM design)

This paper provides a geometric extension of the Backus FL language for doing algebraic calculus with 2D and 3D shapes. The PLaSM language blends the powerful algebraic approach to programming developed at IBM Research, with a dimension-independent approach to geometric data structures and algorithms, the HPC (Hierarchical Polyhedral Complex) representation, linking assemblies and single models, and introducing explicit multi-dimensionality (same expression evaluable within 2D, 3D, and 4D geometric code). This paper shows that such geometric code can be surprisingly compact and easy to write. A project based on it got the first IBM SUR Award

granted in Italy.

A full implementation of the FL language extension has been incorporated in several programming languages (Common Lisp, Scheme, C++, Python) and is still in use in the pyplasm Python library, and extensively used (hundreds of scriptlets) within Paoluzzi's *Geometric Programming for Computer-Aided Design* book.

3. ACM TSAS'20 (Arrangements and Solid algebras)

This paper deals with the computation of 3D space arrangements generated by any kind of 2D geometry. It corresponds to the first use of chain complexes and constructive algorithm of (co)boundary matrices) in computational geometry. Its novelty lies in discovering that columns of matrix representations of the boundary operator are in a one-to-one correspondence with atoms of a finite CSG algebra of a space decomposition generated by any finite number of geometric primitives. Recently this approach has provided a direct linkage among Boolean algebra, arrangements, and chain complexes, producing a novel paradigm, programmable on GPUs, in solid modeling. This is nice work and I am proud to say that it was published in ACM TSAS for which I served as the Founding Editor-in-Chief.

Besides the above work, Prof. Paoluzzi is the author of what I and many others consider the major book in the solid modeling area titled *Geometric Programming for Computer-Aided Design* and published by Wiley. This book is a landmark achievement and demonstrates the impact of his work. It reflects his meticulous attention to details.

Another major contribution of Prof. Paoluzzi is the training of future researchers of which he had trained many. Most notable are Fausto Bernardini and Valerio Pascucci. The research accomplishments of Prof. Paoluzzi have been recognized by his peers in the Solid Modeling Association (SMA) who have granted him the status of an SMA Pioneer. This is a prestigious award not given often especially not in recent years.

It is clear that Prof. Paoluzzi has had an outstanding research career over a long and continuous stretch of time. I consider him to be one of the best researchers in the solid modeling area. He is well deserving of the Emeritus ranking, and has my highest recommendation for it. Should he be a candidate for this ranking at the University of Maryland, then he would get it for sure. All the best and I hope you find these comments useful in your deliberations.



Hanan Samet
Distinguished University Professor