

# Alessandro De Gloria, a Pioneer in Electronic Engineering Applications

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**Abstract.** This article aims to sketch the figure of Alessandro De Gloria, a professor who dedicated his entire life, with generosity and enthusiasm, to engineering and scientific research. He designed one of the first chips in an Italian university and then a set of digital system architectures that contributed to shaping the then-fledgling field of microprocessors. Also, by founding the Applepies conference (International Conference on Applications in Electronics Pervading Industry, Environment and Society), he promoted the intuition of the value for the whole population of the applications of electronic systems. He pioneered the field of mobile apps and started a fruitful dialogue with the humanistic culture, particularly exploiting virtual reality technologies. In the last few years, he also contributed to machine learning and big data, particularly in the domain of automated driving. He founded an MSc program on strategy, intending to shape education in that field from a rigorous engineering point of view. We believe that his generous and enthusiastic academic life can be an outstanding example in the face of today's challenges of Electronic Engineering and higher education in the broader societal context.

**Keywords:** Electronic engineering, higher education, electronic system applications, embedded systems, cultural heritage, virtual reality, machine learning.

## 1 Introduction

The 2023 edition of the International Conference on Applications in Electronics Pervading Industry, Environment and Society (Applepies) is the first without Alessandro De Gloria. He founded the conference in 2013 (Rome) and chaired all the editions until 2017. Then he served as emeritus chair - not honorary role, in his interpretation -. His last public presence was at Applepies 2022, in Villa Cambiaso, the seat of the Aula magna of the Polytechnic School of the University of Genova, for the commemoration of his teacher, Alessandro Chiabrera. Heavily hit by a long-lasting illness, he had carefully organized that event, besides overviewing the whole

organization, from the keynote speeches to the industry-academy dialogue panels. He would have then continued his academic life, even from remote, and died on March 20th, 2023, aged 68, surrounded by family affection. Given Alessandro's outstanding figure in the academic landscape, the authors – professors who collaborated with him at the University of Genova - thought it would be appropriate to recall him to pass on his memory to new generations and to those who did not know him personally.



**Fig. 1.** Prof. Alessandro De Gloria

Alessandro De Gloria was a Full Professor of Electronic Engineering at the Electrical, Electronics and Telecommunication Engineering and Naval Architecture Department (DITEN) of the University of Genova, where he was teaching at the Electronic Engineering MSc, Engineering Technology for Strategy MSc., Computer Science MSc. and Art History MA.

He was passionate about Electronic Engineering, particularly digital system design. He was very attentive to the applications of electronics, as the impactful, “visible” end of an extremely powerful technology that had rapidly become pervasive, but also “hidden”, in the world. To promote the study of electronic engineering applications and the research dialogue with the industries, he founded the Applepies conference and served as responsible for the “Electronic Systems and Applications” scientific area within the Società Italiana di Elettronica (SIE), for which he also seated as national councilor. This was an insightful intuition, as, in the current shortage of Engineering students, we have realized the value of the applications as a privileged way to illustrate the fascination and potential of Electronic Engineering to young people.

Alessandro was a person with a remarkable breadth of vision and strongly believed in the dialogue among people and disciplines. He was long-sighted, full of ideas and gifted in planning, but wanted to share his ideas and plans with a wide community. As mentioned, he served in the SIE, was president of the Electronic Engineering degree course, and founded the Serious Games Society. He strongly believed in the importance of the mentality of the Electronic Engineering (able to manage and design hardware and software systems in an integrated and harmonized view) in the current pervasiveness of information and communication technologies (ICT).

This article aims to sketch the figure of a professor who dedicated his entire life, with generosity and enthusiasm, to University, Electronic Engineering and the broader development of project ideas and knowledge at local, national and international levels. Having he preferred to be coherent with his intuitions rather than following easy success, his academic life was challenging and met not infrequent disappointments. The authors argue that recalling him and learning from his experience can benefit the academic and R&D community in Electronic Engineering and far beyond.

## **2 2 Designing one of the first chips in an Italian University**

Alessandro enrolled in the Electronic Engineering degree course at the Engineering Faculty of the University of Genoa in 1974. In 1978, under the guidance of Prof. Alessandro Chiabrera and Giancarlo Parodi, he began the first studies that would lead him, together with his colleague Daniele Caviglia, to the realization of the degree thesis project. The aim was to create an arbitrary waveform generator designed to study the reactions of living cells (primarily) "in vitro" when subject to electromagnetic fields. The generated signal would then have been suitably amplified to drive the coils surrounding the cellular samples. The degree exam was held on January 29, 1980, and Alessandro passed it with honors. An extension of the thesis project, completed the following year, was published in IEEE Tr. on Instrumentation and Measurement [1].

The collaboration with the Institute of Electrical Engineering was the natural continuation of the thesis activity. Since Ph.D. courses were not yet active in Italy in those years, Alessandro enrolled, in the same year, in the newly established "School of Specialization in Computer Engineering" of the University of Genoa, chaired by Prof. Arrigo Frisiani. It was a very stimulating path, which also, in this case, led to an innovative thesis work: it was, in fact, under the supervision of Prof. Joy Marino, the design of a chip (probably one of the first ones designed and realized in an Italian University) in Negatively Doped Metal Oxide Semiconductor (NMOS)  $5\mu\text{m}$  technology, of a Bus Arbiter for a Multiprocessor Systems [2]. The chip was fabricated, with the support of Prof. Paolo Antognetti, in one of the very first "runs" offered by the newborn Metal Oxide Semiconductor Implementation System (MOSIS) service. The specialization exam was held in 1982.

This was an important turning point for Alessandro's career, which introduced him to the world of Very large-scale integration (VLSI) design. At the same time, he undertook a collaboration with Ansaldo Impianti, and in particular with its Automation Division, regarding the implementation of the monitoring systems for the PEC (Prova

Elementi Combustibile) experimental nuclear power plant, which was under construction in those years. This activity led to the foundation of a start-up, namely Cybertek, which he carried on until November 1983, when he joined the Institute of Electrical Engineering of the University of Genoa as a Research Fellow.

### **3 Digital system architectures**

In the mid of the 1980s, Alessandro targeted the design and development of a 32-bit microprocessor, a very challenging research objective at that time. The project had two main purposes: (i) to study in depth the VLSI design process; and (ii) to design the core hardware for the development of processors for in-house applications. The P32 was characterized by orthogonality and composability of data types, instructions and addressing modes; these features, in conjunction with regularity in the implementation of the instructions, allowed an easy implementation of compilers and a more efficient code generation. The P32 provided a large uniform address space (4 gigabytes), a virtual memory capability, and basic support of Operating Systems (OS) functions. Four privilege levels, privileged instructions and support of memory access privileges provided the basic mechanisms to guarantee the security of the computer system. The instruction set supported general-purpose instructions and could be extended by a co-processor capability. The microarchitecture was designed to be expandable. Alessandro led, with passionate enthusiasm and clear research vision, a group of master thesis students who, under his guidance, achieved remarkable results [3].

Starting from 1990 and for almost a decade, Alessandro continuously supported and contributed to a research field that, at the time, was substantially unprecedented in the Italian academic scenario, i.e. microprocessor architecture design. The first efforts were devoted to the application of instruction level parallelism to Prolog processing [4], followed by a general-purpose innovative study based on static scheduling on Very Long Instruction Word (VLIW) microarchitectures [5] [6]. In this period, Alessandro organized in Santa Margherita Ligure (Genova) the 1995 edition of the IEEE/ACM International Symposium on Computer Architecture (ISCA). For the first time in the history of that outstanding conference, it was held in Italy.

Further research directions addressed the implementation of self-timed microarchitectures, for which a complete library of dedicated standard cells was designed [7] as well as innovative arithmetic units [8], and the implementation of co-processors dedicated to fuzzy logic processing [9] [10] [11] and for the Boltzmann Machine [12] [13], which anticipated the advent of computation hardware acceleration units that is mainstream nowadays, after 25 years.

### **4 Dialoguing with humanistic culture**

Beside continuing the work in the field of electronic systems and architectures, Alessandro (with the support of his group, the ELIOS Lab) pioneered a research dialogue with the humanistic culture, particularly developing two main threads: cultural heritage and languages.

In the city of Genova, the 1990s had been characterized by a renewed focus on the historical and artistic heritage in the wake of a major exhibition entitled “Genoa in the Baroque Age”, which emphasized the city's historical role in the circuit of European power during the ancien régime, while at the same time pointing to the theme of local cultural heritage as a great potential for a contemporary city. At the end of that decade, Alessandro, who had realized the importance of that line far beyond the art-historical context, got in touch with the organizers of the exhibition, Giovanna Terminiello and Ezia Gavazza, who introduced him to Prof. Lauro Magnani, knowing his interest in new experiments. This began a dialogue and friendship that continued for more than twenty years. The early stages were very intense and exciting: alongside the emerging potential of integrating engineering and humanistic knowledge, there was the need to find a common language. A first major achievement consisted of a set of 3D renderings of “cubist” figures by Luca Cambiaso, a renowned Genoese Renaissance painter. After several experiments, the work, together with the relevant virtual reality movie, was taken to Germany on the occasion of an exhibition dedicated to the artist in Osnabrueck. The reading and presentation to the public of the urban artifact in its historical transformations analyzed through the sources, verified on the ground and visualized in a 3D reconstruction, was another of the focuses of the research collaboration between the humanist and engineering research groups.

Along the same line, the Strada Nuova project realized a 3D Virtual Reality video clip illustrating the history of the Renaissance “Via Aurea” road that was built as the representative district of the, at that time, world-powerful Genoese bank families. The clip was exhibited for years in the Museo Rosso, and Carlo Azeglio Ciampi, the Italian President of the Republic, watched it with interest with 3D glasses.

A particularly lively field of experimentation and debate has been the museum field. The discussion on the use of the virtual as a 'recontextualisation' focused on issues that had emerged during the layout design of the Museo Diocesano in Genova and then on the possibility of working on "virtual" museums [14] and experimenting interactive forms with the public [15].

The second thread of interest in the humanistic area concerned natural languages. In 2003, Alessandro contacted the F@rum research group and, in particular, Prof. Elisa Bricco, of the Faculty of Languages and Foreign Literatures of the University of Genova. The group was working on applying new Information and Communication Technologies (ICT) to research and language teaching, and Alessandro wanted to create a multimedia object for language teaching with a playful perspective. The term "edutainment" he proposed made his colleagues skeptical, but Alessandro was far-sighted and had already understood the importance of marketing and communication, even for educational products.

His proposed project was appreciated, and a collaboration was established to create a series of educational paths. These mini-courses were based on accounts from writers who had passed through Genoa during the "Grand Tour", describing places and customs. Thanks to funding from the Liguria Region, the "Scuolagiocando lingue" (School playing with languages) was created, which was available on the Region's portal for several years. The final product consisted of three videos with animations.

Starting from a chance encounter between a young modern traveler and the writer (Alexandre Dumas for the French language, Charles Dickens for English and Miguel de Cervantes for Spanish), the users could follow them on a discovery journey that mirrored what the writers had described in their works. The illustrious traveller accompanied the young person, engaging in conversations in the foreign language and sharing overall impressions, sensations, and appreciation for the food and Genoese hospitality. Each course presented a range of glottodidactics tools for lexical and syntactic insights.

## 5 Games and Simulations

Towards the end of the millennium, Alessandro had the intuition that applications of electronic systems would soon have had a significant impact on the daily life of a large part of people. Particularly, he committed to studying and developing the application of two, at that time, early-emerging technologies: touch screen and 3D virtual reality. Serious Games represented a challenging domain for both these technologies, intending to build potentially great tools for education and training.

In the previous section, we presented his dialogue with the humanistic culture that spurred from these premises. Here we recall some results he and his group achieved (also by leading and/or participating in European research projects, such as e-Tour, games@large, ELU, Chi:Kho, VitalMind), particularly the design of applications that now look like early prototypes of smartphones' apps. The tour guide for Genoa's Aquarium [16] and the VeGame territorial game for Venice [17] were developed as pioneer demonstrators of such new and widely spreading technologies.

Based on these and similar experiences, he led the Games and Learning Alliance (GaLA) Network of Excellence (NoE) (2010-2014). To continue the aims of the GALA NoE, Alessandro founded in July 2012 the Serious Games Society (SGS), of which he was president until 2017. From the SGS, two main initiatives blossomed: the International Journal of Serious Games (IJSG) and the Games and Learning Alliance (GALA) Conference (12 editions until 2023). The IJSG, which Alessandro firmly wanted to be a gold open-access publication, is indexed in Scopus and ESCI Web of Science and has reached the tenth year of publications. Alessandro was its Editor in Chief since the foundation until his death. His achievements in serious games are outstanding and briefly summarized in [18].

Anticipating the current popularity of the topic, Alessandro's talent in finding new applications of electronics in useful sectors could not miss to address health and medicine. Particularly, his contribution concerned simulation-based training, following the 'serious game' approach [19]. As an evolution of the pre-existing medical simulation laboratory, Alessandro contributed to creating the University of Genova's Center for Simulation and Advanced Training (SIMAV), of which Scientific Council he was a member from 2015 to 2020. He significantly contributed to the mission of the Center by developing simulation-based training and assessment tools for medicine, health and accessibility [20]. He also proposed and contributed to developing a brand-new approach in simulation-based medical serious games. The approach follows the Agent-

Based Model Simulation (ABMS) paradigm, exploiting 3D VR devices. The approach led to an easy-to-use, immersive, real-time simulation, providing a realistic experience to the user [21].

## **6 Automotive applications, machine learning and big data management**

The Active FP5 project, which developed the first digital dashboards in automotive cockpits – in 1998, when the liquid crystal displays (LCDs) were still an expensive rarity -, marked the beginning of a long-time collaboration with Centro Ricerche Fiat (CRF) and several other original equipment manufacturers (OEMs). In the years, the collaboration involved several research fields and projects, such as Human-Computer Interaction (Comunicar and Aide), machine learning (Edel), vehicle-to-X cooperation (Safespot), and collaborative mobility (Team). In the last period, Alessandro and his group have been deeply involved in piloting automated driving functions (ADFs) for SAE level 3 and 4 vehicle automation, particularly by developing the big data management architecture [22], based on the Measurify open-source framework [23], and developing machine learning models for perception (e.g., [24]) and decision making (e.g., [25]). Also, in this area, a key appreciated peculiarity was the multidisciplinary approach, which meant designing applications and systems able to effectively exploit the underlying hardware in a holistic, application-requirement-centred view.

## **7 Higher education**

Alessandro was keen to combine his enthusiasm for research with a passion for higher education, to which he dedicated relentlessly, also launching and leading several new initiatives. From the late '90s to 2016, he served as the President of the Degree Course in Electronic Engineering at the University of Genoa. He managed the subdivision of the 5-year course into a BSc and an MSc course. He invented the role of the didactic manager, who acted as an appreciated interface between teachers and students. The realization of a new website for the courses facilitated the management of formal procedures (stages, thesis selection, etc.) and helped students access practical information and educational material (lecture notes for all the teachings were also printed and distributed to the students). He introduced in the syllabus new courses that only recently have become mainstream, like “Soft Skills”, “Entrepreneurship”, and “Orientation workshops”, to introduce students to the labour market. By proposing projects for his courses' exams, he promoted the design and development of educational games and also organized game-based events with students to challenge and stimulate them in unusual contexts.

Alessandro also felt the need to translate into didactics the ongoing experimental research dialogue between information science and technology and the humanistic culture: this is how the teaching of “Art & Image Narrative for Virtual Worlds” was born in the Electronics Engineering MSc and then “3D visualizations for the analysis of the artistic and architectural heritage” in the MA in History of Art and Enhancement

of the Artistic Heritage. Alessandro's work for the DIRAAS courses allowed many students with a humanistic background to learn and practice 3D reconstruction techniques. The numerous theses of which De Gloria was supervisor or co-rapporteur were very useful gyms for combining the art history vocation with digital applications to the point of being translated into scientific publications, doctoral experiences, research grants, or even specialized work activities.

Alessandro's creativity and visionary leadership in conceiving new generations of engineers also led to the creation of the MSc program in "Engineering Technology for Strategy (and Security)" in 2018, after some years in which he did not shy away from academic battles conducted with his proverbial stubbornness and strength. The program combines modelling, simulation, machine learning, big data analysis and social, economic and political studies to prepare the figure of a professional able to manage strategic decision-making processes based on a solid engineering foundation. It is now one of the most attended MSc programs of the University of Genova, attracting students from all over the world.

## 8 Conclusions

As an outstanding academic and charismatic leader, Alessandro has been a highly valued supervisor and mentor for many generations of students and doctoral candidates and an essential support for his colleagues at the University of Genova, with not a few of whom had an intense dialogue.

He always demonstrated remarkable open-mindedness and a genuine curiosity towards the whole reality, without preclusions and with a visionary yet project-oriented approach. He used to make to students and colleagues challenging proposals, with no discounts. They were difficult to implement but long-sighted and impactful. He never surrendered to the difficulties of various types that he met on his paths. Even from his bed of death - that he never referred to as such - he continued to discuss with his colleagues and make plans for the future. You thought you had to bring him words of comfort; he gave them to you instead, together with ideas for collaborations.

He felt an unquenchable push to look at and shape the future. We are confident that he has now reached the plenty of the life that he so much desired.

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