

Curriculum Vitae - Prof. Umberto Cugini

Education and Current Position

Umberto Cugini is Professor Emeritus at the Department of Mechanical Engineering, Politecnico di Milano, Italy.

He received a Master Degree in Mechanical Engineering from Politecnico di Milano, Italy, in 1966 and a Master Degree in Management and Business Administration from Università Bocconi, Milano, Italy, in 1974.

He started his academic carrier at Politecnico di Milano with a CNR fellowship in 1968, and then he became assistant professor at Politecnico di Milano in 1973, and associate professor in 1979. In 1987 he was appointed full professor in the scientific area of "Design and Methods in Industrial Engineering". He had a faculty position at the Università di Cagliari in 1987-1988 and then he was called at the new established Faculty of Engineering at the Università di Parma till 2001. In year 2001 he was called at the Faculty of Industrial Engineering of Politecnico di Milano.

In year 1979, he founded the KAEMaRT research group (Knowledge Aided Engineering Manufacturing and Related Technologies) – www.kaemart.it, that, since then, carries out research activities in several areas related to product development methodologies and tools.

Research activities

Over the years, his primary research interests have been: computer graphics, geometric and feature-based modelling, physics-based modelling and simulation, robotics and automation systems, knowledge-based systems for product development, engineering knowledge management, Business Process Reengineering, Human Computer Interaction, multimodal and haptic-based interaction, Virtual/Augmented Reality, Virtual Prototyping, emotional engineering, Topological Optimization, Systematic Innovation.

Since the beginning of his research activities in the '70s, Umberto Cugini has focused on innovative methodologies and tools to support design in the mechanical engineering domain, studying the potential impact of information technologies on methodologies and on processes and tools for product development, and on the evolution from designing machines and systems to designing products, paying particular attention to the final users of these tools, who are the engineers, intended as "problem solvers". According to this view, he has contributed to the design and has coordinated the development of computer-based design tools oriented to maximize and exploit the engineers' experience and knowledge, following a user-centred approach. Such an approach was rather unusual at that time, when the practice was such that computer scientists were devoted to study the application issues and to develop tools for the final users, who were anyway not involved in the design and evaluation phases of those tools. Instead, the paradigm for the development of computer-based tools for design adopted by Umberto Cugini was based on a user-centred approach, where the users' point of view was focal and fundamental for the specification, development and validation phases of the new tools, and the computer scientists were solely involved in the optimization phase of the already designed tools.

The research activity in the domain of product development has always been carried out in advance of the industrial development of the techniques and technologies addressed, by investigating grounding research areas and foundations on subjects, such as Computer Graphics and geometric modelling, feature recognition, parametric and procedural modelling, feature-based modelling, physics-based modelling, analysis and simulation, robotics, engineering knowledge management, process modelling and simulation, systematic innovation and TRIZ. The comprehensive synthesis of the progresses and of the outcomes of the research in these various domains has resulted in the "Design & Engineering" paradigm, where the issues relating to methods and tools for the design are no longer only directed exclusively to mechanical products, but also focus on products of industrial design. Thus, in addition to the engineering-technical domains, Umberto Cugini has constantly focused on those issues associated with human-computer interaction, on state-of-the-art technologies and techniques for haptic and multimodal interaction, on applications based on Virtual/Augmented/Mixed Reality and on Virtual Prototyping.

The proposed approaches and paradigms have often contributed to the advancement of knowledge in various scientific fields, and have led to the definition of the foundations for the development and improvement of many commercial products. In the following the *major scientific contributions* of the last forty years are listed:

- since the '70s he has studied issues related to the automatic recognition and interpretation of technical drawings and the formalization of the technical knowledge that have led to the subsequent development of a prototype able to transform the scanned data into vectors, and to reconstruct the precise geometry and topology of corresponding mechanical parts;
- in 1985 the research on geometric modelling based on the parametric approach led to the development of a prototype (GIPS-Graphic Interactive Parametric System), whose concepts anticipated -and were then included- in the development of the PTC and SDRG CAD products, which have had a broad diffusion in the industrial design sectors thus revising the design practice;
- in 1993 the research on modelling and simulation of non-rigid materials (NRM) has moved from an approach based on geometrical modelling to one that is physics-based. This innovative approach has strongly being based on the reference scientific field and has been applied in several industrial application contexts (apparel, automotive, packaging, etc.);
- in 1994 Umberto Cugini has introduced the use of haptic interfaces into the product design context, which have been integrated into applications for virtual product development and validation. The subsequent development of some prototypes (developed within the context of FP6-IST funded projects, i.e. T'nD – Touch and Design- and SATIN - Sound And Tangible Interfaces for Novel product design) demonstrates their effective impact, in terms of time reduction and improvement of performances, on the product development process.

National/International Service

Umberto Cugini has been responsible and member of national and EU boards for the **steering and evaluation of research programmes**:

- National representative in the ITC - Information Technology Committee - of the ESPRIT program in the IV Framework Programme of the European Commission (1994-1998);
- Member of the COFIN2001 Board of Trustees of MIUR-Italian Ministry of University and Research, for the coordination of the review of national research proposals in year 2001.

From 1988 to 1996, he has been director of the Targeted Project on Robotics of CNR - National Research Council, the major Italian research project on robotics, managing a total public funding of M€ 34,00: the project involved about 200 research teams - including industry, academic institutions and research centers -, for a total of 1100 person/year.

Research Projects

Since 1988 he has been involved in more than 30 research projects: 15 of them have been funded by the Italian Ministry of University and Research (MIUR) and 18 of them by the European Commission. In addition, he has had several direct research contracts with Italian companies, mainly in the automotive (FIAT, Ferrari, Elasis, IVECO, Lamborghini) and aerospace (AVIO, Agusta, Aermacchi, Alenia) sectors.

In the last years he has been:

- President and responsible of the research of the CO.GE.F. Consortium (COntorzio Gestione Forme), which received a total funding of 10 billion Lira from the Italian Ministry of University and Research (1998-2002) (grant k€ 511,00);
- Coordinator of the training activities and coordinator of local research unit of the SPIKE project, which received a total funding of 10 billion Lira from the Italian Ministry of University and Research (1999-2003) (grant k€ 1.196,00);
- Scientific responsible of Università di Parma research unit in the TA2000 project (1998-2002) funded by the Italian Ministry of University and Research (grant k€ 950,00) in the area of Textile and Apparel;

- Scientific responsible of Università di Parma research unit in the EU project TACIT (1998-2002) (total grant of these projects was k€ 620,00);
- Coordinator of MIUR-FIRB project SIMBAR - Simulation Based on Augmented Reality (2004-2006) – www.kaemart.it/simbar (grant k€ 300,00);
- National coordinator of MIUR-PRIN2005 PROSIT project – From Systematic Innovation to Integrated product development – (2006-2008) - www.kaemart.it/prosit (total grant k€ 280,00);
- Scientific responsible of Politecnico di Milano research unit in the European IP CUSTOM-FIT project – a Knowledge-based manufacturing system, established by integrating Rapid manufacturing, ICT and Material Science to improve the Quality of Life of European Citizen through Custom-Fit Products - FP6-NMP2-CT-2004-507437 (2004-2009) – www.custom-fit.org (grant k€ 80,00);
- Scientific responsible of Politecnico di Milano research unit in the European NoE INTEROP – Interoperability Research for Networked Enterprises Applications and Software - FP6-2002-IST-508011 (2003-2007) – www.interop-noe.org (grant k€ 69,00);
- Scientific responsible of Politecnico di Milano research unit in the European IP VIVACE project – Value Improvement through a Virtual Aeronautical Collaborative Enterprise - FP6-2002-Aero-502917 (2004-2007) – www.vivace-project.eu (grant k€ 346,00);
- Coordinator of the FP6-IST-2002-001996 project T'nD - Touch and Design – (2004-2006) - www.kaemart.it/touch-and-design (total grant k€ 2.220,00);
- Deputy coordinator of European Project - FP6-IST-5-034525 SATIN - Sound And Tangible Interfaces for Novel product design - on the study and development of a multimodal system based on haptic and sound interfaces for the evaluation and modification of aesthetic shapes (2007-2009) - www.satin-project.eu (total grant k€ 2.975,00);
- Coordinator of FIRB project "Made in Italy" funded by the Italian Ministry of University and Research on the study of virtual prototyping for garment design (2007-2010) (grant k€ 870,00).

He is currently involved in the following research projects:

- Coordinator of the local research unit in the following projects funded by the Italian Ministry for Economic Development–Industria 2015 projects:
 - “Development of new domestic energy saving appliances” coordinated by Whirlpool (grant k€ 800,00);
 - “Body Scan coordinated by M31 SpA (grant: k€ 400,00);

Department/University Service

During his career Umberto Cugini has hold several **management assignments in academic institutions**:

- Director of computing centre of the Faculty of Engineering at the University of Parma (1993-1996);
- Delegate of the Rector of the University of Parma for the relations with industries and science park (1993-1998);
- Director of the Department of Industrial Engineering of the University of Parma (1996-1999);
- President of the Committee of the Italian professors of the scientific area of "Design and Methods in Industrial Engineering" (2000-2002);
- Member of the board of Directors of Fondazione Politecnico, Politecnico di Milano (2003-2007);
- President of Consortium Politecnico Innovazione of Politecnico di Milano (2003-2008).
- President of the Steering Committee of ALINTEC (2008-2011).

He has been member and **coordinator of PhD programs**:

- Coordinator of the PhD program on “Industrial Production Engineering” of University of Parma (1990-1999);
- Coordinator of the PhD program on "Virtual Prototypes and Real Products" of Politecnico di Milano (2002-2006);
- Member of several Doctorate committees in foreigner Universities (Université de Metz; University of Bristol; Institut National Polytechnique de Grenoble; Université Claude Bernard, Lyon).

Society Membership

He has been and is member of several **Scientific and Technical Boards** of consortia, institutions and associations:

- Member of the executive board of SIRI – Italian Society for Industrial Robotics (1989-1997);
- Member of the executive board of APRI - Italian Society for Rapid Prototyping (1996-1999);
- Chairman of the IFIP Working Group 5.2. - Computer Aided Design (2000- 2006);
- Founder and member of the scientific board of EUROGRAPHICS (1980-1983) and AICA Associations (1977-1982);
- Member of the scientific board of AGARINI Foundation (since 1998);
- Member of the Conseil Scientifique de l'Université Claude Bernard Lyon 1 (since 1999);
- Member of the technical and scientific board of the CETMA Consortium (Center for product design and technologies for materials manufacturing) based in Brindisi (since 1995);
- Member of the Scientific Board of the PRODE Consortium (Consortium for the design and development of industrial products) based in Napoli (since 2000);
- President of the Systematic Innovation Competence Centre of Fondazione Politecnico - www.innovazione sistematica.it (since 2007).

Scientific Publications:

He has published more than 250 journal papers and refereed international conference papers. Among them, we have:

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