

Juan G. Gonzalez, Ph.D.

Extended Summary of Research Contributions with Publications¹

Last Updated: Spring 2006

¹ *The technical contributions that have shaped my research career would have not been possible without the support of multiple people and organizations that believed in me, and in my ideas. I want to express my gratitude to the numerous friends, colleagues, students, and advisors who have had an impact on my research career. I also want to acknowledge the financial support of the following organizations, without whom none of my contributions would have ever been possible:*

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- CINTEL, Colombian Center for Telecommunications Research, Bogota, Colombia
- Universidad Pontificia Bolivariana, Medellin, Colombia

Juan G. Gonzalez, Ph.D.
Spring 2006

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1. Personal data

JUAN G. GONZALEZ, PH.D.

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2. Education

Ph.D. in Electrical Engineering

1997

University of Delaware, Newark, Delaware, USA

Dissertation: *Robust Techniques for Wireless Communications in Non-Gaussian Environments*

Graduated with the highest honors.

The University of Delaware awarded Dr. Gonzalez the 1997 Allan P. Colburn Award for his doctoral work on the basis of “quality of research and contributions to mankind.” The Colburn Prize is the highest scientific award granted to a doctoral researcher at the University of Delaware. No more than one person can receive this award in a given year.

M.S. in Electrical Engineering

1995

University of Delaware, Newark, Delaware, USA

Thesis: *A New Approach to Suppressing Abnormal Tremor through Signal Equalization*

M.S. in Applied Statistics

1993

National University of Colombia, Medellin, Colombia

Thesis: *Elements for a Theory of Estimation in Impulsive Environments with Applications in Communications*

B.S. in Electrical Engineering

1990

Pontificia Bolivariana University, Medellin, Colombia

Thesis: *Design and Implementation of a Novel Testing System for Digital Payphones*

Graduated with the highest GPA of the class of 1990, and with the highest honors.

B.S. in Mathematics

1990

National University of Colombia, Medellin, Colombia

3. Professional experience

President

2001 – present

Intellectual Property Systems, LLC, Weston, Florida, USA

“Dr. Gonzalez is one of the top scientists alive in the field of digital filtering algorithms, who has made and will continue to make, through his impressive ability to innovate, sustained groundbreaking contributions to the quality of life of society in general.”

Professor Daniel L. Lau, Ph.D.
University of Kentucky
Author of “*Modern Digital Halftoning*,” Marcel Dekker

As the President of Intellectual Property Systems, Dr. Gonzalez leads research on the field of digital filtering and communications algorithm design. His scientific work has had strong impact on fields as varied as wireless and Internet communications, microelectronics, applied astronomy, statistics, computational electromagnetics, education, marketing, robotics, and the development of assistive technologies for people with disabilities. Over 50 of the world’s most prestigious research establishments in over a dozen countries have cited or worked on scientific fields opened by Dr. Gonzalez. Today, Dr. Gonzalez’s scientific contributions continue to be studied and utilized by scientists and practitioners in academia and industry worldwide.

Dr. Gonzalez’s most recent work as an independent researcher has concentrated on the discovery and invention of disruptive technologies in the areas of communications algorithms, hardware architectures, and business intelligence & automation:

I. DIGITAL COMMUNICATIONS OVER HARSH ENVIRONMENTS

Dr. Gonzalez is the inventor and pioneer of the so-called “myriad filtering” technology, which enables groundbreaking quality improvements in systems where impulsive interference and noise are a common impediment, most notably: fast Internet access technologies such as digital cable modems and DSL, wireless systems in urban and cluttered (in-door) environments, radar, and sonar. Myriad filtering technology is currently well-known and in widespread use, is taught at major universities, and continues to be studied by scientists and practitioners worldwide.

“Weighted myriad filters and myriad filtering theory are an extremely valuable legacy of Dr. Gonzalez’s to the signal processing and communications communities. The worldwide impact of myriad filters is merely indicated by the fact that weighted myriad filters are already taught at major universities, and researchers from over ten countries have cited or used myriad filters for processing troublesome signals in fields as varied as electrocardiography, satellite imaging, cellular telephony, astronomy, copyright data protection, digital FM radio, and neural networks.”

Dr. Walid K. M. Ahmed, Ph.D.
Senior Scientist & Technical Manager
M/A-COM, Tyco International
Adjunct Professor, Stevens Institute of Technology

As an independent researcher, Dr. Gonzalez has maintained a leading role in the myriad filtering field, making sustained significant new contributions to both the theoretical and the applied arenas. On the theoretical side, Dr. Gonzalez recently expanded several formulations of the myriad filter structure, and studied its applications in environments with maximal impulsiveness. Dr. Gonzalez recently wrote a scientific book chapter as well as several scientific articles with fundamental theoretical contributions (see section *Refereed Scientific Articles* in this document for currently published material). On the applications side, Dr. Gonzalez invented and introduced a myriad-based decoding system for the protection of information in digital communications systems, establishing a methodology for optimizing frame transmissions in environments where the noise and interference processes vary in time. Among his most recent contributions, Dr. Gonzalez also refined the myriad filter formulation for the demodulation problem in communications, obtaining a process with significantly superior performance in the presence of harsh noise, when compared to the standard systems implemented by industry today. These contributions have enabled important quality and data throughput improvements for mobile wireless communications systems and broadband Internet access communications based on cable modems and DSL. Several U.S. patent applications have stemmed from this work (see the section *Patents* in this document).

Dr. Gonzalez is currently working on fundamental myriad-filtering-based solutions for the design of communications systems in environments that change in time. One of the most fundamental problems that real-life communications systems face today is the issue of system *robustness* against varying environment conditions. Industrial systems are usually designed under ideal statistical models of the environment. Once in production, they are tested and optimized in controlled laboratory environments, again under somewhat idealized stationary conditions. In real life, neither the statistical models nor the laboratory test environment are a precise representation of the complex array of electromagnetic signals that the communications system will encounter during operation. If the system is not designed to be *robust*, as it is usually the case, performance will be degraded or it will even breakdown in the presence of non-typical interference and noise produced by temporary ambient or human-generated conditions that are difficult to predict in the laboratory. A good example is a cellular phone transmission. Every regular user of digital cell phones has experienced the lack of robustness typical of today's wireless technology. By design, cell phone communications will work well most of the time, except for some isolated events in which the communication becomes bursty and corrupted by apparently unpredictable "mutes." These mutes are usually caused by "non-typical" distortion that occurs in short intervals of time as a result of many uncontrollable effects such as thunderstorm lightning or electrical machinery (e.g., a microwave oven) interfering with the cell phone signals. To solve this problem, and motivated by previous work on myriad filtering technology developed for Bell Labs, Dr. Gonzalez developed the concept of "bootstrapped communications," which allows a receiver to learn and adapt to the statistical nature of the environment as it changes in time. Based on a sophisticated intelligent algorithm tied to the hardware architecture of the system, bootstrapped communications can offer extreme robustness while maximizing performance for any kind of interference conditions encountered in the environment. Dr. Gonzalez intends to leverage his unique blend of expertise in hardware architecture and algorithm design to further advance the frontiers of science in this direction.

II. RECONFIGURABLE COMPUTING ARCHITECTURES FOR MODERN COMMUNICATIONS SYSTEMS

"Dr. Gonzalez is not only an exceptional theoretician who has made his name by opening new frontiers of science. He is also a world-class leader in the field of reconfigurable computing for advanced scientific computations and communications systems. His unique understanding of the intricacies between reconfigurable computing and algorithm implementation make him an extraordinary asset for today's scientific computing industry. There are very few people in the world who can build fundamental new theories that solve real-life problems and at the same time are able to bring those theories to practice and implement them. Dr. Gonzalez is one of them."

Reinaldo Valenzuela, Ph.D.
Director, Wireless Communications Research
Bell Laboratories

Dr. Gonzalez has been a pioneer of disruptive design methodologies for industrial communications systems, with emphasis on the maximization of productivity through re-usable architectures. Previous to becoming an independent researcher, Dr. Gonzalez led hardware design re-use initiatives at Bell Labs, and designed innovative hardware architectures for several industrial products. Through his unique understanding of the close interrelation between algorithm design and hardware implementation, Dr. Gonzalez developed and pioneered the first thorough course ever taught on the implementation of communications algorithms in hardware (see section on *Pioneering Contributions to Education* in this document). The course has been taught as part of the electrical engineering graduate program at the University of Delaware.

As an independent researcher, Dr. Gonzalez is using his extensive expertise in communications algorithm implementation to write the first book to be published in the field. The book, called *Implementation of Communications Systems* (in preparation by Dr. Gonzalez), will be launched in conjunction with a novel hardware description language conceived by Dr. Gonzalez and aimed to drastically simplify the design and implementation of communications systems in practice. It is anticipated that with such a language, engineers will be able to design communications systems at a higher level, increasing productivity by at least one order of magnitude when compared against the design languages currently used in industry. Dr. Gonzalez intends to leverage his unique blend of expertise in hardware architecture, high-level language methodologies, and algorithm implementation, to advance the frontiers of science and technology in this direction.

III. ADVANCED DIGITAL FILTERING FOR DATA MINING AND BUSINESS INTELLIGENCE

“Dr. Gonzalez’s recent work on business intelligence has not escaped to his style of pioneering and opening new fields of technology that attack and solve, with the highest scientific quality, very relevant problems for modern society. Dr. Gonzalez’s intelligent search and data mining algorithm technology enables potential groundbreaking applications in critical tasks such as anti-terrorism and anti-intrusion programs.”

Gonzalo R. Arce, Ph.D.
Chairman
Department of Electrical and Computer Engineering
University of Delaware

As an independent researcher, Dr. Gonzalez has leveraged his expertise in digital filtering and communications, to pioneer data mining and web intelligence algorithms that enable groundbreaking applications in sales, marketing, and business process automation. Dr. Gonzalez melted fundamental concepts of digital filtering with well known pattern matching analysis techniques available in computer science, to build contextual linguistic filters that can extract information from text files with a high degree of intelligence. Borrowing from communications design methods for data flow, Dr. Gonzalez developed a computing theory for robust text file processing, and integrated it with his linguistic algorithms to build one of the world’s first prototypes of a fully programmable intelligent automaton for conceptual data analysis and processing. The automaton is programmed through a high-level data flow processing language called BLAST (Batch Line Automated Sequential Tasker), invented and pioneered by Dr. Gonzalez. Business automation projects that would usually take months to design and implement using standard programming languages, can now be completed through BLAST in a matter of days or even hours. BLAST technology allows businesses to run sales automation, market analysis, and business process optimizations to increase revenue and reduce operating expenses. BLAST intelligent search and data mining algorithm technology also has the computing power to enable distributed security systems for governments and organizations, with potential groundbreaking applications in critical protection tasks such as anti-terrorism and anti-intrusion programs.

Dr. Gonzalez is currently working on advanced hardware acceleration algorithms for text pattern matching and BLAST-based linguistic filtering to enable the world’s first conceptual global Internet search engine

with web intelligence. A common limitation faced by global Internet search engines today is the scarcity of computing power to perform advanced pattern matching analysis. For example Google, one of the world's most successful global search engines, must resort to a complex web of thousands of distributed computers to serve its search queries daily. Even with the huge amounts of resources dedicated to its operation, Google queries are extremely simple and do not perform the linguistic or contextual analysis necessary to attain search intelligence. A typical example would be a headhunter trying to find resumes of business executives with experience in wireless systems sales. Running a query in Google for "resume wireless sales" will render over 200,000 web pages, from which only about 10% will match real resumes. Ideally, a linguistic filter engine would be able to identify the real resumes and get rid of the 90% of "noisy" pages, providing the headhunter with the information that he/she really needs. Incorporating linguistic filtering and conceptual pattern matching into a search engine is, however, prohibitively expensive with today's technology, as it would require the use of millions of distributed computers to compute the intelligent algorithms at a global scale. Dr. Gonzalez intends to leverage his unique expertise in the field of hardware acceleration for advanced digital algorithms, to advance the state of the art of searching technologies. Dr. Gonzalez's aim is to achieve global intelligent search queries served by a single computer, with the aid of hardware accelerated pattern matching and linguistic filtering.

R&D Director, Hardware Acceleration Technology

2001

EE Solutions, LLC / EM Photonics, Inc., Newark, Delaware, USA

EM Photonics, Inc is a private R&D company that develops and supports cutting-edge fabrication processes for the electronics and optics industries, with emphasis on circuitry shrinking technologies.

EM Photonics, Inc is a spin-off of EE Solutions, LLC, a consulting company in the field of nano-electronics. EM Photonics is one of the world's first companies to possess every capability required to develop "nano-scale" circuitry, from concept all the way to fabrication, utilizing proprietary technology developed in-house.

Learn more at: www.emphotonics.com

Dr. Gonzalez was directly responsible for leading the company's overall research efforts on hardware acceleration, and securing the worldwide leadership of the company as a provider of groundbreaking technologies for the electronics and optics industries.

Dr. Gonzalez co-founded EM Photonics, Inc in 2001 after attracting US\$1 million in start up funds from strategic science and technology programs of the U.S. Army, the U.S. Navy, and the State of Delaware.

- Pioneered and opened the research field of hardware-accelerated computational electromagnetics, and set the foundations for the world's first industrial and scalable architecture of a hardware acceleration processor for scientific computations in electromagnetics.

"By re-interpreting the formulation of the very well-known Maxwell Equations as a filtering problem, Dr. Gonzalez was able to propose and design hardware technologies that, for the first time in history, accelerate the processing speed of a personal computer by a factor as high as 3,000, when conducting electromagnetic simulations. These technologies are potentially revolutionary for the electronics and electro-optical industry, since they will allow to reduce the design cycles of integrated circuits (e.g., chips) from several months to just several days, saving manufacturing houses millions in design costs."

Dr. Neiye S. Correal, Ph.D.

Principal Scientist
Motorola Labs

- Attracted approximately US\$1 million from strategic science and technology programs of the U.S. Government, with the only goal of starting up the company and pushing on Dr. Gonzalez's hardware acceleration research program. The funds were granted, with Dr. Gonzalez as Principal Investigator, by virtue of the tactical and strategic importance of these technologies to the national and local economy as well as to the interests of the U.S. Department of Defense. No financial obligations were asked by the Government in exchange for these funds, except for the company's commitment to develop the research program and thus "contribute to the U.S. worldwide technological dominance and economic development."
- Invented and designed the core architecture of the company's champion product: a digital chipset with the capacity of computing electromagnetics algorithms 3,000 times faster than the traditional solutions available in industry. This level of computational acceleration enables the use of computer assisted design methods for "nano-scale" electronic circuitry, in processing times that are much shorter than the product's life cycle. Simply put, circuitry design methods that usually required months of computer processing, can be accelerated via this technology to render results in minutes, thus shortening dramatically the production costs and the market cycle of products, while allowing for higher quality designs. This technology enables new groundbreaking applications, as well as the discovery of novel and potentially groundbreaking device geometries, in fields that have been previously unexplored with this level of computational power. Potential paradigm-shifting application fields include optics, integrated circuit design, antenna design, and wireless communications.

On the significance of this technology for society: The fabrication of faster, more powerful, and less expensive computers (and hence, to a greater extent, the technological development of human kind), depends on industry's ability to fabricate smaller and more compact circuitry every year. Circuitry shrinking has been responsible for the growth in speed and processing power of commercial computers and communications networks during the last 30 years. As the size of current state-of-the-art electronic circuitries shrinks to "nano-scale" dimensions (this is, geometrical details smaller than 100 atom diameters), circuitry development becomes increasingly difficult, and new technological breakthroughs, such as the hardware acceleration technology developed by EM Photonics, are necessary to support the fabrication process.

- Recruited and supervised several scientists that worked on Dr. Gonzalez's hardware acceleration research program.

Visiting Professor and Principal Scientist

2000 – 2001

Department of Electrical Engineering, University of Delaware, USA

The University of Delaware is one of the top engineering research and educational institutions in the world, being ranked in the Top 5 of American universities with the best engineering departments. Its combined endowment and funds for research, education, and community outreach surpassed US\$1.5 billion in the fiscal year 2002-2003.

Learn more at: www.udel.edu

- Pioneered and implemented the first thorough course ever taught (in both academia and industry) on the topic of signal processing hardware design for communications systems. Signal processing hardware for

communications has been traditionally an obscure area in the research community, avoided by theoreticians and carefully guarded under industrial trade secret protection by practitioners. This course clarifies and makes available for the first time and in an integrated form, the intricacies of algorithm implementation for communications engineering. The interrelations between algorithm design and the management of critical hardware resources such as chip area, speed and power, are also unveiled. It is only from a thorough understanding of these interrelations, that a researcher in signal processing will be able to achieve breakthroughs with direct impact on today's communications industry. **The course is being used as the basis for the first book to be written in the area** (currently in preparation by Dr. Gonzalez).

“Dr. Gonzalez’s course program on Implementation of Communications Systems is of extreme value to the American education and industrial sectors, as this is the first time that the intricacies of the interrelations between algorithm design and hardware implementation are unveiled and treated coherently at a pedagogic level.”

Gonzalo R. Arce, Ph.D.
Chairman
Department of Electrical and Computer Engineering
University of Delaware

Dr. Gonzalez received the highest scores in the Fall 2000 Electrical Engineering teaching survey for his innovative approach to teaching and the pioneering contributions of this course to advanced engineering education.

World’s first fully hardware-accelerated simulator for communications: As part of the course core program, Dr. Gonzalez led his class to build the world’s first “system-on-chip” 100% hardware-accelerated simulation tool for a digital transmitter/receiver. The prototype system consisted of real-life hardware modules performing all of the fundamental signal processing functions present in a real communication system. Each one of the modules was programmable as an intellectual property soft core, thus allowing the system to “simulate by implementing” almost any simple digital system. The conceptualization of this hardware-accelerated simulator has profound implications in the communications industry, as complex simulations that would typically take weeks to execute in an industrial project, can be run through such an accelerator in real time, rendering results in *less than one second*. This level of acceleration enables the discovery and design of new and better communications systems, while accelerating product development cycles and reducing cost. The prototype system was implemented using Field Programmable Gate Arrays (FPGAs), and consisted of fully programmable VHDL modules for modulation constellations and matched filters, block and convolutional encoders/decoders, and noise control algorithms.

- Conducted basic research in digital signal processing and communications.
- Prepared and taught an electrical engineering course on digital signal processing.

Senior Scientist, Wireless Communications Technology
Bell Laboratories, Holmdel, NJ, USA

1997 – 2000

Bell Laboratories (or Bell Labs, as it is usually known) is one of the world’s top creators of new technology in the field of telecommunications and electronics.

Very few research houses in the world can claim to have transformed and shaped modern society to the extent that Bell Labs has. Bell Labs has a sustained record of research achievement that has resulted in many of the most groundbreaking inventions of human history: the transistor, the laser, the communications satellite, the cellular phone, the fax machine, stereo recording, sound motion pictures, long-distance TV transmission, the touch-tone phone, solar cells, the UNIX operating system, the world's most widely used computer programming languages, the fundamentals of communication theory, and many more. With over 40,000 inventions generated by its researchers, Bell Labs remains one of the most prolific invention factories in the world.

Learn more at: www.bell-labs.com

Dr. Gonzalez was directly responsible for the identification, research, and development of innovative technologies in the field of algorithm design and communications systems implementation, with the goal of improving the quality of current and future wireless products and increasing the company's intellectual-property portfolio. Dr. Gonzalez's work at Bell Labs resulted in groundbreaking contributions to several of Lucent Technologies' champion products in the fields of wireless communications and microelectronics. **Dr. Gonzalez's scientific contributions have impacted directly three of Lucent's product lines, representing yearly revenue of over US\$1 billion.**

"Dr. Gonzalez's pioneering contributions to algorithm design and hardware implementation have had direct impact on three of Lucent Technologies' product lines, with several of Dr. Gonzalez's algorithms and technologies adopted and included in them. The combined revenue generated by these product lines exceeds US\$1 billion. This number is expected to grow significantly in the coming years, as third generation cellular technology penetrates and takes ownership of the consumer markets."

Reinaldo Valenzuela, Ph.D.
Director, Wireless Communications Research
Bell Laboratories

- Led and pioneered the development of the so-called "myriad filtering" communication theory and paved the way for the use of this technology in practical communications systems. The fundamentals of myriad filtering technology were invented and first introduced to the scientific community by Dr. Gonzalez previous to joining Bell Labs. Inside Bell Labs, Dr. Gonzalez led a team of scientists that, by exploiting the theoretical foundations of myriad filtering, were able to formulate a unified theoretical framework under which fundamental communications problems commonly found in practice were easy to optimize and solve. Dr. Gonzalez's work enables groundbreaking quality improvements in systems where impulsive interference and noise are commonly found, most notably: fast Internet access technologies such as digital cable modems and DSL, wireless systems in urban and cluttered (in-door) environments, radar, and sonar. Part of this work has been disseminated through multiple U.S. patent applications in the areas of modulation, coding, equalization, and synchronization (see *Patents* section in this document). Other parts are still guarded under trade secret protection by Bell Labs.

"[With myriad filtering technology] Dr. Gonzalez has brought a fresh perspective to a set of old problems for which the conventional wisdom said that all the gold had already been mined."

Dr. R. Anthony Shober, Ph.D.
Technical Manager
Lucent Technologies – Bell Laboratories

- Provided technical leadership, served as technical advisor and sounding board member, and contributed with R&D innovations to several multidisciplinary groups working on core product and technology development. Dr. Gonzalez's particular contributions include system design and research innovations for third-generation cellular phone systems (CDMA2000, 3GPP/UMTS, DoCoMo's W-CDMA), digital FM radio station broadcasting (Lucent Digital Radio Company), and microelectronics components (Lucent Orca FPGAs – Microelectronics Business Unit).
- Co-invented many of the so-called “baseband processing” algorithms used in the company's third generation cellular phone systems (3G), supporting mobile image, video, and Internet data communications. Particular contributions include novel and groundbreaking algorithms for demodulation, synchronization, error-correction coding, quantization, noise robustness, channel estimation, multiplexing, and interleaving. Many of these technical contributions are currently guarded under Bell Labs trade secret protection programs.
- Designed and implemented novel digital architectures (VLSI) for many of the company's wireless products. Particular contributions currently embedded in company's products and/or intellectual property span most aspects of modern communications algorithm technology, including: CDMA transmitters, RAKE receivers, space-time codes (BLAST), Turbo encoders/decoders, Viterbi decoders, trellis-coded modulation, adaptive modulation systems and timing circuits. Most of these technical contributions are currently guarded under Bell Labs trade secret protection programs.
- Pioneered and led a company-wide initiative to adopt open *system-on-chip* re-usable hardware architectures, which improved the quality of research and innovation, optimized the design processes, and reduced production cycles and cost. In addition to the establishment of a formal state-of-the-art VLSI design methodology for communications systems, Dr. Gonzalez designed and led the development of *the first* high-level intellectual-property core successfully developed and “productized” at Lucent. This core, called VUDU (for “Viterbi Universal Decoding Unit”) enabled the streamline design, from concept to synthesis, of virtually any kind of Viterbi decoding chip, reducing design cycles from months to just days or even hours. VUDU was successfully launched and marketed in the electronics industry, first as a Lucent product, and then as Agere's, Lucent Technologies microelectronics spin-off. Dr. Gonzalez designed the product architecture, and directed a team of eight scientists and technical staff that successfully implemented the system and demonstrated the potential of Dr. Gonzalez's system-on-chip methodology.
- Recruited and supervised several scientists and contractors that worked on Dr. Gonzalez's research programs on communications and microelectronics.

Researcher and Scholar, Advanced Digital Communications 1995 – 1997

U.S. Army ATIRP Federated Telecommunications Consortium / UD

The ATIRP Federated Telecommunications Consortium was formed to conduct tactical communications and information distribution research for the U.S. Army. The Consortium was made of top research organizations from industry and academy, including Lockheed Martin, Motorola, the University of Delaware, the Massachusetts Institute of Technology, and the University of Maryland. Many breakthroughs in telecommunications and computer science were generated by ATIRP during its lifecycle. The overall research work was funded and supervised by the U.S. Army Research Laboratories.

Learn more at: www.arl.army.mil

Dr. Gonzalez's research program investigated pioneering digital filtering algorithms for the treatment of signals in harsh or impulsive environments. Dr. Gonzalez received a Ph.D. with honors from the University of Delaware for part of this work.

- Invented the so-called "digital myriad filter," established its theoretical foundations, and led several research efforts that paved the way for the establishment of myriad filtering methods in communications, image processing, and advanced signal analysis. Myriad filtering technology shifts the paradigm of conventional filtering theory, enabling new groundbreaking applications in practical problems where impulsive noise and interference had been traditionally an impediment to system performance.

Digital myriad filters are currently well-known and in widespread use, are taught at major universities, and continue to be studied by scientists and practitioners worldwide. Researchers from over a dozen countries, encompassing many of the world's most prestigious research establishments, have either cited or used the myriad filter in fields as varied as telecommunications, applied astronomy, digital imaging, applied statistics, and theoretical signal processing. Dr. Gonzalez is widely recognized as the father of myriad filtering technology.

- Attracted over US\$1.1 million in funds from the U.S. Department of Defense and the U.S. National Science Foundation, to conduct advanced research in myriad filtering and its applications in the design of "harsh-noise resistant" wireless communications networks.

"With the invention of the myriad filter, Dr. Gonzalez opened a new paradigm for the analysis and processing of physical signals, which enabled new groundbreaking applications in multiple fields of science, engineering, and economics. [...] Dr. Gonzalez's work in the field of defense myriad filtering technology at the University of Delaware, was funded to the tune of US\$40 million dollars by the U.S. Army as part of a high level research consortium that included communications research heavy-weights such as Motorola, Lockheed Martin, GTE, Bellcore, and the MIT."

Prof. Xiang-Gen Xia, Ph.D.
University of Delaware
Associate Editor
IEEE Transactions on Signal Processing

"In its short life, myriad filtering theory has already had a significant impact on both commercial and academic worlds. Today, only a few years after Dr. Gonzalez introduced the fundamentals of myriad filtering to the research community, his theory has been the subject of research by theoretical and applied scientists at the most prestigious research organizations in the world."

Dr. Neiyer S. Correal, Ph.D.
Principal Scientist
Motorola Labs

- Co-directed the research work of several graduate students working on myriad filtering technology at the University of Delaware.
- The University of Delaware granted Dr. Gonzalez the 1997 Allan P. Colburn Award for his work on myriad filters on the basis of "quality of research and contributions to mankind." The Colburn Prize is the highest award granted for doctoral work completed at the University of Delaware. No more than one person can receive this award in a given year.

Researcher, Applied Signal Processing

1993 – 1995

Applied Science & Engineering Laboratories, A.I. duPont Institute / UD

The Applied Science and Engineering Laboratories conducts and develops advanced research programs on rehabilitation engineering and assistive technology initiatives for people with disabilities. It is jointly operated by the A. I. duPont Institute of the Nemours Foundation and the University of Delaware. The A. I. duPont Institute is a children's hospital and medical research organization, with one of the most prestigious rehabilitation engineering research programs in the world.

Learn more at: www.nemours.org

- Introduced pioneering signal processing methods for filtering out unwanted movement in people with tremor disability. Dr. Gonzalez invented the so-called equalizing “tremor filter,” to assist those with severe neurological illnesses such as Parkinson's disease, cerebral palsy, ataxia, and the elderly who suffer from tremor-related issues. When implanted in a controlling mechanism such as a wheelchair controller, a computer mouse, or a rehabilitation robot, the “tremor filter” enables a person with severe tremor disability to control his or her daily activities without the impediment of the abnormal tremor. Through the use of advanced intelligent algorithms, the tremor filter is able to learn the nature of a person's abnormal tremor and filter out the unwanted movements, providing the user with the ability to clearly direct an object and perform normal daily life activities.

The Rehabilitation Engineering Society of North America (RESNA) granted Dr. Gonzalez the 1995 Whitaker scientific paper award for the quality and potential impact of his research on the quality of life of persons with tremor disability.

“Dr. Gonzalez's invention of the equalizing tremor filter will allow those affected by tremor disability to regain control of much of their daily life activities -- and thus live a more fulfilling life that would enable them to contribute to society. The significance of the work that Dr. Gonzalez has spearheaded in the area of tremor suppression cannot be over-stated. About 1 million people in America suffer from some form of neurological disorder that manifests itself in tremor, and of those, more than 600,000 find themselves severely disabled to perform most of their daily-life activities, including feeding.”

Professor Daniel L. Lau, Ph.D.
University of Kentucky
Author of “*Modern Digital Half-toning*,” Marcel Dekker

“Dr. Gonzalez's seminal contributions in the field of tremor filtering have opened new exciting opportunities and new potential technologies to further enhance the lives of patients with tremor disabilities in the 21st century.”

Edwin A. Heredia, Ph.D.
Senior Scientist and Program Manager
Microsoft Corporation

Visiting Professor of Electrical Engineering *Pontificia Bolivariana University, Medellin, Colombia*

1992 – 1993

The Pontificia Bolivariana University has one of the top programs in electrical engineering in Colombia. Its Advanced Telecommunications Research and Development Group, called GIDAT, is recognized as the number one telecommunications research group in the country, according to the rankings of the Colombian National Science Foundation (Colciencias).

Learn more at: www.upb.edu.co

- Designed and taught three electrical engineering courses on advanced signal processing and telecommunications.
- Dr. Gonzalez received one of the highest scores in the 1992 School of Engineering's teaching survey, for his innovative and effective approach to the teaching of advanced digital signal processing.

Telecommunications Engineer *City of Medellin Telecommunications Company, Medellin, Colombia*

1990 – 1993

The City of Medellin Telecommunications Company is a division of the prestigious "Empresas Publicas de Medellin (EPM)," the organization in charge of all public utilities services in the metropolitan area of the city of Medellin. Serving a population of over 2 million, EPM has gained a well-deserved reputation as the most efficient public utilities services company in Latin America. Its telecommunications network is one of the most sophisticated and better administrated in the Latin American region.

Learn more at: www.eppm.com

Dr. Gonzalez was directly responsible for most traffic-related planning and design aspects of the company's 700,000+ subscribers network.

- Pioneered the formation of the company's teletraffic group, the first group in the company to routinely use and apply mathematical statistics methods to optimize network performance and design expansion plans under critical cost constraints.
- Designed and validated the dimensioning of the company's expansion project for the period 1995-1999, totaling over 160,000 new phone lines and representing a capital investment of over US\$40,000,000.
- Re-engineered obsolete channel and routing policies, improving the overall network architecture, and stimulating capital investments of over US\$1,000,000.
- Conducted research that resulted in economic-technological recommendations for strategic issues on digital signaling, data networks, digital switching and transmission.
- Invented a computer-controlled automated testing system for the company's payphones (software and hardware). Led a team of four technicians that successfully implemented the final prototype.

Research Assistant

1988 – 1990

National University of Colombia, Medellin, Colombia

The National University of Colombia is one of the leading research institutions in Colombia. Founded in 1867, it is the oldest and largest university in the country. Over 100,000 students apply to the university every year.

Learn more at: www.unal.edu.co

- Responsible (with others) for the administration of a state-of-the-art computer lab supporting the School of Sciences research and teaching efforts.
- Prepared and taught many short courses on computer applications for applied mathematics and statistics research.

4. Original scientific contributions

4.1. Refereed scientific publications

- 4.1.1. G. R. Arce, **J. G. Gonzalez**, Y. Li, “Weighted Myriad Filters,” **Invited Book Chapter**, in *Nonlinear Signal and Image Processing*. Edited by K. Barner and G. R. Arce, CRC Press, New York, 2004.

This book is part of CRC’s scientific book collection in Electrical Engineering and Applied Signal Processing. CRC Press is one of the world’s most prestigious editorial houses in science and technology, with a leading market share in engineering, health and mathematical sciences. This invited chapter introduces the basic concepts of Dr. Gonzalez’s myriad filtering theory to a very wide audience.

- 4.1.2. **J. G. Gonzalez** and G. R. Arce, “Statistically-efficient filtering in impulsive environments: Weighted myriad filters,” *EURASIP Journal on Applied Signal Processing*, vol. 2002, No. 1, pp. 4-20, January 2002.

A publication of the European Association for Speech, Signal, and Image Processing, Hindawi Publishing Corporation. The *EURASIP Journal on Applied Signal Processing* is one of the world’s most prestigious scientific journals in the area of applied signal processing.

- 4.1.3. **J. G. Gonzalez** and G. R. Arce, “Optimality of the myriad filter in practical impulsive noise environments,” *IEEE Transactions on Signal Processing*, vol 49, No 2, pp. 438-441, February 2001.

A publication of the IEEE Signal Processing Society, Institute of Electrical and Electronics Engineers, Inc. The *IEEE Transactions on Signal Processing* is the world’s most prestigious scientific journal in the field of signal processing.

- 4.1.4. **J. G. Gonzalez**, E. A. Heredia, T. Rahman, K. E. Barner, and G. R. Arce, "Optimal digital filtering for tremor suppression," *IEEE Transactions on Biomedical Engineering*, vol. 47, No. 5, p. 664-673, May 2000.

A publication of the IEEE Engineering in Medicine and Biology Society, Institute of Electrical and Electronics Engineers, Inc. The *IEEE Transactions on Biomedical Engineering* is the world's most prestigious scientific journal in the field of applied medical engineering.

- 4.1.5. **J. G. Gonzalez**, D. W. Griffith, A. B. Cooper, and G. R. Arce, "Robust adaptive receivers for channels with uncertain impulsiveness," in *Proc. U. S. Army ATIRP Annual Telecommunications Conference*, College Park, MD, January 1997.
- 4.1.6. D. W. Griffith, **J. G. Gonzalez**, and G. R. Arce, "Robust time-frequency representations for signals in alpha-stable noise," in *Proc. 31st International Conference on Information Sciences and Systems, CISS'97*, vol. 1, pp. 16-21, The Johns Hopkins University, Baltimore, MD, March 1997.
- 4.1.7. **J. G. Gonzalez**, D. L. Lau, and G. R. Arce, "Towards a general theory of robust nonlinear filtering: selection filters," in *IEEE International Conference On Acoustics, Speech and Signal Processing, ICASSP'97*, vol. 5, pp. 3837-3840, Munich, Germany, April 1997.
- 4.1.8. **J. G. Gonzalez**, D. W. Griffith, A. B. Cooper, and G. R. Arce, "Adaptive reception in impulsive noise," in *Proc. IEEE International Symposium on Information Theory, ISIT'97*, Ulm, Germany, p. 191, June 1997.
- 4.1.9. D. W. Griffith, **J. G. Gonzalez**, and G. R. Arce, "Robust time-frequency representations for signals in alpha-stable noise using fractional lower-order statistics," in *Proc. IEEE International Signal Processing Workshop on Higher Order Statistics*, Banff, Alberta, Canada, pp. 415-419, July 1997.
- 4.1.10. D. L. Lau and **J. G. Gonzalez**, "The closest-to-mean filter: An edge preserving smoother for Gaussian environments," in *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing, ICASSP'97*, Munich, Germany, vol. 4, pp. 2593-2596, April 1997.
- 4.1.11. **J. G. Gonzalez**, D. W. Griffith, and G. R. Arce, "Zero-order statistics: A signal processing framework for very impulsive environments," in *Proc. IEEE International Signal Processing Workshop on Higher Order Statistics*, Banff, Alberta, Canada, pp. 254-258, July 1997.
- 4.1.12. G. R. Arce, **J. G. Gonzalez**, and P. Zurbach, "Weighted myriad filters in imaging," **Invited Paper**, in *Proc. 30th Asilomar International Conference on Signals, Systems, and Computers*, Pacific Grove, CA, vol.2, pp. 1024-1028, November 1996.
- 4.1.13. **J. G. Gonzalez**, D. W. Griffith, and G. R. Arce, "Matched myriad filtering for robust communications," in *Proc. 1996 International Conference on Information Sciences and Systems, CISS'96*, Princeton, NJ, pp. 821-826, March 1996.
- 4.1.14. P. Zurbach, **J. G. Gonzalez**, and G. R. Arce. "Weighted myriad filters for image processing," in *Proc. IEEE International Symposium on Circuits and Systems, ISCAS'96*, Atlanta, GA, vol.2, pp. 726-728, May 1996.
- 4.1.15. **J. G. Gonzalez** and G. R. Arce. "Weighted myriad filters: A robust filtering framework derived from alpha-stable distributions," in *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing, ICASSP'96*, Atlanta, GA, vol. 5, pp. 2833-2836, May 1996. **Seminal Article on Myriad Filtering.**

- 4.1.16. **J. G. Gonzalez**, "Multiple Access in Wireless Communications," *Colombian Telecommunications Magazine*, CINTEL, November 1995.
- 4.1.17. **J. G. Gonzalez**, E. A. Heredia, T. Rahman, K. Barner, and G. R. Arce, "A customized optimal filter for eliminating operator's tremor," in *Proc. SPIE's International Symposium on Intelligent Systems and Advanced Manufacturing, Telemanipulator and Telepresence Technologies II*, Vol. 2590, pp. 131-142, Philadelphia, PA, October 1995.
- 4.1.18. M. Salganicoff, V. Jayachandran, D. Pino, T. Rahman, R. Mahoney, S. Chen, V. Kumar, W. Harwin, and **J. G. Gonzalez**, "A virtual head-stick rehabilitation robot system," **Invited Paper**, in *Proc. IEEE International Conference on Systems, Man and Cybernetics*, Vancouver, BC, Canada, vol. 3, pp. 2413-2418, October 1995.
- 4.1.19. **J. G. Gonzalez**, E. A. Heredia, T. Rahman, K. Barner, and G. R. Arce, "Filtering involuntary motion of people with tremor disability using optimal equalization," **Invited Paper**, in *Proc. IEEE International Conference on Systems, Man and Cybernetics*, Vancouver, BC, Canada, vol. 3, pp. 2402-2407, October 1995.
- 4.1.20. **J. G. Gonzalez**, E. A. Heredia, T. Rahman, K. E. Barner, S. K. Basu, and G. R. Arce, "A new approach to suppressing abnormal tremor through signal equalization," in *Proc. RESNA International Annual Conference*, Vancouver, BC, Canada, p. 707, June 1995. **Seminal Article on Tremor Filtering and Winner of the 1995 Whitaker Best Paper Award.**
- 4.1.21. **J. G. Gonzalez**, "Random Processes," **Invited Book Chapter**, in *Analog Communications*, pp. 26-38. Edited by J. Restrepo. Nabla-Delta Publications, Pontificia Bolivariana University Press, Medellin, Colombia, 1994.

4.2. Patents

- 4.2.1. *Systems and methods for adaptively decoding transmitted frames*, U. S. Patent Application No. [20030223512](#), (with S. Manji, J. Paredes, and W. Ahmed), Serial No. **161812**, U.S. Class No. **375/316**; 375/341, International Class No. H03K 009/00; H04L 027/06. **Filed:** June 4, 2002.
- 4.2.2. *Systems and methods for correcting errors in a received frame*, U. S. Patent Application No. [20030226086](#), (with S. Manji, J. Paredes, and W. Ahmed), Serial No. 159523, U.S. Class No. 714/755, International Class No. H03M 013/00. **Filed:** May 31, 2002.
- 4.2.3. *Method and system for processing a signal*, U.S. Patent Application, (with S. Manji, and J. L. Paredes), assigned to Lucent Technologies, Inc., **Filed:** May 27, 2002.
- 4.2.4. *Symbol synchronizer for impulse noise channels*, U. S. Patent Application No. [20030012316](#), (with S. Manji, J. Paredes, and W. Ahmed), Serial No. **903881**, U.S. Class No. **375/354**; 375/376, International Class No. H04L 007/00. **Filed:** July 12, 2001.
- 4.2.5. *Method and apparatus for making a channel estimate*, U. S. Patent Application No. [20020181624](#), (with S. Manji), Serial No. **837387**, U.S. Class No. **375/346**, International Class No. H03K 005/01. **Filed:** April 19, 2001.

4.3. Industrial papers and products

- 4.3.1. *Programming BLAST for business process automation and data mining*, Intellectual Property Systems, LLC, (with R. Nunez), January, 2004.
- 4.3.2. *BLAST (Batch Line Automated Sequential Tasker) – User’s Guide*, Intellectual Property Systems, LLC, (with R. Nunez), January, 2004.
- 4.3.3. *BLAST (Batch Line Automated Sequential Tasker) – Programmer’s Guide*, Intellectual Property Systems, LLC, (with R. Nunez), January, 2004.
- 4.3.4. *A multiline processor architecture for web crawling applications*, technical report, Intellectual Property Systems, LLC, (with R. Nunez), May, 2003.
- 4.3.5. *Electromagnetic-Based Computer Aided Design (CAD) for Wavelength Scale Optics*, Small Business Innovation Research (SBIR) Phase II Proposal, U.S. Army Topic Number 00-046, EE Solutions, LLC / EM Photonics, Inc., Dr. Juan G. Gonzalez, Principal Investigator, (with D. Prather, M. Mirotznik, S. Shi, U. Nguyen, and J. Durbano), May, 2001.
- 4.3.6. *VUDU 2.0, Viterbi Universal Decoding Unit*, Product Brief, Lucent Technologies, Microelectronics Unit, Preliminary Product Brief, August 2000 (with A. Baetz and R. Rajnarayan).

VUDU is a specialized “intellectual property” product that facilitates the design of communications integrated circuits. *VUDU* was conceived and invented by Dr. Gonzalez at Bell Laboratories. Dr. Gonzalez led a team of scientists and technical staff that developed *VUDU* and brought it to its final stages of “productization.” After productization, *VUDU* was first marketed as a Lucent Microelectronics product. After the spin-off of Lucent’s Microelectronics Business Unit as Agere, it was marketed in the microelectronics industry as an Agere product.

- 4.3.7. *Fixed-point turbo normalization and scaling*, Bell Labs Technical Memo, Lucent Technologies UMTS/3GPP algorithms group, (with L. Caceres and J. Lee), January, 2000.
- 4.3.8. *Improving IS-95 performance through the List-Viterbi Algorithm*, Bell Labs Technical Memo, Lucent Technologies Wireless Technology Laboratory, (with F. A. Sakarya), March 2000.
- 4.3.9. *Turbo normalization: fixed-point implementation*, Bell Labs Technical Memo, Lucent Technologies UMTS/3GPP algorithms group, (with L. Caceres and J. Lee), March, 2000.
- 4.3.10. *Multiplexing, Channel Coding and Interleaving Design for DoCoMo/UMTS BTS*, Lucent Technologies MCI/UMTS BTS product documentation, Lucent Technologies UMTS/3GPP algorithms group, (with R. Bachl, L. Caceres, J. Lee, A. Lu, P. Monogioudis, M. Shahid, and S. Varda), March 2000.
- 4.3.11. *Soft-decision channel estimation*, Bell Labs Technical Memo, Lucent Technologies Wireless Technology Laboratory, (with S. Manji), March, 2000.
- 4.3.12. *Adaptive decoding system for efficient communications in non-Gaussian non-stationary environments*, Bell Labs Technical Memo, Lucent Technologies Wireless Technology Laboratory, (with S. Manji and J. L. Paredes), August, 2000.
- 4.3.13. *Robust symbol synchronization in the presence of impulsive noise*, Bell Labs Technical Memo, Lucent Technologies Wireless Technology Laboratory, (with S. Manji and J. L. Paredes), August, 2000.

- 4.3.14. *Baseband diversity – a new technique to recover system losses from non-Gaussianities*, Bell Labs Technical Memo, Lucent Technologies Wireless Technology Laboratory, (with S. Manji and J. L. Paredes), September, 2000.
- 4.3.15. *Robust reception in impulsive noise – a new matched filter architecture*, Bell Labs Technical Memo, Lucent Technologies Wireless Technology Laboratory, (with S. Manji and J. L. Paredes), October, 2000.
- 4.3.16. *VUDU, Viterbi Universal Decoding Unit, Product Description and Integration Guide*, Lucent Technologies, Wireless Technology Laboratory/Bell Labs Design Automation, Holmdel, NJ, 1999 (with J. Potechin, A. Baetz, C. Zizzo, G. Jennings, and A. Rabaeijs,).

Supporting documentation to *VUDU*, the intellectual property microelectronics product conceived and championed by Dr. Gonzalez at Bell Laboratories.

- 4.3.17. *VUDU, Viterbi Universal Decoding Unit, C-model description*, Lucent Technologies, Wireless Technology Laboratory/Bell Labs Design Automation, Holmdel, NJ, 1999 (with J. Potechin, A. Baetz C. Zizzo, G. Jennings, and A. Rabaeijs,).

Supporting simulation software for *VUDU*, the intellectual property microelectronics product conceived and pioneered by Dr. Gonzalez at Bell Laboratories.

- 4.3.18. *Parallel VUDU, Viterbi Universal Decoding Unit, Lucent Technologies Product Brief*, Wireless Technology Laboratory/Bell Labs Design Automation, Holmdel, NJ, 1999 (with A. Baetz and R. Rajnarayan).

Parallel VUDU is an enhancement to *VUDU* with applications in fast communications networks. This product was conceived and championed by Dr. Gonzalez at Bell Laboratories.

- 4.3.19. *Parallel VUDU, Viterbi Universal Decoding Unit, User Manual*, Lucent Technologies, Wireless Technology Laboratory/Bell Labs Design Automation, Holmdel, NJ, 1999 (with J. Potechin, A. Baetz C. Zizzo, G. Jennings, and A. Rabaeijs,).

Supporting documentation to *Parallel VUDU*, a product conceived and championed by Dr. Gonzalez at Bell Laboratories.

- 4.3.20. *Decoders for UMTS*, technical report, Lucent Technologies Wireless Technology Laboratory, (with R. Rajnarayan, A. F. Sakarya, and R. A. Shober), June, 1999.
- 4.3.21. *Soft-decision decoding improvements for non-Gaussian noise*, report on summer research results, Wireless Technology Laboratory, Lucent Technologies, (with J. Lai), August, 1999.
- 4.3.22. *Algorithms for 2G and 3G – how to get the next 3 dB gain?*, technical report, Lucent Technologies Wireless Technology Laboratory, (with R. Rajnarayan, A. F. Sakarya, and R. A. Shober), September, 1999.
- 4.3.23. *A proposal for quantization scaling*, technical report, Lucent Technologies UMTS/3GPP algorithms group, Mount Olive, October, 1999.

- 4.3.24. *Scaling/normalization issues for Viterbi and Turbo decoding in the 3GPP BTS*, Bell Labs Technical Memo, Lucent Technologies UMTS/3GPP algorithms group, (with L. Caceres and J. Lee), December 1999.
- 4.3.25. *VUDU and beyond*, technical report, Lucent Technologies Wireless Technology Laboratory, December, 1998.
- 4.3.26. *A technical look into the future and penetration of telecommunication services*, technical report, Department of Electrical Engineering, University of Delaware, 1995.
- 4.3.27. *Efficient data transmission techniques for bandlimited channels – Telephone channels and modems*, technical report, Department of Electrical Engineering, University of Delaware, 1994.
- 4.3.28. *Estimation of the traffic matrix for the Aburra Valley telecommunications network, 161K lines expansion plan 1995-1999*, technical report, Inside Plant Technical Division, Empresas Publicas de Medellin, Telecommunications Unit, (with G. J. Ramirez), Medellin, Colombia, 1993.

5. Pioneering contributions to education

CONTRIBUTIONS TO ADVANCED EDUCATION IN COMMUNICATIONS HARDWARE

Dr. Gonzalez pioneered and implemented the first thorough course ever taught (in both academia and industry) on the topic of signal processing hardware design for communications systems. This course was taught for the first time at the University of Delaware in the Fall of 2000. **Dr. Gonzalez is using the material of this course to write the first book to be published in this field (currently in preparation).** According to Dr. Neiyer Correal, Principal Scientist at Motorola Labs, and Associate Editor of the IEEE Transactions on Education:

“Dr. Gonzalez was one of the first university professors to design and implement a graduate course on signal processing hardware design for communications systems. Signal processing hardware for communications has been traditionally an obscure area in the research community, avoided by theoreticians and carefully guarded under industrial trade secret protection by practitioners. However, it is only until one can understand the implications of theory on hardware architecture, as well as the algorithmic nature of the hardware, that research with true impact on real life applications can be made. Dr. Gonzalez’s course program, implemented at the University of Delaware, builds on his unique understanding of the interrelation between theoretical and practical issues.”

Dr. Neiyer S. Correal
Principal Scientist, Motorola Labs
Associate Editor
IEEE Transactions on Education

Dr. Gonzalez received the highest scores in the Fall 2000 University of Delaware Electrical Engineering teaching survey for both the innovative approach to teaching and the pioneering contributions of this course to advanced engineering education.

6. Research organizations citing or working on fields opened by Dr. Gonzalez

- 6.1. Massachusetts Institute of Technology, Cambridge, MA, USA
- 6.2. Advanced PHY Development Group, Intel Corporation, Sacramento, CA 95827, USA
- 6.3. Lucent Technologies, Inc, NJ, USA
- 6.4. National Science Foundation, USA
- 6.5. U.S. Air Force Office of Scientific Research, USA
- 6.6. Aware, Inc, Bedford, MA 01730, USA
- 6.7. Electrical and Computer Engineering Department, Northeastern University, Boston, MA 02115, USA
- 6.8. Advanced Telecommunications/Information Distribution Research Program (ATIRP) Consortium, U.S. Army Research Laboratory, USA
- 6.9. National Institute on Disability and Rehabilitation Research (NIDRR) of the U.S. Department of Education, USA
- 6.10. Department of Electrical and Computer Engineering, Department of Mechanical Engineering, University of Delaware, Newark, DE 19716, USA
- 6.11. Facultad de Informatica, Universidad de Sevilla, Avda. Reina Mercedes, s/n. 41012 Sevilla, SPAIN
- 6.12. Department of Electrical and Electronic Engineering, University of Newcastle upon Tyne, Newcastle upon Tyne, NE1 7RU, U.K.
- 6.13. Max-Planck-Institut fur Kernphysik, Heidelberg, GERMANY
- 6.14. Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA
- 6.15. ISO Data Centre, ESA Villafranca, Spain
- 6.16. European Southern Observatory, Santiago, CHILE
- 6.17. University of Arizona, Tucson, AZ, USA
- 6.18. Observatoire de Paris, Meudon, FRANCE
- 6.19. Max-Planck-Institut fur Aeronomie, Katlenburg-Lindau, GERMANY
- 6.20. Penn State University, Erie, PA, USA
- 6.21. Laboratoire d'astrophysique spatiale, Marseille, FRANCE
- 6.22. Max-Planck-Institut fur Astronomie, Heidelberg, GERMANY
- 6.23. Space Telescope Science Institute , Baltimore, MD, USA

- 6.24. University of Kent, Canterbury, U.K.
- 6.25. National Aerospace University (Kharkov Aviation Institute), 17 Chkalova Street, Kharkov, 601070, UKRAINE
- 6.26. Signal Processing Lab, Tampere University of Technology, FIN-33101, Tampere, FINLAND
- 6.27. Extended Manipulation Laboratory, A.I. duPont Hospital for Children, Wilmington, DE 19899, USA
- 6.28. Department of Biophysics, Faculty of Medicine, Pilsen, Charles University, Ovocný trh 5, Praha 1, 116 36, CZECH REPUBLIC
- 6.29. Department of Cybernetics, The University of Reading, Whiteknights, PO Box 225, Reading, ENGLAND
- 6.30. Applied Science and Engineering Laboratories, Alfred I. duPont Institute / University of Delaware, Wilmington, DE, USA
- 6.31. Department of Mechanical Engineering, John Hopkins University, Baltimore, MD 21218-2686, USA
- 6.32. The John Hopkins Microsurgery Advanced Design Laboratory, The Wilmer Ophthalmological Institute, Baltimore, MD 21287-9277, USA
- 6.33. Department of Electrical Engineering—Systems, Tel Aviv University, Tel Aviv, ISRAEL
- 6.34. Centre National de la Recherche Scientifique, Departement TSI, Ecole Nationale Supérieure des Télécommunications, Paris, FRANCE
- 6.35. Department of Electrical and Computer Engineering, North Carolina State University, Raleigh, NC 27695, USA
- 6.36. University of Geneva – CUI, 24 rue General Dufour, CH 1211, Geneva 4, SWITZERLAND
- 6.37. Faculty of Physical Education and Physiotherapy, Department of Neurorehabilitation and Department of Kinesiology, Katholieke Universiteit Leuven, Tervuursevest 101, B-3001 Heverlee, BELGIUM
- 6.38. Magnolia, Center for Rehabilitation, Brussels, BELGIUM
- 6.39. Zakład Elektroniki Biomedycznej, Instytut Elektroniki, Politechnika Śląska, POLAND
- 6.40. Cheops Technology, Deurne, BELGIUM
- 6.41. Systems and Computer Science Department, Howard University, Washington, DC, USA
- 6.42. Aggregate Network Solutions, Washington, DC, USA
- 6.43. National Multiple Sclerosis Center, Melsbroek, BELGIUM
- 6.44. Masku Neurological Rehabilitation Center, Masku, FINLAND
- 6.45. Multiple Sclerosis Unit, Bristol General Hospital, Bristol, U.K.
- 6.46. Perceptual Robotics (PERCRO), Scuola Superiore St. Anna, University of Pisa, ITALY

- 6.47. Sultane Qaboos University, OMAN
- 6.48. Institute of Signal Processing, TUT, FINLAND
- 6.49. The Robotics Institute, Carnegie Mellon University, Pittsburgh, PA 15213, USA
- 6.50. Department of Electrical Engineering, Ruhr-Universität Bochum, Bochum, GERMANY
- 6.51. Department of Mechanical and Systems Engineering, Kyoto Institute of Technology, JAPAN

7. Scientific accomplishments reported by others, that cite or build on Dr. Gonzalez's original contributions

- 7.1. L. Khriji and M. Gabbouj, "Rational-based adaptive fuzzy filters," *International Journal of Computational Cognition*, vol. 2, No. 1, pp.113.-132, 2003-2004.

Cites Dr. Gonzalez's myriad filters in the context of image processing.

- 7.2. T.Pander, "Robust filtering of ECG signal with a myriad filter," *Polish Journal of Medical Physics and Engineering*, przyjęty do druku, Poland, 2003.

Uses Dr. Gonzalez's myriad filter for the processing of electrocardiogram signals when corrupted by harsh interference.

- 7.3. V. V. Lukin, S. Abramov, A. A. Zelensky, and J. T. Astola, "Blind evaluation of noise variance in images using myriad operation," *Proceedings of SPIE* Vol. #4667, January 2002.

This scientific article builds entirely on Dr. Gonzalez's myriad filtering theory, to develop advanced algorithms for applied digital imaging. Important applications for the radar industry are identified and evaluated based on myriad filtering methods.

- 7.4. I. Djurovic and L. Stankovic, "Realization of robust filters in the frequency domain," *IEEE Signal Processing Letters*, vol. 9, No. 10, pp. 333-335, October 2002.

This scientific article uses the weighted myriad filter as a benchmark for new scientific findings in the field of digital filtering.

- 7.5. L. L. Burge and K. A. Loney, "IT Perspectives: Optimization of IEEE 802.11 CSMA/CA protocol in ad hoc networks using real-time protocols and algorithms," *BDPA Online Journal*, online-only article available at <http://www.bdpajournal.org/OldJournals/2001-02/persadhoc3.htm>, www.bdpajournal.org, 2002.

This article builds several algorithmic solutions to the optimization of data network traffic. It cites Dr. Gonzalez's theory of zero-order statistics (ZOS) in the context of alpha-stable statistical distributions.

- 7.6. S. K. Abramov and V. V. Lukin, "Adaptive myriad filters for 1-D signal processing," *The Fifth All-Ukrainian International Conference, Ukrobraz'2002*, Kyjiv, Ukraine, 2002.

This article studies and proposes new practical methods for using myriad filters in 1-D signal processing. Myriad filters were invented and established by Dr. Gonzalez.

- 7.7. *Uvahy o virtualni realite*. MEDLINK – texty, odzaky a informace. **Czech Encyclopedia**. Faculty of Medicine, Pilsen, Charles University, Czech Republic, available at <http://dante.lfp.cuni.cz/mednet/text.asp?typ=virtual&co=1> (accessibility verified March 28, 2002).

This is an on-line Medical Encyclopedia in Czech. It cites Dr. Gonzalez's work on signal processing for tremor suppression and its applications in virtual reality technology. (Manuscript is in Czech.)

- 7.8. I. Djurovic, L. Stankovic, and J. Boehme, "Myriad filter based form of the DFT," *Proc. 11th European Signal Processing Conference, EUSIPCO'2002*, September, 2002.

This article studies and proposes a new structure for the well-known Discrete Fourier Transform, using Dr. Gonzalez's myriad filtering theory. Myriad filters were invented and established by Dr. Gonzalez. The myriad filter based Discrete Fourier Transform has multiple applications in modern communications and image processing in impulsive environments.

- 7.9. A.Gertych and T.Pander, "Median and myriad filters - an evaluation," *International Conference on Computer Vision and Graphics, Conference Proceedings 1*, September 25-29, 2002, Zakopane, Poland, pp.275-281

A scientific evaluation of Dr. Gonzalez's myriad filters along with the well known class of so-called median filters.

- 7.10. T. C. Chuah, B. S. Sharif, and O. R. Hinton, "Performance of C-filter based adaptive spread spectrum receiver in non-Gaussian channels," *IEEE Proceedings*, vol. 148, pp. 321-326, 2001.

This article proposes and evaluates the performance of the so-called "variably-trimmed C-filter" for the processing of wireless communication signals using "DS-CDMA." It proposes an adaptive method that varies the resistance of the communications receiver by making a real-time estimation of an "impulsiveness" parameter. Dr. Gonzalez was one of the first persons in the world to propose this type of advanced technique for communications systems. The authors make use of Dr. Gonzalez's theory of zero-order statistics to analyze and evaluate the performance of the new technique.

DS-CDMA is one of the most widely used access technologies in the wireless communications and cellular telephony industries today.

- 7.11. Y. Li and G. Arce, "Robust and tunable correlation estimates using weighted myriads," *Proc. 2001 IEEE/EURASIP Workshop on Nonlinear Signal and Image Processing, NSIP'01*, Baltimore, Maryland, U.S.A., June 2001.

This scientific article builds on Dr. Gonzalez's rich myriad filtering theory to construct a powerful class of algorithms that generate extremely efficient estimates of *signal correlation* over a wide class of impulsive and not impulsive contamination environments. Signal correlation is a very important parameter used in many applied science fields, such as economics, geology, statistics, quality control, communications, and many more.

- 7.12. S. Abramov, V. Lukin, and J. Astola, "Adaptive Myriad Filter," *Proc. 2001 IEEE/EURASIP Workshop on Nonlinear Signal and Image Processing, NSIP'01*, Baltimore, Maryland, U.S.A., June 2001.

This article introduces new basic scientific contributions on myriad filtering theory. It builds on the seminal work introduced by Dr. Gonzalez's and extends the theoretical foundations of myriad filters by proposing novel myriad-based adaptive algorithms as well as practical recommendations for practitioners to design myriad filters in real life problems. Dramatic performance results are demonstrated when using several types of myriad filters to clean up noisy signals.

- 7.13. S. Pledgie, K. E. Barner, S. K. Agrawal, and T. Rahman, "Tremor suppression through impedance control," *IEEE Trans. On Rehabilitation Engineering*, vol. 8, No 1, p. 53-59, March 2001.

Cites Dr. Gonzalez's work on tremor filtering algorithms as valuable contributions that will benefit people suffering from tremor disability. Proposes new force feedback techniques that complement signal-processing-based tremor filters, and builds on several of the methodologies developed by Dr. Gonzalez to assess tremor filtering experiments.

The IEEE Transactions on Rehabilitation Engineering is the world's most prestigious scientific journal in assistive technologies for people with disabilities.

- 7.14. P. Feys, A. Romberg, J. Ruutinen, A. Davies-Smith, R. Jones, C. A. Avizzano, M. Bergamasco, and P. Ketelaer, "Assistive technology to improve PC interaction for people with intention tremor," *Journal of Rehabilitation Research and Development*, vol. 38, No. 2, March/April 2001.

This group of scientists from several of the most prestigious Multiple Sclerosis research centers in Belgium, England, Finland and Italy, cites Dr. Gonzalez's pioneering work on pathological tremor suppression through advanced signal processing.

The Journal of Rehabilitation Research and Development is a key part of the Rehabilitation Research and Development Service of the U.S. Department of Veteran Affairs. It is the most important scientific journal devoted to "advancing the discovery of new knowledge that optimizes rehabilitation health care for veterans."

- 7.15. A. B. Hamza and H. Krim, "Image denoising: A nonlinear robust statistical approach," *IEEE Transactions on Signal Processing*, vol. 49, No. 12, December 2001.

This article introduces several extensions to the myriad filtering framework established by Dr. Gonzalez, and applies the results to the important problem of cleaning noisy digital images, such as those found by telecommunications satellites. The theoretical properties of a newly proposed digital filter, called “Mean-LogCauchy filter,” are analyzed by means of Dr. Gonzalez’s fundamental myriad filtering theory.

The *IEEE Transactions on Signal Processing* is the world’s most prestigious scientific journal in the field of signal processing.

- 7.16. S. Voloshynovskiy, S. Pereira, V. Iquise, and T. Pun, “Attack modeling: Towards a second generation watermarking benchmark,” *Signal Processing*, vol. 81, pp. 1177-1214, 2001.

This article introduces a very thorough formulation of the so-called *digital watermarking attacks*, based on statistical estimation methods. Digital watermarking is a technique by which a hidden signature is embedded into digital data, such as an image or a one dollar bill, to protect data from being copied. Digital watermarking will be essential to protect any form of copyrights and prevent forging of currency or proprietary material in the twenty-first century. A watermarking attack is an attempt (usually fraudulent) by somebody to crack the watermarking protection system. The article cites Dr. Gonzalez’s myriad filter as a well known filter class based on statistical estimation.

Signal Processing is the leading European scientific journal in the field of signal processing.

- 7.17. S. Kalluri and G. R. Arce, “Robust frequency-selective filtering using weighted myriad filters admitting real-valued weights,” *IEEE Transactions on Signal Processing*, vol 49, No. 11, pp. 2721 – 2733, November 2001.

This scientific article builds on the theory of myriad filters introduced by Dr. Gonzalez, extending the myriad filter to the class of “frequency-selective” filters. This important filter class has fundamental applications in communication system design.

The *IEEE Transactions on Signal Processing* is the world’s most prestigious scientific journal in the field of signal processing.

- 7.18. J. V. Vaerenbergh, R. Vranken, L. Briers, and H. Briers, “A neural network for recognizing movement patterns during repetitive self-paced movements of the fingers in opposition to the thumb,” *Journal of Rehabilitative Medicine*, vol. 2001, No. 33, pp. 256-259, 2001.

This research article cites Dr. Gonzalez’s pioneering work on tremor suppression to assist people with Parkinson’s disease, as a good example of virtual reality techniques in which intelligent algorithms can perform certain tasks consistently better than a human would without assistance.

- 7.19. E. Grun, M. S. Hanner, S. B. Peschke, T. Muller, H. Boehnhardt, T. Y. Brook, H. Campins, J. Crovisier, C. Delahodde, I. Heinrichsen, H. U. Keller, R. F. Knacke, H. Kruger, P. Lamy, C. Leinert, D. Lemke, C. M. Lisse, M. Muller, D. J. Osip, M. Solc, M. Stickel, M. Sykes, V. Vanysek, and J. Zarnecki, “Broadband infrared photometry of comet Hale-Bopp with ISOPHOT,” *Astronomy & Astrophysics*, vol. 377, pp. 1098 – 1118, 2001.

This multidisciplinary team of scientists from eight different countries encompassing twelve of the world's most prestigious scientific research establishments, used Dr. Gonzalez's myriad filtering algorithms to improve the quality of their data in the observations of a recently discovered comet. Many outstanding scientific results in the fields of astronomy and astrophysics were obtained and reported from this research.

- 7.20. T. C. Chuah, B. S. Sharif, and O. R. Hinton, "Robust decorrelating decision-feedback multiuser detection in non-Gaussian channels," *Signal Processing*, vol. 81 No. 2001, pp.1997-2004, 2001.

This scientific article makes use of Dr. Gonzalez's theory of zero-order statistics to provide a framework that benchmarks a novel algorithm proposed for wireless communications networks. The authors mention Dr. Gonzalez's contribution as the world's first conceptually valid theory that can characterize the important class of impulsive signals under a mathematical framework.

- 7.21. S. K. Abramov, V. V. Lukin, and A. A. Zelensky, "Multiplicative noise variance evaluation in mm-band radar images using myriad estimation," *The Fourth International Kharkov Symp. on Physics and Engineering of Millimeter and Sub-Millimeter Waves*, vol. 1, pp. 429 – 431, 2001.

These scientists from the Ukraine's Kharkov Aviation Institute, build on of Dr. Gonzalez's myriad filtering technology to obtain improved automated imaging from radar devices. They demonstrate the superior quality of myriad filtering when compared against other commonly established methods for image detection. A concrete image construction based on the myriad filter is reported, which renders results with the same degree of "intelligence" as that of a "highly qualified human expert." Automated image construction based on radar is of paramount importance in the aerospace industry, and it is used widely in both commercial and military applications.

- 7.22. T. Pander, "Median and myriad nonlinear filters: a review," *VI International Conference SYMBIOSIS 2001 Proceedings*, pp. 121-127.

A review of myriad filtering technology in the context of median filters. Myriad filtering technology was invented and pioneered by Dr. Gonzalez.

- 7.23. T. C. Chuah, B. S. Sharif, and O. R. Hinton, "Robust adaptive spread-spectrum receiver with neural-net preprocessing in non-Gaussian noise," *IEEE Trans. Neural Networks*, vol. 12, pp. 546-558, 2001.

This scientific article introduces a novel neural network algorithm (artificial intelligence) for the so-called multi-user "CDMA" communications systems, with dramatic performance superiority in the presence of impulsive and bursty interference. The authors make extensive use of Dr. Gonzalez's theory of zero-order statistics (ZOS) to validate the performance studies of their techniques. Referring to Dr. Gonzalez's "geometric signal-to-noise ratio," or G-SNR, derived from the theory of ZOS, they say in this article:

"[...] the geometric SNR (G-SNR), based on the theory of zero-order statistics (ZOS) [cite to Dr. Gonzalez's published work], is evidently the first approach toward a mathematically and conceptually valid characterization of the relative strength between information-bearing signal and channel noise with infinite variance."

Multi-user “CDMA” technology is one of the most important (and pervasive) technologies in the multi-billion dollar wireless and cellular phone industry. The *IEEE Transactions on Neural Networks* is the world’s most prestigious scientific journal in the field of neural network technology.

- 7.24. T. C. Chuah, B. S. Sharif, and O. R. Hinton, “Robust signal processing for CDMA communications in non-Gaussian noise,” *5th International Conf. on Mathematics in Signal Processing*, Warwick, UK, 2000.

These scientists study and explain the concepts behind Dr. Gonzalez’s theory of zero-order statistics, and give a rationale for the practical use of the geometric signal-to-noise ratio (G-SNR) proposed by Dr. Gonzalez for characterizing impulsive statistics under a unique strong theoretical roof.

- 7.25. T. C. Chuah, B. S. Sharif, and O. R. Hinton, “Nonlinear space-time decorrelator for multiuser detection in non-Gaussian channels,” *IEE Electronics Letters*, Vol 36, No 24, pp. 2041-2043, 2000.

Dr. Gonzalez’s zero-order statistics (ZOS) theory is used by these scientists from the University of New Castle, United Kingdom, to characterize and assess the performance of a communications link when it is corrupted by impulsive interference. Dr. Gonzalez’s theoretical framework gives a solid scientific foundation to the findings of this research.

- 7.26. S. Kalluri and G. R. Arce, “Fast algorithms for weighted myriad computation by fixed-point search,” *IEEE Transactions on Signal Processing*, vol. 48, No. 1, pp. 159 – 171, January 2000.

This scientific article builds entirely on Dr. Gonzalez’s theory of myriad filters. It is a very valuable contribution to the development of myriad filtering theory and its applications, as it introduces new faster algorithms for the computation of the myriad filter.

The *IEEE Transactions on Signal Processing* is the world’s most prestigious scientific journal in the field of signal processing.

- 7.27. T. C. Chuah, B. S. Sharif, and O. R. Hinton, “Nonlinear decorrelator for multiuser detection in non-Gaussian impulsive environments,” *IEE Electronics Letters*, Vol 36, No 10, pp. 920-922, 2000.

This article makes use of Dr. Gonzalez’s theory of zero-order statistics (ZOS) to assess the performance of novel signal processing techniques used for multiuser wireless communication networks. The paper adopts Dr. Gonzalez’s “generalized signal-to-noise ratio” statistics, and makes use of the so-called “Gonzalez constant,” denoted by C_g , to compute quality of service graphs. Without Dr. Gonzalez’s theory of ZOS, the validation of the contributions in this article would have not had a solid scientific foundation.

- 7.28. S. K. Abramov, V. V. Lukin, and J. T. Astola, “Myriad filter properties and parameter selection,” *Ukrobraz 2000*, Ukrainian Research and Academic Network, Ukraine, 2000.

- 7.29. J. Friedman, H. Messer, and J. F. Cardoso, “Robust parameter estimation of a deterministic signal in impulsive noise,” *IEEE Transactions on Signal Processing*, vol. 48, No. 4, April 2000.

This scientific article introduces novel algorithms that allow to transmit and receive signals in environments corrupted by impulsive noise. It cites Dr. Gonzalez's myriad filtering statistical methods as a motivator to the development of the proposed approach.

The *IEEE Transactions on Signal Processing* is the world's most prestigious scientific journal in the field of signal processing.

- 7.30. S. Abramov, V. Lukin, J. Astola, "Myriad filter properties and parameter selection," in *Proc. of the Fifth All-Ukrainian International Conference UkrOBRAZ'2000, "Signal/Image Processing and Pattern Recognition,"* pp. 59-62, Kiev, Ukraine, November 2000.

- 7.31. M. Belge and E. L. Miller, "A sliding window RLS-like adaptive algorithm for filtering alpha-stable noise," *IEEE Signal Processing Letters*, vol. 7, No. 4, pp. 86-89, April 2000.

Cites Dr. Gonzalez's digital myriad filtering theory as one of the established methods to filter the important class of impulsive noise called "alpha-stable noise."

- 7.32. A. Cívít-Balcells, M. A. Jódar, C. Amaya, F. Díaz, L. Miró, and J. L. Sevillano, "A system for the analysis and scanning of tremor on handicapped people," *The 5th European Conf. for the Advancement of Assistive Technology*, Düsseldorf/Germany, November, 1999. Also in: *Assistive Technology on the Threshold of the New Millenium*. Edited by C. Buhler and H. Knops, IOS Press, 1999, pp. 539-544.

Reports a novel device built to measure and analyze upper-limb tremor in people with tremor disability. The device is intended to be used in the design of advanced tremor filters based on signal processing. The article cites Dr. Gonzalez's work as one of the pioneers in using and applying these techniques, and one of the motivators for the work reported in this article.

- 7.33. S. Pledgie, K. Barner, S. Agrawal, and T. Rahman, "Tremor suppression through force feedback," *Proc. 1999 International Conference on Rehabilitation Robotics, ICORR '99*, Stanford, CA, USA, pp. 16-26, 1999.

Cites Dr. Gonzalez's pioneering work on advanced signal processing algorithms for the suppression of tremor in people with disabilities.

- 7.34. Y. Berananda, *Adaptive myriad filters for image processing in alpha-stable impulsive noise*. Master's thesis, Department of Electrical Engineering, University of Delaware, Newark, Delaware, U.S.A., 1999.

This research work builds completely on Dr. Gonzalez's myriad filtering theory. It applies adaptive algorithms for computing the myriad filter, with particular emphasis on applications in digital imaging.

- 7.35. S. Kalluri and G. R. Arce, "A general class of nonlinear normalized adaptive filtering algorithms," *IEEE Transactions on Signal Processing*, vol 47, No. 8, pp. 2262 – 2272, August 1999.

This scientific article introduces a new class of the so-called “normalized adaptive algorithms” for nonlinear digital filters. The algorithms are then successfully tested using the digital myriad filter class invented by Dr. Gonzalez.

The *IEEE Transactions on Signal Processing* is the world’s most prestigious scientific journal in the field of signal processing.

- 7.36. A. B. Cooper, “Sequence demodulation in impulsive noise,” in *Proc. IEEE International Conference on Telecommunications, ICT’98*, Chalkidiki, Greece, June, 1998.

This scientific article builds on Dr. Gonzalez’s theory of zero-order statistics to develop the so-called “zero-order Viterbi decoder,” a decoding algorithm that allows the correction of transmission errors in the presence of very heavy impulsive noise. This decoder is optimal when the impulsiveness of the environment is maximal.

- 7.37. S. Kalluri and G. R. Arce, “A general class of nonlinear normalized LMS-type adaptive algorithms,” *Proc. 1998 Conf. on Information Sciences and Systems*, Princeton, NJ, U.S.A., March 1998.

This article uses Dr. Gonzalez’s myriad filters as a benchmark to validate a novel class of algorithms proposed by the authors.

- 7.38. E. E. Kuruoglu, “Signal processing in alpha-stable noise environments: A least P-norm approach.” PhD Thesis, Signal Processing and Communications Laboratory, Department of Engineering, University of Cambridge, 1998.

Cites Dr. Gonzalez’s work on robust alpha-stable time-frequency signal processing, as the world’s first.

- 7.39. S. Kalluri and G. R. Arce, “Adaptive weighted myriad filter algorithms for robust signal processing in alpha-stable noise environments,” *IEEE Transactions on Signal Processing*, vol. 46, no. 2, pp. 322-334, February 1998.

This article builds entirely on Dr. Gonzalez’s contributions to propose novel adaptive filters with potential applications in communications and signal processing problems corrupted by impulsive noise. It extends Dr. Gonzalez’s theory of myriad filters to the so-called class of “stochastic gradient-based” adaptive algorithms. New powerful algorithms are discovered based on Dr. Gonzalez’s seminal work.

The *IEEE Transactions on Signal Processing* is the world’s most prestigious scientific journal in the field of signal processing.

- 7.40. C. N. Riviere, R. S. Rader, and N. V. Thakor, “Adaptive canceling of physiological tremor for improved precision in microsurgery,” *IEEE Trans. on Biomedical Engineering*, vol. 45, No. 7, pp. 839-846, July 1998.

Cites the pioneering work of Dr. Gonzalez’s on the suppression of pathological tremor through signal filtering. Due to the possibility of designing filters with zero latency, Dr. Gonzalez’s techniques can be applied to suppress the hand tremor of a surgeon, when operating a microsurgery robot for ultra-precise

operations. Several novel adaptive techniques based on advanced zero-latency filters are proposed by the authors, independently of Dr. Gonzalez's work.

- 7.41. S. Kalluri, *Nonlinear Adaptive Algorithms for Robust Signal Processing and Communications in Impulsive Environments*. Ph.D. dissertation, Department of Electrical and Computer Engineering, University of Delaware, Newark, Delaware, U.S.A., December 1998.

This research work builds completely on Dr. Gonzalez's myriad filtering theory, and extends both the theory and applications of digital myriad filters to a wide class of important signal processing and communications problems. Powerful algorithms for the computation of myriad filters are introduced.

- 7.42. S. Pledgie, "Tremor suppression through force feedback," Master's thesis, Department of Biomechanics and Movement Science, University of Delaware, Newark, Delaware, U.S.A., May 1998.

Cites Dr. Gonzalez's work on tremor filtering algorithms as valuable contributions that will benefit people suffering from tremor disability. Proposes new force feedback techniques that complement signal-processing-based tremor filters, and builds on several of the methodologies developed by Dr. Gonzalez to assess tremor filtering experiments.

- 7.43. Q. Xu, *Control strategies for tremor suppression*. Master's thesis, Department of Mechanical Engineering, University of Delaware, Newark, Delaware, USA, 1997.

Cites Dr. Gonzalez's tremor filtering algorithms as a solution for people with Parkinson's disease and other tremor disabilities. Builds on Dr. Gonzalez's results to propose advanced methods that include force feedback in the manipulator used by the person suffering from the pathological tremor.

- 7.44. S. Kalluri and G. R. Arce, "Adaptive algorithms for weighted myriad filter optimization," *Proc. 1997 IEEE Int. Conf. on Acoustics, Speech and Signal Processing, ICASSP'97*, Munich, Germany, April 1997.

This scientific article builds entirely on Dr. Gonzalez's theory of digital myriad filters. The authors introduce new methods for computing the myriad filter, that would aid in the penetration of myriad filters to technology fields such as data modem communications, in which computing speed is a critical factor.

- 7.45. C. N. Riviere and P. K. Khosla, "Augmenting the human-machine interface: improving manual accuracy," In *Proc. IEEE Int. Conf. on Robotics and Automation*, Albuquerque, New Mexico, pp. 20-25, April 1997.

Cites Dr. Gonzalez's pioneering work on tremor filtering algorithms for people with disabilities.

- 7.46. Q. Xu, J. Sun, T. Rahman and K. E. Barner, "Some control strategies for tremor suppression," *Proceedings of the 2nd Annual Alfred I. duPont Institute Orthopedic Research Symposium*, Wilmington, DE, 1996.

- 7.47. S. Kalluri and G. R. Arce, "Adaptive weighted myriad filter optimization for robust signal processing," *Proc. 1996 Conf. on Information Sciences and Systems*, Princeton, NJ, U.S.A., March 1996.

This scientific article introduces new algorithms for computing the myriad filter adaptively. It builds entirely on the rich theory of digital myriad filtering introduced and established by Dr. Gonzalez.

- 7.48. W. Harwin and T. Rahman, "Analysis of force-reflecting telerobotic systems for rehabilitation applications," *Proceedings of the 1st European Conf. on Disability, Virtual Reality and Associated Technologies* Maidenhead, UK, 1996

- 7.49. J. Q. Sun, Q. Xu, and T. Rahman, "Adaptive strategies for tremor suppression," *Proc. of the First Annual Alfred I. duPont Institute Orthopedic Research Symposium*, Wilmington, DE, June, 1995.

- 7.50. P. Zurbach, *Weighted myriad filters for image processing*. Master's thesis, Department of Electrical Engineering, University of Delaware, Newark, Delaware, U.S.A., 1995.

This research work builds completely on Dr. Gonzalez's myriad filtering theory. It applies myriad filtering technology to several important problems in digital imaging, such as image denoising and edge sharpening for digital imaging manipulation and quality improvement.

8. Honors & Awards

U.S. Small Business Innovation Research Award (SBIR)

2001

U.S. Department of Defense

Dr. Gonzalez received approximately US\$950,000 from strategic science and technology programs of the U.S. Army and the U.S. Navy, with the only goal of pushing on Dr. Gonzalez's hardware acceleration research program. The funds were granted to EE Solutions, LLC, with Dr. Gonzalez as Principal Investigator, by virtue of the tactical and strategic importance of Dr. Gonzalez's program to the national economy as well as to the interests of the U.S. Department of Defense. No financial obligations were asked by the U.S. Department of Defense in exchange for these funds, except for the company's commitment to develop the research program and thus "contribute to the U.S. worldwide technological dominance and economic development."

The Small Business Innovation Research Award (SBIR) is a prestigious and highly competitive award coordinated by the U.S. Small Business Administration and ten of the strongest U.S. Government R&D agencies and federal departments, including the Department of Defense. **From the extensive pool of high-quality SBIR proposals submitted continuously by top scientists and technology companies nationwide, only the top 3.3% are selected for an SBIR Award of this type on the basis of technical merit.**

The funds received were used to start up EM Photonics, Inc., now a leading company in the field of hardware-accelerated computational electromagnetics.

State of Delaware Innovation Award

2001

State of Delaware Economic Development Office (DEDO)

Dr. Gonzalez received US\$50,000 from the State of Delaware's Economic Development Office for the development of fundamental technologies in hardware acceleration for electromagnetics. The funds were granted to EE Solutions, LLC, to develop Dr. Gonzalez's research program with the purpose of "supporting and stimulating sustained economic development in the State of Delaware."

Allan P. Colburn Award

1998

University of Delaware, Newark, DE, USA

Dr. Gonzalez received the 1997 Allan P. Colburn Doctoral Award for pioneering research work on digital filtering that enabled new applications and improved the quality of wireless and mobile communications technology worldwide. **This is the highest award granted to a doctoral researcher at the University of Delaware for the "quality of research and contributions to mankind in the engineering and mathematical sciences."**

According to the U.S. News & World Report's ratings, the University of Delaware is in the Top 5 of American universities with the best engineering departments. The University of Delaware allocates over US\$35 million each year on research programs supported by doctoral researchers. Many of these programs consistently rise to the very top of their fields of endeavor worldwide, and, year after year, open new frontiers of knowledge in science and engineering technology. The Colburn Award is the most prestigious prize that a doctoral researcher in engineering can receive at the University of Delaware. Only one person can receive this award in a given year.

Whitaker Best Scientific Paper Award

1995

Rehabilitation Engineering Society of North America (RESNA)

Dr. Gonzalez received the 1995 Whitaker International Scientific Award from the Rehabilitation Engineering Society of North America (RESNA) for pioneering research work on tremor filtering for people with Parkinson's disease and other tremor disabilities. This is the highest international prize granted to a junior scientist for "groundbreaking engineering research work on assistive technologies for people with disabilities." No more than five persons around the world can receive this award in a given year.

Honor Degree Distinction in Electrical Engineering

1993

Pontificia Bolivariana University, Medellin, Colombia

This prestigious award is granted to the most outstanding individual graduating from the School of Electrical Engineering at the Pontificia Bolivariana

University. The Honor Degree is awarded on the basis of exceptional academic achievement, and it cannot be granted to more than one single person in a given year.

The Pontificia Bolivariana University has one of the top programs in electrical engineering in Colombia. It is recognized as the number one telecommunications research establishment in the country, according to the rankings of the Colombian National Science Foundation (Colciencias).

Graduate Honor Scholarship in Statistics

1992

National University of Colombia, Medellin, Colombia

Honor Scholarship funded by the National University of Colombia to pursue graduate studies in Statistics. This scholarship is granted on the basis of academic achievement to the single most outstanding student in the university's graduate program in Statistics.

First Place

1988

Advanced Mathematics Competitions

National University of Colombia, Medellin, Colombia

Dr. Gonzalez won the 1988 Math Competitions of the National University of Colombia in the Advanced Level Category. The competition was open to all of the 10,000+ undergraduate students of the Medellin Campus, and offered multiple monetary awards to the winners.

The National University of Colombia is the largest university in the country, and is ranked as the number one university with the best programs in mathematics and science nationwide.

ASHME Honor Roll International Medal in Mathematics

1986

The Mathematical Association of America

Dr. Gonzalez received the 1986 ASHME Honor Roll International Medal from the Mathematical Association of America in recognition of outstanding achievement in the 1986 ASHME/AMC International Mathematics Competitions. The ASHME/AMC is the most popular math competition for secondary school students in the United States and most of the western world, with a participation of over 413,000 students in over 5,100 schools last year. Only one person from each country can receive the ASHME Honor Roll International Medal in a given year.

First Place

1986

VI National Mathematical Olympiad, Colombia

Dr. Gonzalez won the first place in the VI Colombian National Mathematical Olympiad in 1986. The Colombian National Mathematical Olympiad is recognized as the most prestigious and meritorious math competition at the national level in Colombia, and it is widely known throughout the country. It is

made of two regional qualifying rounds and a two-day final held in Bogotá, Colombia. The competition is open to more than 1.5 million university and secondary school students nationwide.

Member, Colombian Mathematics Olympic Team

1986

XXVII International Mathematical Olympiads, Warsaw, Poland

Dr. Gonzalez was one of six olympists qualified through the Colombian National Olympiad to be part of the Colombian team at the XXVII International Mathematical Olympiad in Warsaw, Poland, in 1986. The International Mathematical Olympiad is the most prestigious and highly respected mathematics competition in the world. More than 80 countries take part in this competition every year.

Honor Roll Scholarship in Electrical Engineering

1986-1987

Pontificia Bolivariana University, Medellin, Colombia

Dr. Gonzalez received three Honor Roll Scholarships from the Pontificia Bolivariana University. This scholarship is granted on the basis of academic achievement to the single most outstanding student in the university's electrical engineering program.

Bronze Medal

1985

I Ibero-American Mathematical Olympiads, Paipa, Colombia

Dr. Gonzalez won a Bronze Medal in the I Iberoamerican Mathematical Olympiad in 1985. This competition is open to twenty-two of the so-called "Iberoamerican" countries, conformed by Spain, Portugal, and the core Central and South American countries, including Mexico.

Member, Colombian Mathematics Olympic Team

1985

XXVI International Mathematical Olympiads, Helsinki, Finland

Dr. Gonzalez was one of six olympists qualified through the Colombian National Olympiad to be part of the Colombian team at the XXVI International Mathematical Olympiad in Helsinki, Finland, in 1985. The International Mathematical Olympiad is the most prestigious and highly respected mathematics competition in the world. More than 80 countries take part in this competition every year.

Third Place

1985

V National Mathematical Olympiads, Colombia

Dr. Gonzalez won the third place in the VI Colombian National Mathematical Olympiad in 1986. The Colombian National Mathematical Olympiad is recognized as the most prestigious and meritorious math competition at the national level in Colombia, and it is widely known throughout the country. It is made of two regional qualifying rounds and a two-day final held in Bogotá,

Colombia. The competition is open to more than 1.5 million university and secondary school students nationwide.

Third Place

1985

I National Physics Olympiad, Colombia

Dr. Gonzalez won the third place in the I Colombian National Physics Olympiad in 1985. The National Physics Olympiad is recognized as the most prestigious and meritorious math competition at the national level in Colombia, and it is widely known throughout the country. It is made of two regional qualifying rounds and a two-day final held in Bogotá, Colombia. The competition is open to more than 1.5 million university and secondary school students nationwide.

First Place

1985

1985 Cauca Valley State Regional Mathematics Competition, Colombia

Dr. Gonzalez won the first place in the 1985 Cauca Valley State Regional Mathematics Competition, which coincided with the first qualifying round of the V National Mathematical Olympiad. The competition was open to more than 100,000 university and secondary school students in the Cauca Valley State.

Andres Bello Medal

1985

Ministry of Education, Government of Colombia

The Andres Bello Medal is the most prestigious recognition granted by the Colombian Ministry of Education to a High School graduate on the basis of academic achievement. It is granted to the very top scorers in the Colombian scholastic assessment test (SAT) for high school seniors. From over 400,000 students that take the test every year, the Ministry of Education designates fewer than one in 5,000 as recipients of the Andres Bello Medal.

9. Published media material about Dr. Gonzalez

In: Good News from Colombia

November, 1998, p.32

International Periodical

Dr. Gonzalez's work as a pioneer of cellular telephone technologies was featured in a special column of this periodical.

Good News from Colombia is a monthly independent periodical edited by several of the most important newspapers in the country. Only the most outstanding Colombians in the arts and sciences are featured by *Good News*. The periodical has multilingual national and international distribution.

In: El Colombiano*Colombian periodical – national circulation*

Dr. Gonzalez was nominated by *El Colombiano* as one of the Most Outstanding Colombians in Science.

El Colombiano is the second largest newspaper in Colombia. It has daily national circulation and more than 3 million readers nationwide.

National press (Colombia)

1985-1986

Dr. Gonzalez was featured repeatedly in the major national newspapers in Colombia during the period 1985-1986, for winning the 1986 National Mathematics Olympiad, and for taking part in multiple international Olympiads as a member of the national mathematics Olympic team – in one of these Olympiads, Dr. Gonzalez had the honor of winning a Bronze Medal for his country.

National television (Colombia)

1985-1986

Dr. Gonzalez was featured repeatedly in most major national TV news in Colombia during the period 1985-1986, for winning the 1986 National Mathematics Olympiad, and for taking part in multiple international Olympiads as a member of the national mathematics Olympic team – in one of these Olympiads, Dr. Gonzalez had the honor of winning a Bronze Medal for his country.

10. Participation as judge of the work of others

Member**Research Grant Proposals Technical Evaluation Committee***National Institute on Disability and Rehabilitation Research (NIDRR)**U.S. Department of Education*

Member of NIDRR technical evaluation committee for research grant proposals submitted to the U.S. Department of Education. Participated as expert in the fields of rehabilitation engineering and advanced signal processing techniques for the improvement of the quality of life of people with disabilities. The NIDRR is one of the top providers of funding for advanced rehabilitation engineering research in the United States. Only people who are recognized contributors to the field of rehabilitation are designated by NIDRR as evaluation committee experts.

Book Reviewer Scientist*John Wiley & Sons, Editorial House*

Expert scientific book reviewer for John Wiley & Sons Editorial House, in the field of digital signal processing. John Wiley & Sons is the world's most prestigious editorial house for scientific textbooks. With a market capitalization of over US\$1.3 billion, John Wiley & Sons was recently ranked in the top 40 of the world's most respected companies, according to *Financial Times*.

Peer Reviewer

IEEE Transactions on Signal Processing

Peer reviewer for scientific articles submitted to the journal. Participates as international expert in digital filtering and advanced signal processing. The *IEEE Transactions on Signal Processing* is the world's most prestigious scientific journal in the field of signal processing. Only world recognized experts in the subject are invited to participate as peer reviewers for the journal.

Peer Reviewer

IEEE Transactions on Image Processing

Peer reviewer for scientific articles submitted to the journal. Participates as international expert in digital filtering and advanced image processing algorithms. The *IEEE Transactions on Image Processing* is the world's most prestigious scientific journal in the field of digital image processing. Only world recognized experts in the subject are invited to participate as peer reviewers for the journal.

Peer Reviewer

Colombian Science Foundation (Colciencias)

Member of technical evaluation committee for research grant proposals submitted to the Foundation. Participated as expert in digital filtering and advanced signal processing algorithms. *Colciencias* provides most of the national funding for basic research in engineering and sciences in Colombia. Only well recognized international experts in a given field are invited as grant proposal reviewers by *Colciencias*.

Scientific Peer Reviewer

IEEE International Conference on Nonlinear Signal and Image Processing

Peer reviewer for scientific articles and proposals submitted for the conference. Participates as international expert in digital filtering and advanced nonlinear signal processing techniques. The IEEE International Conference on Nonlinear Signal and Image Processing (NSIP) is the world's premiere scientific conference in the field of nonlinear signal processing. Only world recognized experts in the field are invited to participate as peer reviewers.

Ph.D. Dissertation Committees

Member, Doctoral Dissertation Committee, Dr. A. Flaig, *Nearfield spot-beamforming with distributed arrays*, Department of Electrical Engineering, University of Delaware, 2000.

Master's theses

1. Y. Berananda, "Adaptive myriad filters for image processing in alpha-stable impulsive noise," Master's thesis, Department of Electrical Engineering, University of Delaware, 1999.
2. P. Zurbach, "Weighted myriad filters for image processing," Master's thesis, Department of Electrical Engineering, University of Delaware, 1996.

11. Other leadership activities in the field

11.1. Organization of international scientific conferences

- 11.1.1. Chair, Signal Detection and Estimation Session, *IEEE/EURASIP Conference on Nonlinear Signal and Image Processing*, Baltimore, MD, June, 2001.
- 11.1.2. Chair, Signal Processing for Communications Session, *IEEE/EURASIP Conference on Nonlinear Signal and Image Processing*, Baltimore, MD, June, 2001.
- 11.1.3. Invited to chair session, 1996 International Conference on Information Systems Analysis and Synthesis, Orlando, FL, USA, 1996.

11.2. Invited speeches

- 11.2.1. Honor Speaker, Plenary Session, *VII UPB Electrical Engineering International Technical Workshop*, Universidad Pontificia Bolivariana, Medellin, Colombia, October, 1999.
- 11.2.2. "Help! There is a thunderstorm – robust techniques for wireless communications in impulsive environments," *Bell Labs Wireless Coffee Hour*, Lucent Technologies, Whippany, NJ, 1998.
- 11.2.3. *VUDU 2.0 (Viterbi Universal Decoding Unit): The Story of an IP Soft Core in the Wireless Business Unit*, 1998 Lucent Technologies Design User's Conference, LTUDUC'98, Holmdel, NJ 1998.
- 11.2.4. Industry expert panelist, "Non-Gaussian methods in communications – a personal medley," *Panel on Non-Gaussian Signal Processing and Applications*, University of Delaware, Newark, DE, 1998.
- 11.2.5. "Robust algorithms for communications over impulsive environments," *Wireless Communications Symposium*, Motorola Research Labs, Schaumburg, IL, 1997.

- 11.2.6. “Weighted myriad filters for image processing,” *IEEE Int. Symp. on Circuits and Systems, ISCAS-96*, Atlanta, GA, 1996.
- 11.2.7. *Statistical signal processing*, continued education course, EAFIT University, Medellin, Colombia, 1996.
- 11.2.8. “Filtering involuntary motion of people with tremor disability using optimal equalization,” *IEEE Int. Conf. on Systems, Man and Cybernetics*, Vancouver, BC, Canada, 1995.
- 11.2.9. “A virtual head-stick rehabilitation robot system,” *IEEE Int. Conf. on Systems, Man and Cybernetics*, Vancouver, BC, Canada, 1995.

11.3. Executive boards

- 11.3.1. Executive Board Member, Forum for Colombian Development, Washington, DC (1996 – 1997).
The FCD was a U.S. non-profit organization whose primary mission was to push on the technological development of Colombia.