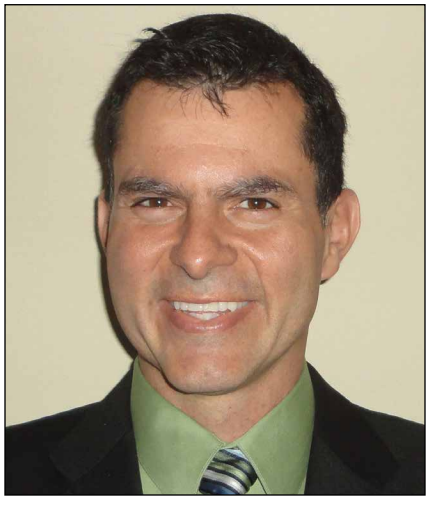
Interview

Keshab K. Parhi, *Life Fellow, IEEE*

Interview With Prof. Gabriel Alfonso Rincón-Mora

Gabriel Alfonso Rincón-Mora was awarded the 2025 IEEE Circuits and Systems Society's Charles A. Desoer Technical Achievement Award "for contributions to power-supply and energy-harvesting integrated circuits." He received the B.S. degree from Florida International University in 1992 and the M.S. and Ph.D. degrees from Georgia Institute of Technology in 1994 and 1996, respectively, all in electrical engineering. He has been with the Georgia Institute of Technology since 2001, where he is currently the Motorola Solutions Foundation Professor. He was with Texas Instruments from 1994 to 2003. He is a Fellow of the National Academy of Inventors, IEEE, and the Institution of Engineering and Technology. He was the Director of the Georgia Tech Analog Consortium from 2001 to 2004 and the TI Analog Fellowship Program from 2001 to 2015, and a Visiting Professor at National Cheng Kung University, Taiwan, from 2011 to 2019.



Prof. Rincón-Mora received the National Hispanic in Technology Award from the Society of Hispanic Professional Engineers, the Charles E. Perry Visionary Award from Florida International University, the Distinguished Faculty Achievement Award from the Georgia Institute of Technology, the IEEE Joseph M. Biedenbach Outstanding Engineering Educator Award from IEEE Region Three, the IEEE Outstanding Educator Award from the IEEE Atlanta Section, the Three-Year Patent Award from Texas Instruments, the Orgullo Hispano Award from Robins Air Force Base, the Hispanic Heritage Award from Robins Air Force Base, the State of California Commendation Certificate from Lieutenant Governor Cruz M. Bustamante, and the IEEE Service Award. He was inducted into Georgia Tech's Council of Outstanding Young Engineering Alumni, named one of "The 100 Most Influential Hispanics" by *Hispanic Business*, included in "List of Notable Venezuelan Americans" in Science, and selected IEEE Distinguished Lecturer for three two-year terms.

His body of work includes four textbooks, five slide books, three literary books, eight handbooks, four book chapters, 44 patents, over 200 articles, 25 educational videos, over 26 commercial power-chip products released to production, and over 160 keynote addresses, distinguished lectures, and research seminars. He has been featured on *Electronic Engineering Times*, *Planet Analog*, *Intown*, *Summa Cum Laude*, and *EEWeb* and has been on the covers of *Hispanic Business*, *Official Magazine of the Society of Hispanic Professional Engineers*, *La Fuente*, and *Nuevo Impacto*. He has served as the General Chair and Co-Chair, the Technical Program Chair and Co-Chair, an Associate Editor, a Guest Editor and the Co-Editor, the Chapter Chair and Vice-Chair, an International Liaison, a Steering Committee Member, and an Advisory Panel Member on multiple occasions for the IEEE CAS Society and other technical organizations.

Question 1: How did you feel when you learned you were selected for the Charles A. Desoer Technical Achievement award?

Prof. Rincón-Mora: I felt immensely honored and grateful. The IEEE Circuits and Systems Society has been my professional home for over thirty years, so receiving this award is very special for me.

The author is with the Department of Electrical and Computer Engineering, University of Minnesota Twin Cities, Minneapolis, MN 55455 USA (e-mail: parhi@umn.edu).

Digital Object Identifier 10.1109/MCAS.2025.3599335
Date of current version: 29 December 2025

Question 2: How would you describe what you do?

Prof. Rincón-Mora: I design integrated circuits that derive, condition, and manage power and energy from small exhaustible sources to supply and sustain portable devices and wireless microsensors for biomedical, consumer, and industrial applications. These microchips draw power from batteries, fuel cells, inductively coupled coils, or energy-harvesting transducers, such as photovoltaic cells, thermoelectric generators, electrostatic charge pumps, and piezoelectric cantilevers. And they embed intelligent feedback loops that manage and control how the system utilizes energy, steers power, damps ambient sources, supplies steady and dynamic loads, and tracks the maximum power point.

Question 3: How did you get into this field? Who inspired you?

Prof. Rincón-Mora: The first person to spark and inspire my interest and passion for analog integrated circuits was my Ph.D. advisor Phil Allen. He was also the one who inspired me to become a professor. I'll never forget the day he asked me in a seemingly off-handed fashion (and this was after I had already been working in industry for four to five years): "have you ever thought of becoming a professor?" My life would never be the same after that. I owe much of my career to him, Al Connelly, Randy Geiger, and Dick Jaeger. They have been beacons of insight and pillars of support throughout my career. I dedicate this award to another teacher, mentor, personal role model, and dear friend, Edgar Sánchez-Sinencio, who passed away in 2020, which was way too soon. (I miss him.) I was also inspired by the work of Paul Gray, Johan Huijsing, Barrie Gilbert, and Paul Brokaw. They have all helped shape my foundational perspectives on analog integrated circuits.

Question 4: You were selected as a Fellow of the Institution of Engineering and Technology in 2009, the IEEE in 2011, and the National Academy of Inventors in 2017. On which technologies have you had the most impact?

Prof. Rincón-Mora: I would say voltage references, low-dropout regulators (LDOs), switched-inductor power supplies, and energy-harvesting microchips. My designs, patents, papers, and books all pivot around these central themes. My first textbook was on voltage references with IEEE Press and John Wiley & Sons in 2001 [A1]. I have two editions on LDOs that McGraw-Hill published in 2009 and 2014 [A2] and one edition on switched-inductor power IC design that Springer Nature published in 2022 [A3]. I'm currently working on a second edition of this last textbook, which if all goes well, is due to publish in 2026.

Question 5: You've been working on analog and power IC design for over three decades. How have your focus and research evolved over these decades?

Prof. Rincón-Mora: My journey began at Texas Instruments in the 1990's with voltage references and LDOs. The challenges were to integrate accurate on-chip solutions that, with little stand-by current, could wake and respond quickly to fast asynchronous load dumps. I developed accurate low-voltage, piecewise-linear voltage references [A4] and fast pole-tracking LDOs that use positive feedback to accelerate their response time [A5]. This work grew to include highly-integrated BiCMOS switching power supplies. I designed accurate, fast-responding, and compact hysteretic power supplies [A6] with soft start-up features, automatic mode hopping, and droop compensation. I was told my designs went into many of the phones and laptops in use at the time, into Motorola, Nokia, and Ericsson phones and laptops with Intel chips.

When I returned to Georgia Tech in 2001, I continued working on many of the same power-management issues, but with an increasing focus on wireless microsensors. My team began exploring microsystems that draw power from tiny fuel cells and assistance from small on-board batteries. One key challenge was to develop fuel-cell and battery models [A7] that could predict performance and be used to dictate how the system could manage stand-by and fast-responding on-demand functions. Another challenge was to design intelligent controllers that could draw steady dc power from the fuel cell and dynamic asynchronous power from the battery with very high peak-to-average power ratios.

This line of research evolved and progressed to include harvesting energy from ambient sources, which became our focus in the 2010's. We began with tiny electrostatic charge pumps and quickly expanded our research to include piezoelectric, photovoltaic, thermoelectric, and electromagnetic sources. A key and ongoing challenge in this area is power density, because millimeter-scale transducers typically output very little power, on the order of nanowatts to a few microwatts [A8]. To draw more power from these elusive sources, we started recycling and investing energy back into the system, to increase the damping force with which the harvester extracts power [A9]. We're also developing intelligent, low-power CMOS controllers that can track the maximum power point, regulate the output voltage, recharge the battery with excess power, and use battery power to assist the ambient source when the load is too heavy for the transducer.

Question 6: You've received two IEEE educator awards for teaching analog and power integrated circuits. What do you think has been your most impactful contribution there?

Prof. Rincón-Mora: Perhaps my most important contribution has been fostering the idea that analog integrated-circuit design is rooted in insight. I teach and develop intuitive ways of understanding, analyzing, and designing analog and power integrated circuits. I use what I call trans–ohmic translations to determine gains directly from visual inspection, shunt-circuit transformations to approximate frequency response, feedback translations to predict the closed-loop behavior of systems that embed feedback loops [A10], insightful voltage-divider models to calculate power-supply gain and rejection, and other relatively easy-to-use tools and concepts to evaluate power-conversion efficiency, load-dump response, and other performance metrics. At the core of everything I teach is insight.

Question 7: Tell us a little bit about your literary work?

Prof. Rincón-Mora: I believe artistic expression and analog, and more broadly, engineering design go hand-in-hand. I wrote two books of poems and short stories and a novella that romanticize and fictionalize different aspects of my life. I've also performed in theatre and musical productions. These creative outlets have been incredibly enriching and rewarding for me. These days, however, my focus is more on engineering. I still love writing fiction and performing, of course, but I feel engineering is the creative outlet that allows me to impart the most impact.

Question 8: Is there something about you that people wouldn't normally know?

Prof. Rincón-Mora: I don't think many people know I like a little adventure. I summited Kilimanjaro, trekked to Base Camp on Mt. Everest, and hiked in the Amazon jungle, for example. I also volunteered in Ulaanbaatar in Mongolia and Kigonigoni in Tanzania. These days, my trips are a bit more subdued. My wife and I enjoy hiking in the woods on weekends and traveling to scenic and cultural destinations, like Hubbard Glacier and Pompeii.

Question 9: Do you have any advice for young engineers?

Prof. Rincón-Mora: When I was a student at Georgia Tech, I saw a poster that read: "What is the definition of luck? It's when talent meets opportunity." That simple line shaped much of my outlook on life and career. I took three lessons from it. First, we should work hard to develop our talent and skills, because success hinges on talent. Second, we should remain vigilant and flexible when unexpected opportunities arise, because achievements often spring from unexpected beginnings. And third, the word "luck" is really a mask for effort and readiness, which made me realize anyone who has had any "luck" in their careers is almost always because they've earned it.

Question 10: Anything else you would like to include?

Prof. Rincón-Mora: Maybe just this: do what you love, so you can love what you do.

Appendix: Related Articles

[A1] *Voltage References: From Precision to High-Order Bandgap Filters*, Wiley, Hoboken, NJ, USA, 2001.

[A2] *Analog IC Design With Low-Dropout Regulators*, 2nd ed., McGraw-Hill, New York, NY, USA, 2014.

[A3] *Switched Inductor Power IC Design*. Springer Nature, New York, NY, USA, 2022.

[A4] G. A. Rincón-Mora, "Low voltage, current-mode, piecewise-linear curvature corrected bandgap reference," U.S. Patent 5 952 873, Sep. 14, 1999.

[A5] G. A. Rincón-Mora and P. E. Allen, "A low-voltage, low quiescent current, low drop-out regulator," *IEEE J. Solid-State Circuits*, vol. 33, no. 1, pp. 36–44, Jan. 1998.

[A6] G. A. Rincón-Mora, "Integrated low ripple, high frequency hysteretic controller for DC–DC converters," U.S. Patent 6,369,555, Apr. 9, 2002.

[A7] M. Chen and G. A. Rincón-Mora, "An accurate electrical battery model capable of predicting runtime and I–V performance," *IEEE Trans. Energy Convers.*, vol. 21, no. 2, pp. 504–511, Jun. 2006.

[A8] E. O. Torres and G. A. Rincón-Mora, "Electrostatic energy-harvesting and battery-charging CMOS system prototype," *IEEE Trans. Circuits Syst. I, Reg. Papers*, vol. 56, no. 9, pp. 1938–1948, Sep. 2009.

[A9] D. Kwon and G. A. Rincón-Mora, "A single-inductor 0.35 μm CMOS energy-investing piezoelectric harvester," *IEEE J. Solid-State Circuits*, vol. 49, no. 10, pp. 2277–2291, Oct. 2014.

[A10] T. Zhao and G. A. Rincón-Mora, "Unraveling negative feedback translations: Gains, peaking, stability, and loop variations," *IEEE Trans. Circuits Syst. II, Exp. Briefs*, vol. 72, no. 3, pp. 454–458, Mar. 2025.