

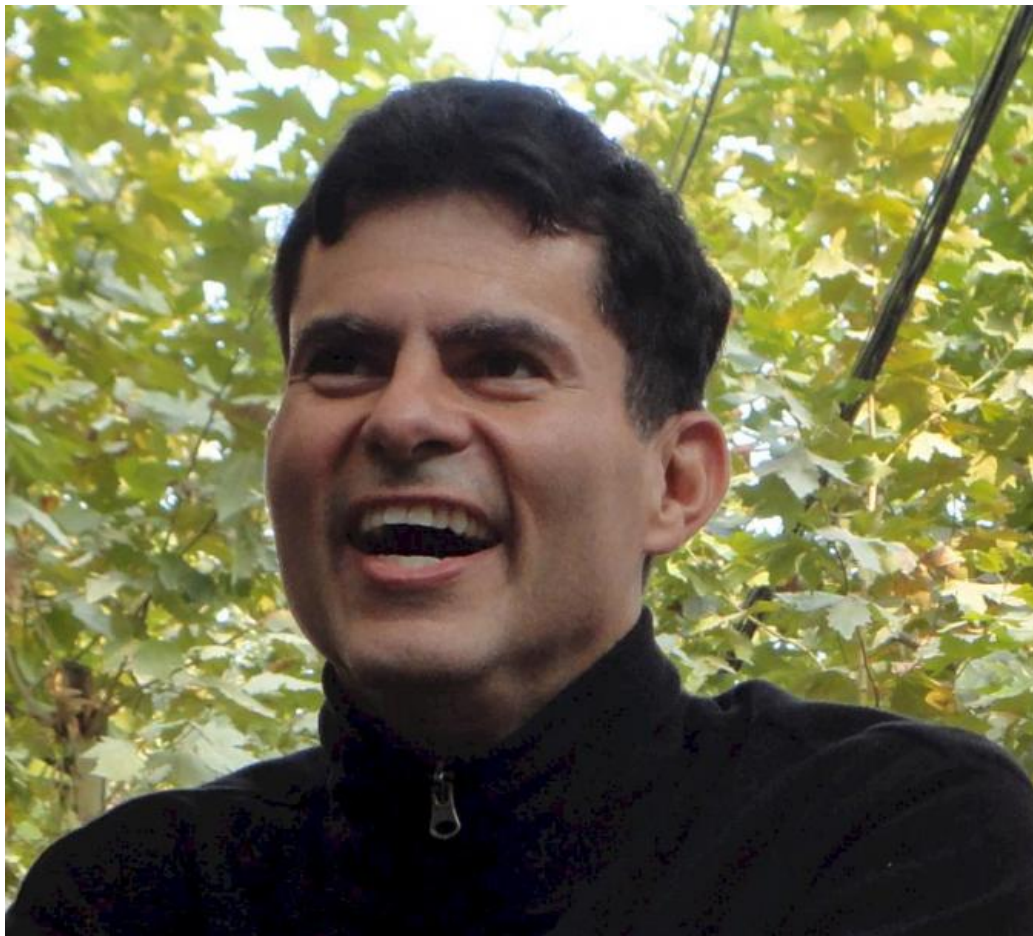


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## Featured Engineer



### **Gabriel Alfonso Rincón-Mora**

Gabriel Alfonso Rincón-Mora, Ph.D. - Professor, IEEE, IET Fellow

#### **How did you get into electronics and engineering and when did you start?**

As a child, I was interested in business, law, medicine, science, and engineering, but of these, science and engineering fascinated me the most. I have always been curious, and finding how the natural universe works and using it to build systems we humans can use captivated me from the start.

I do not remember when I first started exactly, but I remember disassembling, reconfiguring, and re-assembling the printed circuit board (PCB) in my mom's broken broiler when I was around eleven years old. I remember because, when I reconnected the broiler to the wall outlet, it exploded in front of my face. Fortunately, I managed to escape the accident unscathed, but the incident sparked quite a commotion in my family, as many of my aunts, uncles, and cousins heard the thunderous blast from the living room where they were sitting – it was a family gathering.

### **What is your favorite part of your job?**

Learning and building, without a doubt. Gaining insight into why and how the physical world functions excites me. And when I say “insight,” I do not mean equations – I mean understanding what causes what and how. Using this knowledge to design and build a working piece of hardware that is useful is thrilling for me. Seeing how often people use the cellular phone, for example, is a unique source of satisfaction for me because my colleagues and I when I was in industry designed many of the integrated circuits (ICs) that made the device work more efficiently and in a smaller platform. Now, as a professor, hearing others say they appreciate and use my technology to inspire and design next-generation products delights me, which is why sharing my research with the technical community at large culminates the design experience that I enjoy, because society can only reap the benefits of our technology when people hear about it.

### **What was the trickiest bug you ever fixed?**

The output voltage of one of my dc-dc regulator designs exhibited an unusual behavior: an erratic, seemingly uncorrelated, semi-periodic noise. I first suspected the feedback loop was unstable, but the frequency response measured and re-measured, simulated and re-simulated, and analyzed and re-analyzed could not account for it. Then I thought the part I selected was bad, but changing the PCB and the chip did not remedy the problem. Disbelieving my understanding of the system, I tried adjusting the frequency-compensating filter, but my efforts were in vain. To make a long story short, I ended up de-capping the microchip and probing different points on the actual die until I found that landing a probe on the bias-current generator stabilized the response. The issue was that substrate noise inadvertently triggered the asynchronous start-up circuit in the bias block, prompting the currents that biased the voltage reference and the feedback amplifier to fluctuate across time. In the end, adding more capacitance to the node that the start-up circuit sensed fixed the problem.

### **What is on your bookshelf?**

Hemingway's *The Old Man and the Sea*, Garcia Marquez' *Cien Años de Soledad*, Tolstoy's *War and Peace*, Guan Zhong's *Three Kingdoms*, Coelho's *El Alquimista*...I am a huge fan of classical literature. In fact, I never leave home without a book, or these days, without my electronic reader in hand, and I never have enough time to read as much as I would like. I must admit, though, that this was not always the case. I forced myself to start reading as a hobby when I finished graduate school. I started with short stories as a way of easing my way into the habit, until I developed a fancy to reading, and later a passion for it.

### **Do you have any tricks up your sleeve?**

Do I? I am not sure. Perhaps being somewhat organized is one. Another one can be my thirst for basic insight (that transcends algebraic formulations). I also think simplicity in design is a virtue, because unnecessary complexity is both risky and costly.

### **What has been your favorite project?**

Whatever project I am currently on is always my favorite, which means all my on-going research on energy-harvesting ICs and miniaturized low-power supplies are my favorite right now. And since all my previous projects on battery- and fuel cell-derived energy and power supplies were at some point my favorite, they are all very special to me. The books and articles I have written and am writing are like projects to me, so they too form part of the body of work that I like the most.

### **What are you currently working on?**

I am generally working on miniaturized supply systems that draw energy from lithium-ion batteries, super capacitors, and ambient energy, such as light, motion, temperature, and electromagnetic radiation. More specifically, my research team and I are working on fast, single-inductor, multiple-output switching dc-dc converters; photovoltaic charger-supply chips; piezoelectric chargers; electrostatic chargers; near-field wireless power transmission; and energy-harvesting starter circuits. I am also working on the second edition of one of my books and on two book chapters that I was invited to submit as contributions for upcoming books on microsystems and energy harvesting.

### **Within the context of your research, what direction do you see technology heading in the future?**

Wireless microsensors for homes, hospitals, factories, cars, motorcycles, bicycles, military camps, space stations, the human body, and many, many other places. All devices will communicate wirelessly, power themselves from the surrounding environment, sense their surrounding environment, and process and compress information. These networked contraptions will generally add intelligence to old, expensive-to-replace, difficult-to-reach, and unsafe infrastructures so they can perform more functions better with less energy and power.

### **What challenges do you foresee in our industry?**

Integration of diverse materials and functions into miniaturized, non-intrusive platforms. In other words, performing many functions well and reliably with limited energy and power at low cost is and will remain, I think, a fundamental challenge in our industry.

### **Do you do or have you done anything that most people might not expect from you?**

I do not think people suspect that I climbed Kilimanjaro; went to Tibet and hiked to base camp across Mount Everest; worked as a volunteer with orphans, kids with disabilities, and kids with aids in Tanzania, India, Mongolia, and Vietnam; and performed in theatre productions for several years. Now that I am married, however, my wife and I are ready to embark on other adventures...and maybe some of the same.

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