Engineering EDUCATOR

The latest news about teaching tools, measurement technologies and innovations in engineering education

Getting Ready for Growth

Mel Downs, Guest Editor

While everyone from the White House to Wall Street is worrying over Asia's financial and economic uncertainty, those who are watching Latin American countries should be pleased. Over the last few years they've made a lot of progress in controlling inflation, increasing exports, and reducing debt. And with healthier economies, they are experiencing faster, stronger growth. This is especially evident in the area of communications—which is not only an expanding industry in its own right, but is an essential part of the infrastructure required to support the growth of other industries.

Already, some Latin American countries feature wireless systems rivaling the best of the rest of the world's capabilities. It's a market ready to explode. But it can only do so with talented, trained, knowledgeable people to support it.

As an educator, you know that education is key to driving and sustaining growth. And that's why investment must be made to develop the engineers, scientists, and technicians who can produce the communications performance required to facilitate the rest of the economy.

In this issue you'll learn about one program—the Ibero-American Science and Technology Education Consortium (ISTEC)—that is doing a great job bringing educators and industry together. This multi-national effort helps talented engineering students gain the knowledge and expertise necessary to invent, build, and support the technologies that contribute to economic expansion and growth. ISTEC offers a model that can be implemented at even local and regional levels. It may suggest some ideas for you to consider in your own community.

I hope you enjoy all the articles in this issue, which focuses on engineering education initiatives in the Americas. And if your focus is on communications, keep watching our website (**www.hp.com/info/college_lab101**) as we roll out HP's *Back to Basics RF Symposium* over the next few months. This sought-after seminar will be on our website as a slide presentation with storyboard attached for your personal teaching or learning use. We hope you'll find it of great benefit.

Mel Downs
HP Test & Measurement
Education Program Manager for America

VOLUME 2, NUMBER 3
FALL 1998

IN THIS ISSUE

Share Your Thoughts

Marsh Faber, Editor

This newsletter, as well as the HP Educator's Corner Website **(www.hp.com/info/college_lab101)**, is intended to help you, the educators responsible for shaping students into competent engineers. But to do a good job of meeting your needs, we ask for your feedback. Please e-mail your comments, questions and concerns to: MARSH_FABER@hp.com.

Consistency, Please!

I suggest you use consistent units, preferably S.I. units. Don't mix BTU with watt. The unit symbol of hour is h, not hr. I expect HP to be consistent and accurate.

Professor Krish Chawla
University of Alabama at Birmingham

You caught us on that one. Hmmm, seems chilly in here. I'd better turn the thermostat up to 299 kelvins.

It's a Small World, After All

I really enjoy reading about engineering education around the world and various programs in the U.S.

Chris S. Baldwin
University of Maryland, College Park

Thanks. In fact, a number of readers say they like our global perspective. We'll try to keep it up. (See the ISTEC article in this issue.)

Grow that Website!

Expand the HP Educator's Corner website to include vector and scalar network analyzers. The matching tutorials are very informative and I will be directing my students to this site. It may be useful to have access to the interactive tutorials offline, since our internet link with a full campus is very slow. Ditto for all instrumentation tutorials. Please continue expanding this site as you have been doing.

Mr. Stephen McDonald
University of Natal Durban
South Africa

Thanks for the positive feedback. You can find the entire HP "RF: Back to the Basics Symposium" in Microsoft PowerPoint (.ppt) format on the site, plus hundreds of pages of RF lecture material, including network analysis.

The June 1, 1998 version of the entire site is also available on a CD-ROM that you can order via the HP Educator's Corner Website. The CD-ROM is for educators like yourself who suffer slow Internet connections or who want quick access.

Best Feedback by an Educator

In a survey, we recently asked an educator: "What are your measurement challenges?"

His reply: "College students."

Perked Up by Lab Idea

The [Rowan University] Lab Idea is super! From the obvious to the sublime. Well done!!

Greg P. Bazinet
University of Southern Maine

Thanks. We'll pass that on to the team at Rowan. We've had many positive comments about the Rowan coffeepot experiment. We'll look for more like it—experiments that go from a simple device or principle and move to something more substantial.

Editor's Note

Correction to the Coupled Oscillator URL: The easiest way to get to this virtual lab is to:

- *Go to HP Educator's Corner,* ***www.hp.com/info/college_lab101***
- *Select* ***Experiments****, then* ***Interactive Advanced***

Note: On June 1 we improved the site navigation to make it easier for you to find experiments.

For those of you who had trouble accessing Professor Sturm's URL: ***www.et.htwk-leipzig.de/fg_nach/profs/sturm.html*** *...*
It does work if you first access ***www.et.htwk-leipzig.de/fg_nach*** *and then go through the menus to* ***/profs****, and then to* ***/sturm.html****.*
Please note: contents of this site are written in German.

Connecting Students, Educators and Industry

We've had requests for information on HP education initiatives for K-12 education. Here's a story about a great one. What's more, it has application to all levels of schooling.

If "hindsight is an exact science," what could be better than for a future scientist to access its benefits through contact with a seasoned professional?*

This is the idea that inspired David Neils, an HP software engineer, to turn a simple request for math and science help into the HP E-mail Mentor Program. It is changing children's lives. And it has changed his.

Take the former South Carolina junior high school dropout and gang member. Within four months of connecting with a mentor, she raised her math grade to an 'A' and has plans to run her own business someday.

Take the high school student in a remote part of Alaska. Her dream of working in medical research looks more like reality since her mentor has helped her connect with scientists interested in her area of research and helped her apply for scholarships.

And take young Erin Lock, a Fort Collins, Colorado, sixth-grader, who was embarrassed about her interest in chemistry, zoology and biology, until her mentor put her in touch with a female microbiologist at Colorado State University. This professional now provides the perfect role model—not to mention valuable advice for Erin's science fair project.

Erin Lock's mentor helped her develop an award-winning science fair project.

The emotion and enthusiasm Neils has for the program he fondly refers to as "telementoring" is borne out with every anecdote he tells. It all began in 1995 when he asked fellow HP employees to volunteer their time with fifth- through twelfth-grade students via e-mail.

As Neils puts it, "Here was a way we could ensure a healthy workforce for the future . . . by helping students pursue their dreams in a professional manner. Both the mentors themselves and people they connect the students with offer the benefit of their own experiences—the successes and the pitfalls—in a structured, safe environment, cost-effectively, with no geographical limitations. It's an idea that can be applied to any educational situation at any level."

Through regular e-mail correspondence, mentors help motivate students to excel in math and science and to improve their communication and problem-solving skills. The program is an integrated part of the students' curriculum, and there must be a teacher who supervises it in the school. In the '97/ '98 school year, the program included a pilot for third-grade students in Palo Alto and one for college students at the University of Arizona. In addition to the benefit to students, teachers seek mentors' suggestions to help make their curricula more relevant to current issues in the professional world.

The program provides a valuable link between industry and education. It has been such a success that, in April, the program began a migration from an HP-based initiative to an international one involving other companies, as well. Today the program—under the auspices of the International Telementoring Center—is managed by the Mid-Continent Regional Education Laboratory (McRel) based in Aurora, Colorado. McRel is a leader in research for standards-based education.

*The HP E-mail Mentor Program (**http://mentor.external.hp.com**) is only one of HP's efforts to assist students and educators in the academic community. You can learn more about HP education programs from the "HP in Education" section at **www.hp.com/info/college_lab101**. For information on McRel, please see **www.mcrel.org.***
*The International Telementoring Center is at **www.telementor.org**. For information on HP education programs for K-12, please see **www.hp.com/go/hped.***

*Guy Bellamy, American journalist and author

Telephone Systems and Dialing Tones

OBJECTIVES:

1. To gain a basic understanding of telephones.

2. To demonstrate that we think in the frequency domain.

DISCUSSION:

Figure 1 shows the circuit diagram of a telephone circuit. Telephones are generally connected to a central office using a pair of twisted wires; however, new installations use a coaxial-fiber system for wider bandwidth. Unlike high-fidelity audio systems with bandwidths of 20 Hz – 20 kHz, a telephone operates over a 300 Hz – 3.3 kHz bandwidth. Most of the energy of the human voice is within this frequency range and that results in a reliable (but not excellent) conversation. This bandwidth limitation is the primary reason we have trouble distinguishing "b" from "p" from "d" over a telephone. The audio voltage swing is 5 – 500 mV peak, leading to a dynamic range of 40 dB, which is much lower than a hi-fi system (dynamic range of 70 – 90 dB).

Partly because they were invented before the AC 60 Hz power distribution system, telephones operate on a 48 V DC system supplied over a pair of lines from a central office. To activate the ringer, the control office sends

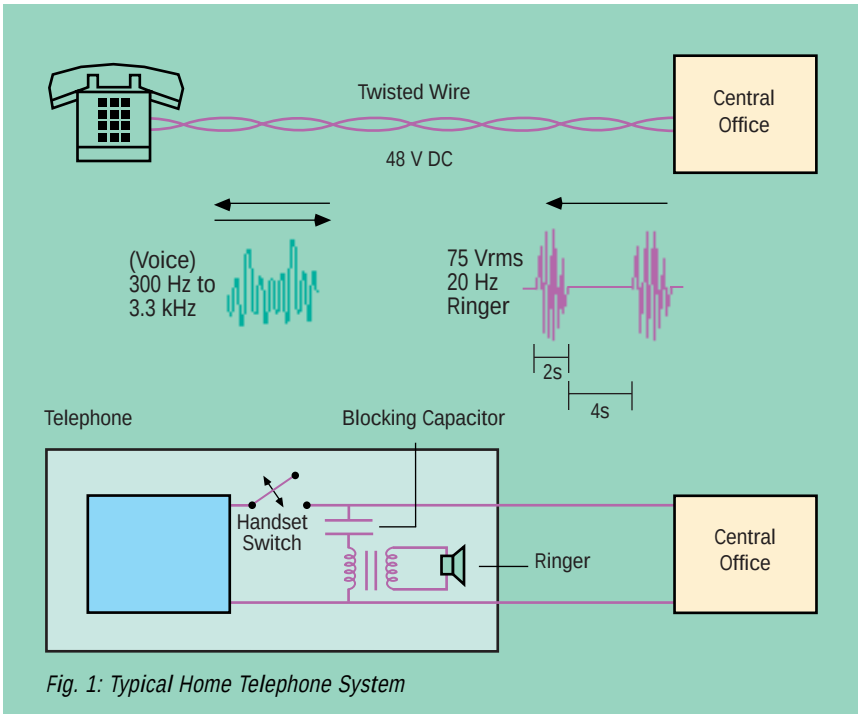


Fig. 1: Typical Home Telephone System

75 Vrms bursts of a 20 Hz sinusoidal signal—on for 2 seconds and off for 4 seconds. When someone answers the phone, the telephone switch closes, the central office detects a DC current in the circuit and stops the ringing signal. Why such a huge (75 V) voltage? Because it takes this level of power to activate inefficient ringers on old telephones. In newer phones with electronic ringers, a TTL (5 V) digital signal is enough; however, a TTL system is not compatible with old phones!

The lines between the central telephone office and your home carry:

DC (0 Hz) at 48 V: Powering the phone

20 Hz Bursts at 75 Vrms: Activating the ringer

300 – 3,300 Hz at 5 mV – 0.5 V: Voice signal

In order to dial a phone number, you need to transmit specific frequencies within the 300 Hz – 3,300 Hz range. However, if you assign a simple frequency to each number, the sound of someone whistling while you're dialing (or a loud clean sound) could actually cause a misdial! A simple way to solve this *interference* problem is to send two frequencies for each number. The probability that two specific frequencies with a ratio equal to a rational number are present in the background noise while you're dialing is quite low.

Professor Gabriel M. Rebeiz,
University of Michigan

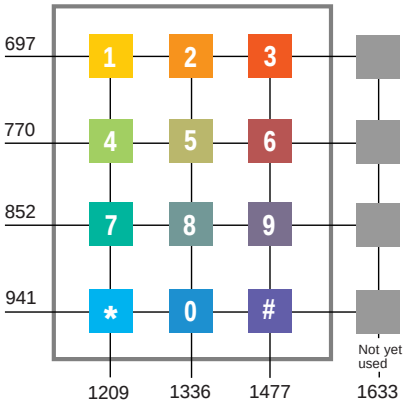


Fig. 2: Telephone Dial Pad (all frequencies in Hz)

Figure 2 shows the dial pad of a telephone. Pressing a key sends the two tones corresponding to the intersection of the vertical and horizontal axes. Notice that no frequency is the harmonic of any other frequency. This prevents problems due to distortion and harmonic generation. In addition, it's impossible for a frequency to be synthesized from the sum or difference of any two frequencies. This prevents misdialing problems due to intermodulation products.

EXPERIMENT:

Equipment:

- HP 34401A Multimeter
- HP E3631A Triple Power Supply
- HP 54645A Digital Oscilloscope (or another HP 54600-series scope)
- HP BenchLink/Scope Software with PC (optional)
- Telephone touch-pad, or inexpensive POTS (Plain Old Telephone Set)

Set-Up:

Set the HP E3631A power supply to: 4 V, Current limit = 100 mA. Insure that the power supply (–) terminal is connected to the ground (⏚) terminal. With the HP 34401A DMM, check the voltage before connecting the telephone dialer unit. The dialer LED should turn on when properly connected.

[Ed. Note: If you use a complete phone set instead of the dialer unit, you can power most phones over the two external wires by setting the HP E3631A to 12 – 15 volts, current limit = 100 mA.]

Exercises:

One

Dial any number(s) you wish and listen to the generated tones.

Two

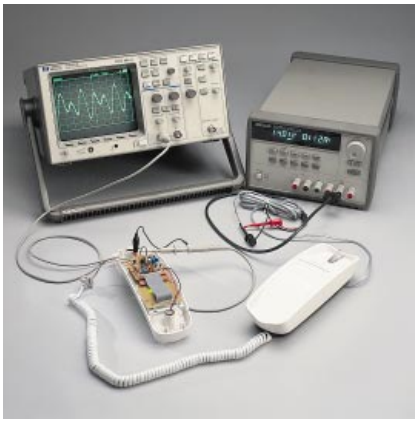
In the time domain, measure the signal resulting from the number 8. Choose a time span that results in a signal with many periods on the screen, and "STOP" the triggering of the scope (button in top right section). In cursor mode, try to read the "period" of this complex waveform (this is a bit tricky) and the corresponding "frequency" (f = 1/ΔT).

- Sketch the time waveform in your notebook.
- Now, "RUN" the oscilloscope again and set the FFT correctly. With cursors, measure the two frequencies (~852 Hz, ~1336 Hz), amplitudes (dBV) and the first five (5) harmonics/intermodulation products of decent amplitude (not noise) you see on the screen.
- Sketch the frequency spectrum in your notebook (don't include the noise), label the axes and put the measured values on the graph.

If you have HP BenchLink software, capture the waveforms and FFTs. See Figures 3 and 4.

Three

Repeat above exercise with any other number you choose (but not on the same column or row as the digit 8).



An HP 54600B Oscilloscope displays dialer output for digit 8 at speaker.

Four

Play for 5 – 10 minutes with the dialer, but don't take any data. See how the frequencies jump around but are understandable? See how *different* the time waveforms are from number to number, and how we can't quickly get a lot of information from them? This is yet another indication that *we think in the frequency domain!*

Five

- Take two sinusoidal signals at 852 Hz and 1336 Hz (number 8).

  $v_1(t) = \cos(2\pi\ (852)t)$

  $v_2(t) = \cos(2\pi\ (1336)t)$

- Plot: $v(t) = v_1(t) + v_2(t)$ using MatLab (or any program you wish).

  x-axis = 0 – 0.01 sec.
  (Choose small time steps).

  y-axis = –2 to +2 V

- The resulting waveform is complex. Look *carefully* at the graph: can you find the period, T, of the complex waveform? What are the peak voltages?

continued on page 6

Telephone Systems and Dialing Tones

Continued from page 5

Six

- If a circuit exhibits nonlinear behavior, it will generate harmonics and intermodulation products between two signals. For $f_1 = 852$ Hz and $f_2 = 1336$ Hz (number 8), calculate the following harmonic and intermodulation frequencies:

  $2f_1,\ 2f_2,\ f_2 - f_1,\ f_2 + f_1,\ 2f_2 - f_1,\ 2f_1 + f_2,\ 2f_1 - f_2,\ 2f_1 + f_2$

  The $(2f_1)$, $(3f_1)$, … and $(2f_2)$, $(3f_2)$, … are called the *harmonics* of the signals.

  The $(f_1 - f_2)$, $(f_1 + f_2)$, $(2f_1 + f_2)$, … are called the *intermodulation products* of the signals.

- Don't be surprised if you find some of these frequencies on your dial-tone spectrum.

Seven

Using the measured spectrum of the digit 8 in the telephone dialer, find the harmonic/intermodulation product $(nf_2 \pm mf_1)$ corresponding to each of the seven measured frequencies (for example: $f_1 = 852$ Hz, $f_2 = 1336$ Hz, then $2304 \text{ Hz} = 3f_2 - 2f_1$, …). Remember, the FFT and the inexpensive dialer are accurate to ± 50 Hz (or more), so your calculations need only be correct to ± 100 Hz (or more).

Eight

Translate the measured dB of the spectrum of #8 into Vrms for all the measured frequencies. Plot the following two functions (a) and (b) on the same graph. (Choose the appropriate x- and y-axis.)

Function a):

$$V_1(t) = \sqrt{2}\left(V_{\text{rms}_{(f_1)}} \cos\left(2\pi\,(f_1)\,t\right) + V_{\text{rms}_{(f_2)}} \cos\left(2\pi\,(f_2)\,t\right)\right)$$

$f_1 = 852$ Hz, $f_2 = 1336$ Hz

This is the ideal waveform for digit 8.

Function b):

$V_2(t) = V_1(t) + \sqrt{2}$ (measured values of five harmonics/intermod products)

This is the true measured waveform for digit 8.

Nine

Now, plot $V_2(t) - V_1(t)$ on a different graph and note the peak amplitude(s). This difference is partly due to nonlinearities in the speaker. Comment on $V_2(t) - V_1(t)$.

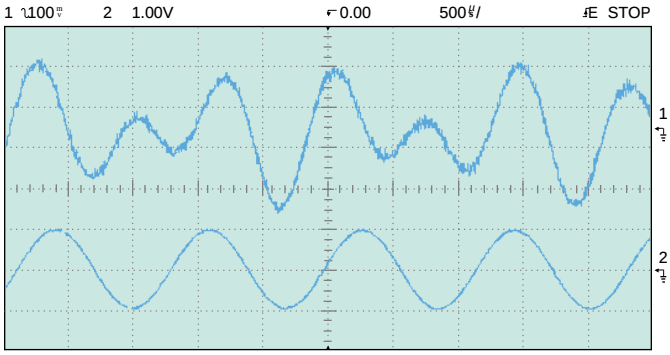


Figure 3a: Oscilloscope image of composite keypad signal for the number 8 (CH1). An 852 Hz signal from the HP 33120A (CH2).

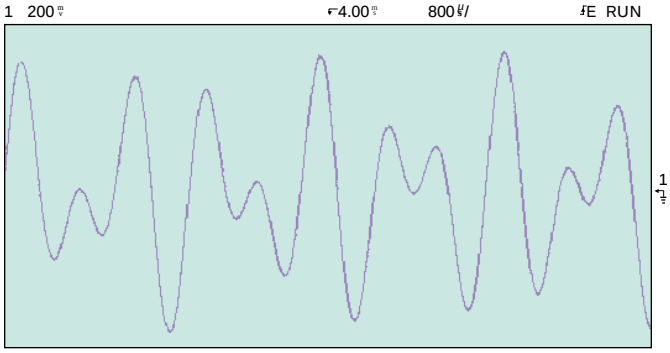


Figure 3b: You can simulate the composite signal by using HP Benchlink/Arb software to create an arbitrary waveform on the HP 33120A.

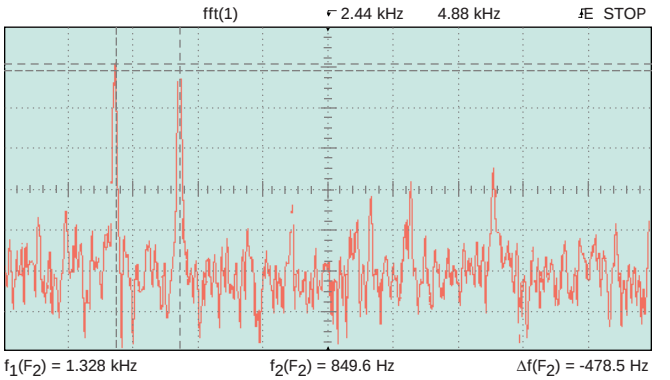


Figure 4: FFT of the mixed signal. Note that the frequencies (f_1 and f_2) are not exactly as predicted.

For permission to use this Lab Idea, please contact:
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What Engineers Wish They Had Learned In School

To know the road ahead, ask those coming back. -Chinese proverb

Even though you probably lace your teaching with worldly wisdom, the reality is that things like interpersonal relationships, boss-and-team communications, how to balance work and family life, and how to use company benefits wisely are often outside the limits of your curriculum. As a concerned educator, you probably do your best to direct your students toward other sources for this kind of information.

Now you can add one more resource to your list of suggestions: HP's "Crossroads for New Engineers" home page at **www.hp.com/info/student_web**.

Here's a place where graduating seniors and graduate students who are joining the work force for the first time can learn from practicing engineers—novices to 30-year lifers—about their own experiences and observations.

We invite working engineers to answer the question "What things didn't you learn in engineering school that you wish someone had taught you before you started your career?" Many engineers responded with advice that can only have come from astute observations—or some hard-learned lessons.

For example, you'll find an essay on interviewing which includes this valuable suggestion: "During a technical interview, think out loud. Let the interviewer know everything you know about the question or problem being discussed. In many cases, the interviewer is not looking for the right answer so much as for the problem-solving approach." And there are thoughts on issues to consider when accepting a job offer, such as "Be sure to get complete benefits information before you decide to accept an offer."

Your students will also find pointers like this one on how to face the real world after years as a student: "Try not to go immediately to the nearest car dealership and purchase the sportiest car on the lot." And there are many tips on the real world of work—from "Always invest in your 401k plan" to "If your new job involves traveling…only take with you what you can run with."

Some advice may sound humorous, but it's all valuable and based on practical, personal experience. What's more, it's all stuff they'll never see in a textbook.

We encourage you to encourage your students to visit our website and also to investigate the thousands of on-line, off-line, and human resources that can help put them ahead in the game of life at work.

"Your first year … you'll build a reputation that will stay in people's minds for many years. You'll want to be known for productive, thoughtful results, willingness to learn, and clear, courteous communications."

Dr. Ramiro Jordan:

How One Man's Idea Changed the Course of Engineering Education in 17 Countries

Dr. Ramiro Jordan (above, right), with the Ambassador of Bolivia at the ceremony where he received an award from the government of Brazil, at the Brazilian Embassy in Washington, D.C.

In that nonlinear phenomenon known as chaos, "a tiny event over here can have an enormous effect over there . . . equations that governed the flow of wind and moisture looked simple enough . . . until researchers realized that the flap of a butterfly's wings in Texas could change the course of a hurricane in Haiti . . ."

M. Waldrop, *Complexity*

ONE INDIVIDUAL CAN MAKE A DIFFERENCE.

He always knew he wanted to be an electrical engineer. And while he always hoped that one person's work could make a positive difference, he never expected such rapid change on an international level from his one simple idea.

Born in Bolivia, Dr. Ramiro Jordan spent his early years attending schools in almost every country of South America before graduating from the Universidade Nacional de La Plata, La Plata, Argentina, with an undergraduate degree. Though at the time his university's equipment and curricula were out of date, he learned engineering. He went on to receive his doctorate in electrical and computer engineering from Kansas State University, and in 1987 he joined the Electrical and Computer Engineering faculty at the University of New Mexico. Yet Ramiro Jordan never forgot his early educational experiences in the southern hemisphere.

Everywhere he lived throughout South America, Jordan had seen outstanding talent and serious desire for scientific and technological learning in the young people—in Argentina, Brazil, Venezuela, and parts in between. At the same time, he had witnessed and experienced first hand the difficulty of learning technical skills in an environment that lacked appropriate resources and current information. "The universities of South America had every ingredient they needed for student success," Jordan recalled, "except the resources."

As a professor with a passion for teaching electrical and computer engineering, Jordan wondered how the necessary educational resources might be provided for students in all of Latin America, that is, Mexico, Central America, and South America. Clearly, Latin America had the talent and the human potential to turn out the first-class engineers needed by high-technology firms. He began to formulate a plan: What if industry leaders could be persuaded to provide the necessary resources to Latin American universities? Wouldn't students be better educated, and wouldn't industry gain an invaluable source for knowledgeable employees, creative minds, and new business opportunities?

Arguing that there already existed strong connections in culture and language, Jordan and fellow professors Howard Pollard, Chaouki Abdallah, Sohail Naqvi, as well as doctoral student Paulo Franco, gained the support of University of New Mexico authorities to begin developing new mechanisms for cooperation between industry and educational institutions in all of the Americas, Spain, and Portugal.

Early in 1990, Jordan received funding from Motorola, Inc. to survey the status of science and technology in Latin America. Jordan and his colleagues visited with university professors, local industry leaders, multi-national company executives,

and government officials throughout Latin America, and they identified the four key problems facing engineering students in every country from Mexico to Argentina:

Lack of current information. People had no real-time access to information on new industry developments nor high-tech trends and needs. Only three countries then had Internet connections available.

Lack of training for the trainers. New, updated curricula were needed, especially at the graduate levels.

Lack of access to current technology. Students were working with outdated equipment and antiquated instruments in poorly designed laboratories.

Lack of expertise. Countries lacked the expertise and critical mass of informed persons to address problems crucial to the country's well-being, e.g. environmental issues, etc.

Following the survey in Latin America, Jordan and others created a list of key people in the information technology industry, educational institutions, and governments of Canada, the United States, Mexico, Central America, South America, Spain and Portugal. He invited them all to join him and his colleagues at the University of New Mexico for a two-day brainstorming session in December, 1990. They came. They brainstormed. They created a *Memorandum of Understanding for the Creation of the Ibero-American Science and Technology Education Consortium (ISTEC)*, along with four primary initiatives that would set the course for ISTEC over the next seven years.

In the following article you'll learn more about ISTEC and the way it has improved education for would-be engineers.

We celebrate and salute Dr. Ramiro Jordan for his significant contributions to the improved education of scientific and technological students in Latin America. And we thank him for reminding us that, indeed, one person can make big things happen.

HP VEE Educator's Instrument Lab Starter Kit

Here's everything you need to get your lab off to a good start - and at a price that's hard to pass up. The HP VEE Educator's Instrument Lab Starter Kit includes HP VEE Graphical Programming Language software that you can copy up to 40 times, as well as a collection of books, videos and computer-based training packages to get your teaching assistants up to speed quickly. Including rights to copy, it would sell to commercial customers for more than $60,000 (U.S.), but this starter kit, available only to educational institutions, is priced at less than $900 (U.S.).

HP VEE software lets your students focus on learning their course material rather than on mastering the intricacies of a programming language. With HP VEE students can create test and measurement programs for simulation, modeling and analysis by clicking and dragging icons into place and entering parameters and formulas in dialog boxes. To learn more about how universities around the world are using HP VEE, use the reply card to request an HP VEE brochure or visit **www.hp.com/go/HPVEE.**

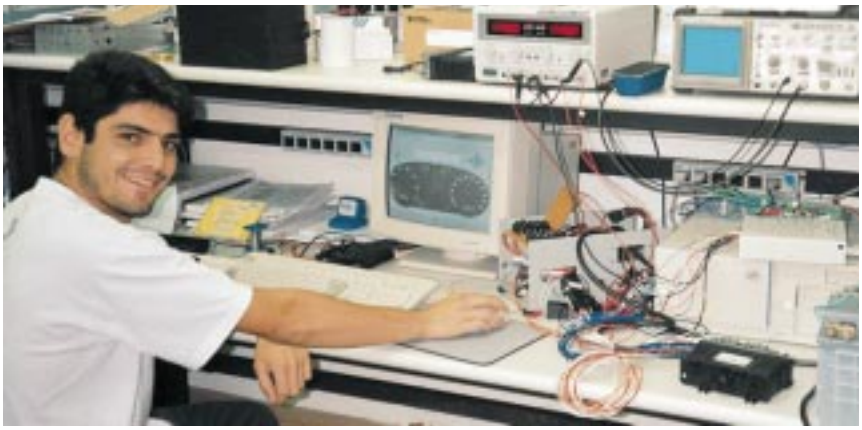
ISTEC: A Quiet but Powerful Revolution in Engineering Education

Dr. Ramiro Jordan, a founder of ISTEC

"*Scholarships are great, but they're pretty meaningless when students have no access to the resources essential to learning.*" *Dr. Ramiro Jordan*

It all started with an invitation for a two-day brainstorming session at the University of New Mexico (UNM). Dr. Ramiro Jordan and his colleagues in the Department of Electrical and Computer Engineering at UNM had invited people they believed could help change technical and scientific education in Latin America by giving students access to modern equipment, current information and professional contacts. As a result, educators, government officials, and high-tech industry leaders from throughout the Western Hemisphere met at the university in December of 1990. After intense discussion they wrote the *Memorandum of Understanding for the Creation of the Ibero-American Science and Technology Education Consortium (ISTEC)*, along with the following four primary initiatives that would set the course for ISTEC over the next seven years.

1. Library Linkages Initiative: Promotes the use and creation of innovative, real-time information-sharing services. Projects under this initiative include using networked communication systems to distribute materials, developing and maintaining regional databases, and generally improving access to materials for education and research. Two examples:

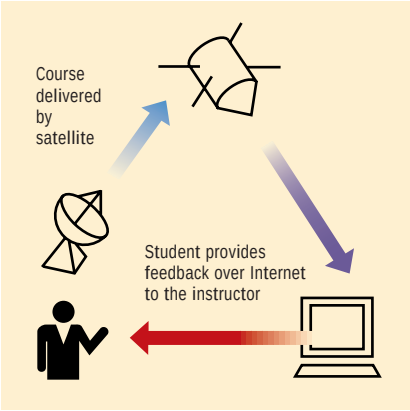


At a Universidade Estadual de Campinas lab in Brazil, performing research for Magneti Marelli of Italy, a student works on an automated test for automotive instrument panels.

- The Cooperative Interlibrary Loan project delivered 2,500 pages of current periodicals and theses during the first year of operation. Last year the number of documents more than doubled the volume of all previous years.
- Much Ibero-American research data is excluded from the worldwide exchange of information. The Information Access and Exchange Project aims to break this trend.

2. Advanced Continuing Education Initiative: Short "train-the-trainer" courses are being developed and delivered in a series of advanced technical presentations. ISTEC broadcasts its video courses to more than 300 institutions over Asociacion de Television Educativa Ibero-americana (ATEI) satellite. Two Examples:

- Hewlett-Packard Company is helping to cover production costs of *Introduction to Computer Networks* as part of the ISTEC-designed curriculum enhancement project, *Tecnologias de la Informacion*. Part of an 8-course series, it taps the technical expertise of senior research faculty from the Ibero-American world. It will be broadcast from Spain to member institutions.



- The Digital Image Processing course is a 10-hour video co-produced by the University of New Mexico (USA) and the Universidade Estadual de Campinas (Brazil). Its interactive format makes good use of web browsers, encouraging student progress and input by running atop the visual programming environment Khoros. The course is delivered via satellite; students provide feedback to instructors via the Internet.

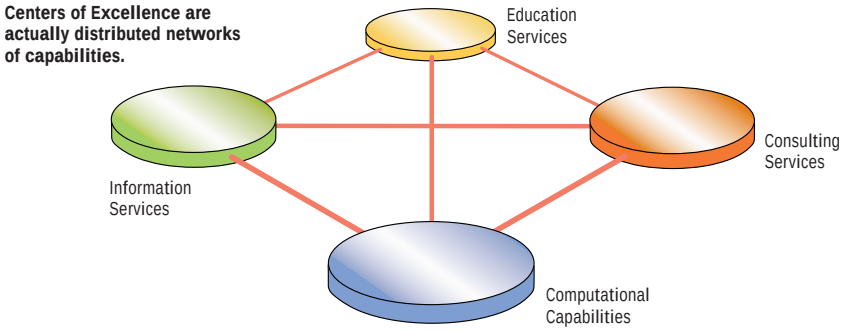
ISTEC is a non-profit organization that comprises educational, research, and industrial institutions throughout the Americas and the Iberian Peninsula. Currently there are 52 member institutions in 17 Ibero-American countries, including Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Paraguay, Peru, Portugal, Spain, Uruguay, and Venezuela. Motorola, Inc., Nortel, and Fluke, Inc. are founding members.

3. Research and Development Laboratories Initiative: Creates cooperating laboratories that are modular, flexible, and expandable for educational and R & D purposes. There are now similar laboratories in many ISTEC institutions. By having basic elements in common, laboratories can share experiments, experiences and techniques. Two examples:

- With the assistance of Motorola, Inc., the Consortium is in the process of installing over 30 laboratory sites throughout Latin America and the Iberian Peninsula.
- The *Multimodal Communications in the 21st Century* project supported by Nortel focuses on joining 12 universities, Nortel and other telecommunication service companies in order to develop educational curricula, joint R & D programs, laboratory facilities and faculty development.

4. "Los Libertadores" Initiative: Inspired by the famous liberators who changed the face of Latin American history, this initiative will create a next-generation network of multi-disciplinary Centers of Excellence. Rather than a central building, the Center will be a network of capabilities that will provide needed services to the country, including state-of-the-art information, education services, computational capabilities and world-wide access to expertise, as needed.

Without a lot of fanfare, ISTEC has progressed steadily since its founding days in late 1990. The work of the Consortium is raising the level and quality of education among the academic institutions of Latin America by providing key links with the private sector. Member countries of the Consortium are seeing their science and technology education brought to competitive levels. And, perhaps most importantly, ISTEC is helping young people continue to live and work in their own countries by providing learning and employment opportunities throughout Latin America.



The Consortium creates new investment opportunities, provides support for existing industries and finds solutions to local problems using current technologies. Funding comes from a number of local, regional and international sources. Additionally, each member of ISTEC contributes to operational expenses through annual membership dues. As partners in a win/win endeavor, the high technology industry members of ISTEC benefit from a trained workforce in many countries, new markets and contacts, and ready access to the universities and R & D centers throughout Latin America and the Iberian Peninsula.

The most meaningful aspects of the Consortium's work, of course, are the real-life opportunities it creates for the people of the participating countries. Professor Jose Martin Filho, Rector for Universidade Estadual de Campinas (UNICAMP) is so pleased with the program's impact on the capabilities of the UNICAMP Engineering Library that "our universities are extending this facility to the area of humanities."

One of the most exciting effects of ISTEC's work is that it brings the latest trends and information in the fast-moving fields of science and technology to educators who were formerly at the bottom of the technology distribution chain. Today, engineering students throughout Latin America are finally able to learn and work with state-of-the-art equipment, and will soon be using second-generation Internet linkages.

Success is contagious. And ISTEC expects that more companies from high technology industries will seek to join their quiet revolution.

You can find current information about ISTEC at **www.eece.unm.edu/istec**.

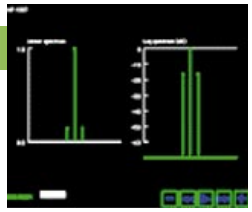
Website Update

The original HP Educator's Corner website, which we designed in April, 1997, was adequate to carry us through the past year, but with the content bulging to over twice its original length, your feedback made it clear that we needed to do a serious overhaul. And we listened. In June we redesigned the site, adding a much-improved navigation system and a new layout that makes it easier for you to discover what's new each month. Check it out at: **www.hp.com/info/college_lab101.**

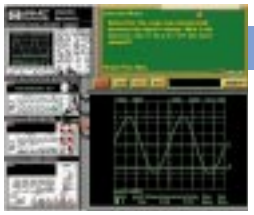
FEATURE ARTICLES

Now the HP Educator's Corner website will keep you up to date on trends in engineering education, new lab ideas, innovative ways to use equipment and more. We'll keep things more current and informative for you by periodically posting a feature article on the site.

NEW SIMULATIONS



Judging by how many educators download them onto their own sites, the spectral animations and computer-based learning packages are very popular. We've added more of them, covering new and more advanced topics. We'll keep this up as long as the budget holds out.



EXPERIMENTS

Lots of them. Lab experiments are the heart of the HP Educator's Corner website, and we've been fortunate to have some wonderful contributions by educators who use HP equipment. Check out some great new labs from Budapest, Duke University and the University of Michigan.

Do you know that the entire content of the HP Educator's Corner website—experiments, simulations, everything—is available on a single CD-ROM? And it's FREE! To order, see: **www.hp.com/info/college_lab101**.

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