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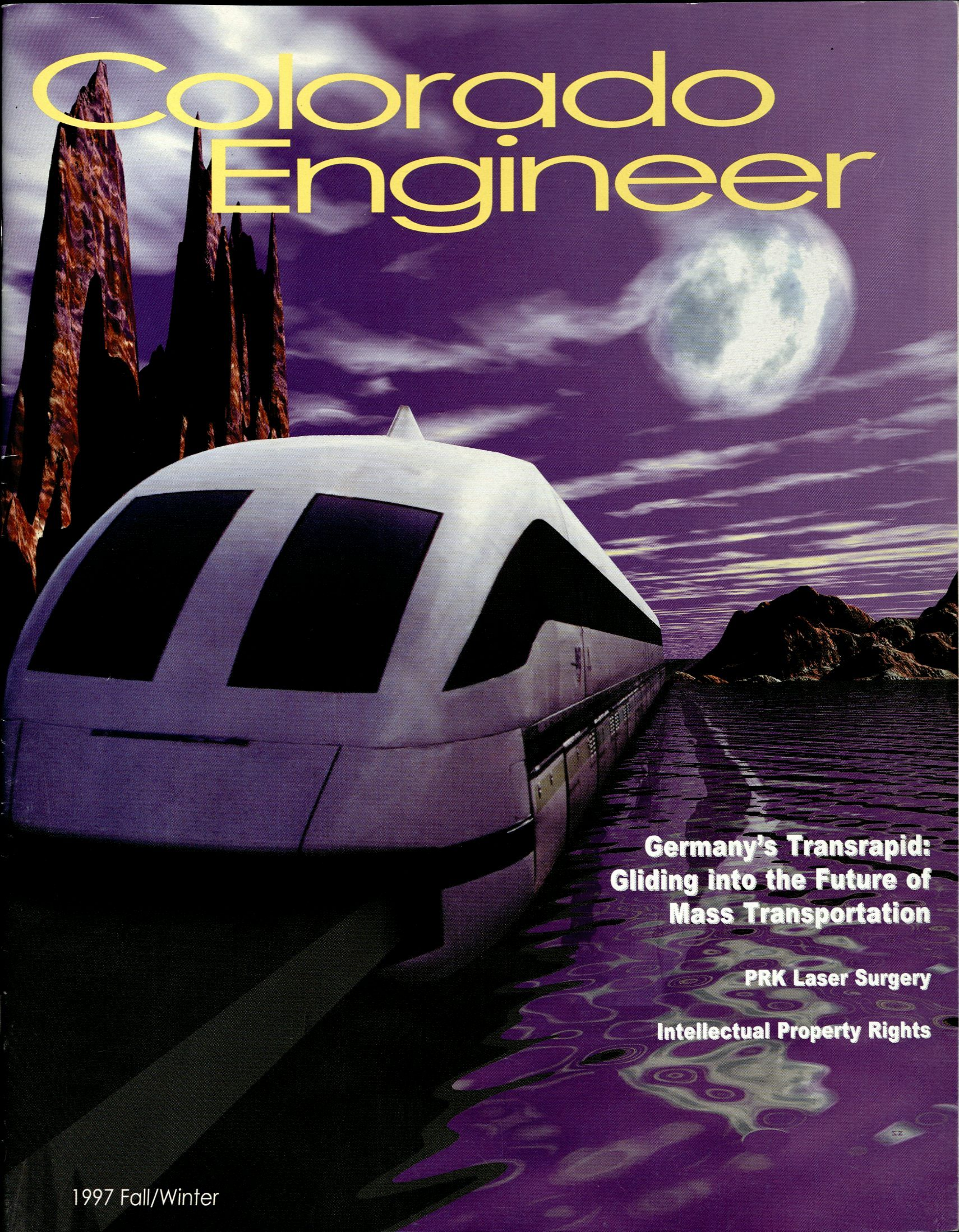

Germany's Transrapid: Gliding into the Future of Mass Transportation

PRK Laser Surgery

Intellectual Property Rights

1997 Fall/Winter

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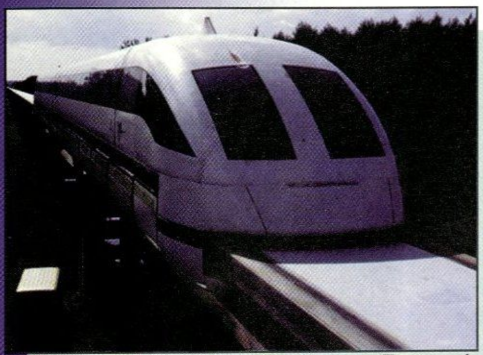

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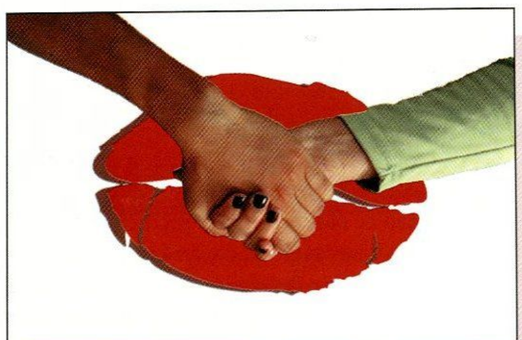

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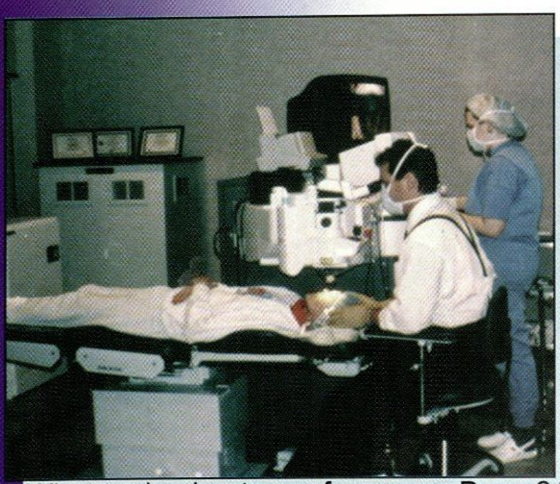

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the norm

editor's note

Ted Turner, media mogul and billionare, is giving $1 billion to the United Nations over 10 years. This gift is the largest recorded monetary gift in history and one third of Turner's net worth. With the U.S. stock market at an all time high, many people like Turner have made lucrative investments, gaining huge returns from their stocks. Hopefully, others will follow his lead and give of their excess to service organizations to help humanity.

Because We Can

Although most of us do not have the sheer magnitude of personal wealth as Ted Turner, we are still wealthy by the world's standards. As future engineering professionals and creators of new technology, we will probably make an average income well above the mean of the nation.

Along with our prosperity, there comes a responsibility to give some of what we have to those in need. This can either be done by donating to charities and individuals in need, or volunteering our time to help out a service organization--it doesn't matter. Whether it is giving to Habitat for Humanity, Greenpeace, United Way or contributing to your local church, a political campaign or taking an active part in a local school, the possibilities are endless when it comes to philanthropy. We cannot rely solely on entitlement programs like welfare and other government-funded service organizations to sufficiently provide for everyone nor should we. Those of us who can give, should.

Selfish by Nature

Ultimately the idea of "philanthropy for the sake of philanthropy" is a relatively foreign concept to most Americans, especially those with the most money. We have our constitutional right to "life, liberty and the pursuit of happiness," including our right to hoard whatever we have or to give whatever we have. In fact, we are naturally selfish and must "learn" to share. When we voluntarily give up our "right" to something (e.g. time, money) in order to benefit others who are not as fortunate, we are acting contrary to our nature. It is in defying our selfish instincts, and the act of giving separates us from the rest of the animal kingdom.

Why Give?

Giving has direct financial benefits. Any non-profit donation is tax-deductible (up to a point) if your taxes are itemized. This makes sense because if the donation is tax-deductible, the money can be channeled to a specific need or cause, wholly dictated by you. What better way to pay your taxes? And who knows where your hard-earned taxable income goes? But even more than tax-deduction, we should give because we can have the self-satisfaction of knowing we are helping individuals less fortunate than ourselves.

So give. Ted Turner has shown the world that even a billionare can give generously. Our actions are on display to the rest of the world, both good and bad. There are so many service organizations and individuals who need our help; we have the means to help them. Find one to give to and receive satisfaction in knowing you are helping others, being part of humanity.

Luke

college of engineering

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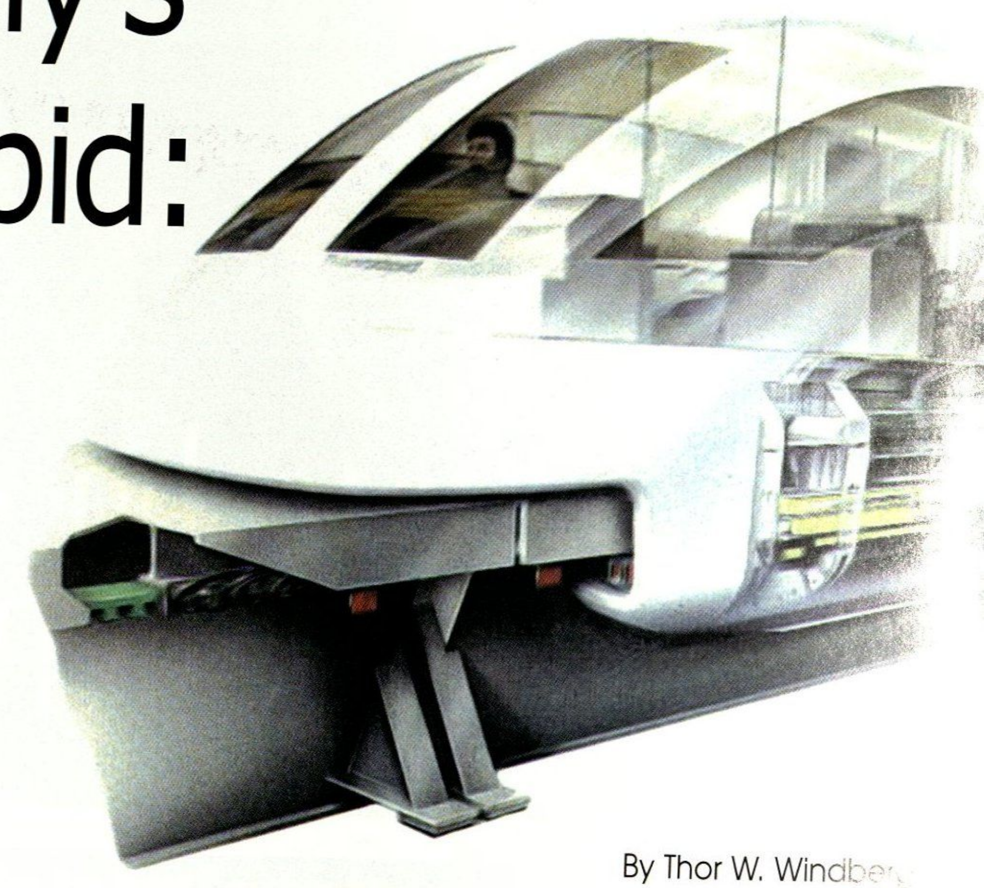
Germany's Transrapid:

Gliding into the Future of Mass Transportation?



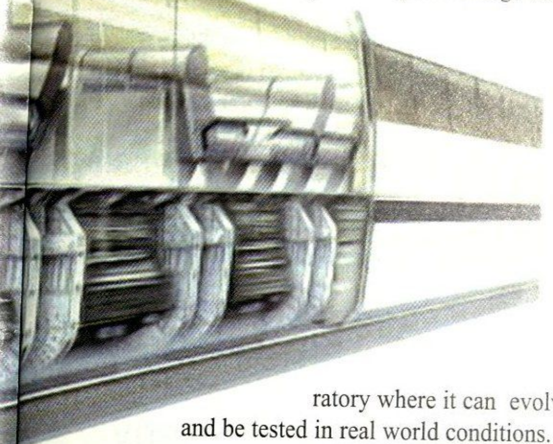
By Thor W. Windberg

Germany's floating train, the Transrapid, is the first completely new transportation technology developed since the advent of the airplane. But what is a Magnetic Levitation (Maglev) train? Simply put, a Maglev is a wheel-less vehicle using magnetic forces to lift, propel and guide the vehicle down a track with the capacity for much greater speeds than conventional trains. This Maglev rapid transit system holds the possibility for greatly increasing the transportation options here in the U.S. with its high speed, rapid acceleration, ergonomic design, energy efficiency and environmental friendliness.

A little history

In 1922 a German engineer named Hermann Kemper recorded his first ideas for an electromagnetic levitation train. He received a patent in 1934 and one year later demonstrated the first functioning model. It wasn't until 1969, however, that a government-sponsored research project built the first full scale functioning Transrapid 01. The first passenger Maglev followed a few years later and carried people a few thousand feet at speeds up to 50 mph. The company, Munich's KraussMaffei, which built the first Transrapid, continued to build improved versions in a combined public-private research effort and completed Transrapid 02 in 1971, TR 03 in 1972 and TR 04 in 1973. The Transrapid 04 set a speed record for passenger Maglevs of 157 mph in December, 1973. The first large scale demonstration occurred in 1979 at the International Transportation Fair in Hamburg, where Transrapid 05 carried 50,000 visitors between parking and exhibition halls for six months.

But any large, new and complicated system requires a large laboratory where it can evolve and be tested in real world conditions.



Such a test center, including a 19-mile figure "eight" test track, was erected between the years of 1979 and 1987 in North Germany. Going into service with the new test facility in 1979 was the vehicle Transrapid 06. This vehicle reached a speed of 221mph shortly after the completion of the first 13-mile section of track. With the completion of the track, the TR 06 eventually achieved a of speed 256 mph, traveling some 40,000miles before being retired in 1990. Through the continuous testing and refinements on the TR 06, it became possible to build the next generation vehicle Transrapid 07, built by the Thyssen Co. in Kassel. Since 1989, the Transrapid 07 has been the workhorse reaching the record speed of 280 mph and traveling some 248,000 miles by the end of 1996.

Furthermore, this vehicle received government certification to carry passengers at 261 mph and will have carried an estimated 200,000 by the end of 1997. Currently the wait for a test ride is six months to a year. Although the numbers are impressive, the most significant milestone was reached in 1991 when the Transrapid system received its certification of commercial worthiness. Since 1992 a Transrapid line from Hamburg to Berlin has been in the planning, cost study and political negotiation process. Technical development continues and as you read this the test track has paused operations to install some updated systems to be used in the final commercial guideway.

But how does it work?

The Transrapid uses electromagnetic levitation for its contact-free support, guidance, propulsion and braking systems. Unlike normal means of transportation, the motor is not carried in the vehicle but mounted below and on both sides of the guideway. The vehicle interacts with the motor/guideway by reaching around the sides of the T-shaped guideway and using attractive forces to lift itself and float (Figure 1). The interplay between the regulated electromagnets attached to the vehicle and the electrically controlled stator packages mounted on the guideway generate all the forces necessary to levitate, propel, brake and hold the vehicle within tight vertical and horizontal tolerances.

The drive system for the Transrapid is called a synchronous long stator linear motor. Unlike a normal electric motor which produces rotation, a linear motor creates a longitudinal force. You can envision this technology by taking the principle of a normal electric motor, in which the stator or winding normally found in the motor shell surrounding the rotor is opened up and stretched along the guideway (Figure 2, p. 6). The electromagnetic traveling field in the guideway pulls the vehicle when the stator packages are energized. Thus, the support magnets mounted on the arms of the vehicle take on the function of the "rotor" in our analogy.

The vehicle accelerates when the propulsion unit is switched via the cable winding. The linear motor's DC current is increased or decreased depending on the power needed to propel the vehicle and the speed of the vehicle is controlled by varying the frequency of the current between zero and 270 Hz. When the motor polarity is reversed, a generator is created out of the motor so that the traveling field can similarly brake the vehicle contact-free while regenerating energy to be fed back into the main power grid.

For supplying the on-board heating and air conditioning, lighting and battery systems with power, electromagnetic induction coils, also mounted on the arms of the vehicle, make up the linear generator system. The system generates power contact free when the vehicle is in motion. Batteries activate the backup systems and can keep the train levitated for about 20 minutes without power. The results of this highly evolved electrical system is a form of mass transit that has only one moving part and glides speedily and precisely from one station to another.

What are its advantages?

"Geschwindigkeit"—Speed

With regard to technology alone, the Transrapid is truly new and novel. But in this day and age any new technology must be truly innovative and offer significant advantages over existing technologies in order to sell itself. The Maglev system offers several advantages over conventional transportation systems. The first and most obvious trait is the speed at which the Transrapid glides through the country. Although the current speed record is 280 mph, only the geometry of the test track prevents the Transrapid from achieving its designed daily operating speed of 313 mph or its maximum design speed of 342 mph. Besides the high top speed, the Maglev's superior acceleration and deceleration brings large time savings over shorter distances. This advantage over other forms of mass transit allows the Maglev to reach speeds of 100 to 150 mph, while stopping frequently in urban commuter environments. But Maglev's top end speed is never compromised and is capable of sprinting to speeds of 250 mph in under three minutes within a distance of 11miles. What this might mean to the long-distance (40-100 miles) American commuter would be a 50% time savings, allowing one to travel 75 miles in 20 minutes. But in this affluent age of travel, patrons demand to arrive not only quickly, but with style and comfort as well.

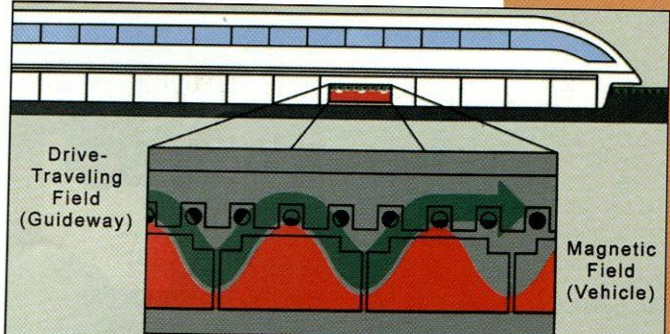
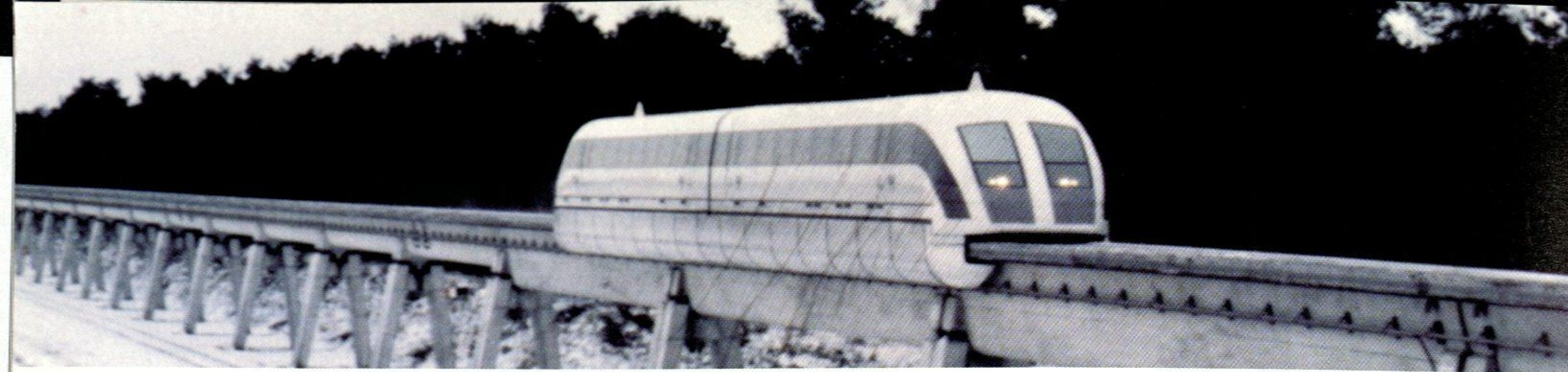


Figure 1: Electromagnetic wave traveling inside of guideway.



Gliding in Style

The interior comfort of the Transrapid vehicle includes being designed around human dimensions, meaning a 6-foot man can walk up to and into the vehicle and take his seat without stooping. Naturally, the environment inside the Transrapid is heated, air conditioned and pressurized. The seats are more akin to airline business class as opposed to the typical bus, train, car or economy class airline seats. Besides these features, the Maglev surpasses all other forms of mass transit systems with its comfortable ride. You can view the world supremely through the wide windows as you write, without shakes or bobbles. The construction of the guideway and the control of the systems prevents the transmission of vibrations to passengers, while offering riders unobstructed views from 65 feet off the ground.

Another standout feature of the Transrapid system is its ease of construction. The guideway is very flexible in its placement. It can be placed at ground level, in tunnels or on bridges like existing railroads. A distinct advantage of the Maglev system, however, is when it is placed in the air on stilts like the Monorails found in the Walt Disney parks. Usually pylons are placed about 100 feet apart and support a two-track guideway. These double elevated guideways are especially advantageous in cities or in the country side as they allow free access underneath the Maglev.

Combining these placement options with the fact that the Transrapid can easily handle grades up to 10% and tighter curves than conventional trains improves the alignment corridor options greatly.

What's all the noise about?

Due to the contact free nature of the Maglev system, the only noise is result of air friction upon the vehicle, making it the quietest mass transport system yet. At 250 mph, the Maglev develops a noise signature of about 91dB at 80 feet away, about the same as current freeway noise levels. For comparison, a TV at normal room loudness measures at 65 dB, or a car at 65 mph can generate 76 dB. But at a more typical speed of 155 mph, the generated 69dB at 330 feet would completely disappear in normal background noise of a city.

1000 miles on a tank of gas?

The Transrapid is also the most energy efficient system ever developed. Compared to the current high speed rail systems (not available in the U.S.), the Transrapid uses 30% less energy, 3 times less energy then an automobile, or a full 5 times less energy than an airplane for the same passenger mile.

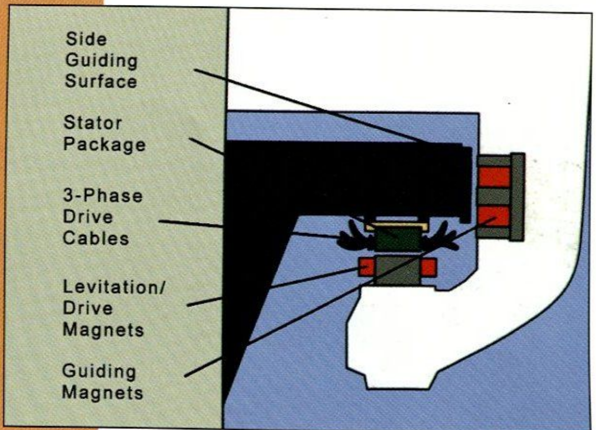
Furthermore, the Transrapid is powered by electrical energy, not petroleum based like the fuels used in the aviation and automotive industries. Although producing electrical energy is not completely clean, it can be done more efficiently, and away from the population that suffers the effects of air pollution from cars and airplanes.

The innovation of the German Transrapid's technology offers many advantages for the future of transportation.

All Aboard!

Currently the only place to see the Transrapid is at the test track in North Germany. However, after many proposals, much planning, and several cost studies, the first Transrapid line in Germany, between Hamburg and Berlin, will break ground in 1999. With public and private money financing the $5.5 billion cost, the Maglev line should be complete by 2005. The companies of Thyssen, Siemens, Adtranz (a joint venture from ABB and Daimler Benz) will build the systems and vehicles while the DB AG (the privatized German Federal Railroad) will build the guideway, run, and market the system. Thyssen will deliver the first train and the eighth generation of vehicles, Transrapid 08, for testing in late 1998. This new three section vehicle will be lighter in weight and utilize optimized aerodynamics, making it quieter and more energy-efficient than its predecessor. Beginning in 2005, one will be able to travel the 181-mile distance between Hamburg and Berlin in one hour for a cost of $60, with trains departing

Figure 2: Front view of motor/guideway system.



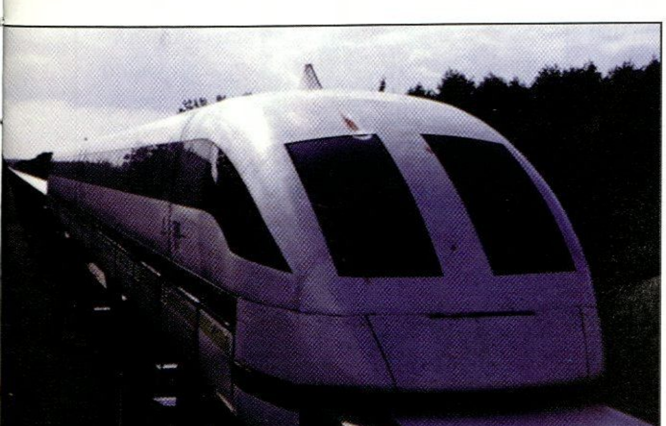
every 10 to 15 minutes!

The U.S. may eventually get to try the Transrapid, but it won't be until 2012, when an actual route connecting two cities could be completed. Some cities have considered constructing shorter Maglev routes. Pittsburgh may connect its airport to downtown with a 19-mile Maglev line based on the Transrapid, while Florida wants to connect the Orlando airport with a eight-mile link to Walt Disney World. The first large scale study for a line was done in the 1980s to connect Las Vegas with Los Angeles.

The innovation of the German Transrapid's technology offers many advantages for the future of transportation. With its combination of speed and acceleration the Transrapid is faster then all other forms of travel for trips up to 600 miles. The system scores well in environmental friendliness with its low noise emissions, high energy efficiency and flexible placement, as well as boasting a high level of comfort for passengers. And who knows, it might even be fun to glide over the landscape at 300 mph.

Photos courtesy of MVP (www.mvp.de)
For further information contact the author at windberg@ucsu.colorado.edu

Thor is a senior double majoring in Mechanical Engineering and German. Thor is also a native Boulderite who can't wait to catch the first Maglev out of here.



feature

PATENTS: what every engineer should know

By Kevin Jones

Take the case of Chemical Engineer John Doe. John has just perfected a method of treating bread to increase its resistance to mold growth. His company is very pleased with his work, and asks him to patent his invention. Now what does John Doe do? And why should he worry about patents?

Originally conceived to promote the development of technology, an inventor must meet particular requirements in order to be granted exclusive rights to the invention. Patents should not be confused with copyrights, which protect the work of an author or artist, or trademarks, which protect unauthorized use of particular phrases, symbols, or names. The whole idea of a patent is to grant a monopoly to the inventor of a new process, method, or design. His company is naturally interested in the business potential of such a bounty. After meeting with the corporate legal staff, Doe is left to cope on his own.

> Obtaining a patent can involve long, drawn out legal battles.

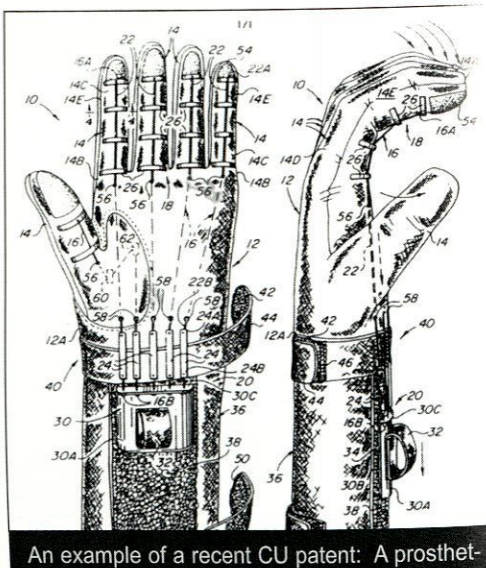
He receives the necessary forms from the United States Patent and Trademark Office (USPTO), including an application for a federal patent. The patent application doubles as both a technical document and a filing form. Should the patent be approved, scientists, engineers, and businesses nationwide can consult the design for any possible application to their own fields. In addition, the patent contains a description detailed enough to allow reconstruction by those with technical ability. This facilitates others' improvement upon the original design, which can in turn be patented.

The legal portion of the patent simply gives the owner exclusive rights to the patented idea in the United States. Claims are made upon certain portions of the design, more in legal than technical terms, as a safeguard against patent infringement. Should any claim be duplicated in another process, the legal grounding of an infringement suit would be much more concrete.

After thoroughly detailing his invention, Doe mails the forms to Washington. His company picks up the filing fee of $730 and the patent is thoroughly investigated by USPTO officials. Approval of the patent can be withheld should it be proven that his chemical process is not useful, novel, or significantly obscure. If its workings have been published anywhere in the world before John Doe conceived of the idea, the patent cannot be issued. In addition, the invention must be an idea that is not immediately obvious to those well-acquainted with the field, but fulfills a necessary, even unknown, need.

Suppose John Doe's request for the patent is approved. Though John Doe is required by law to be named as the inventor, in all likelihood the patent will be owned by the company he works for. Because the company supplied him with the environment to make the discovery, and because Doe is contractually bound to release his rights to the patent, ownership must revert to the company.

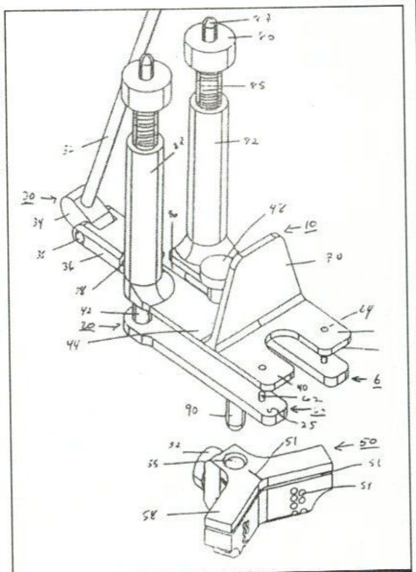
This brings another aspect of corporate engineering: the nondisclosure agreement. Usually signed upon starting employment, the agreement is a legal document signing over any developments an employee might make during employment with the company. This almost always precludes any royalty payment,



An example of a recent CU patent: A prosthetic glove designed to enhance gripping ability.

but it is unlikely that a beneficial inventor would remain unnoticed when payday arrives. Freelancers, be warned: some nondisclosure agreements can, in theory, sign away your rights to all your creations, including those that appear far removed from the workplace. Though it seems cumbersome, even threatening, to the rights of an inventor, corporate ownership is not without benefits. For example, the inventor does not have to pay the nearly $7,000 of fees related to the maintenance of his patent.

Perhaps most important in the process of validating a patent is the quality of the inventor's records. Our hypothetical scenario is about as smooth as the patenting process gets. Obtaining a patent can involve long, drawn out legal battles based on matters that seem insignificant during product development. Should there be any dispute over the ownership of a particular invention, accurate research logs can be invaluable in assigning rights to the patent. Patent rights go to the first person to conceive of the idea and reduce it to practice as long as there is sufficient documentation. Logs that are accurately dated, witnessed, and descriptive of work towards practical application of the idea can be a great asset to the engineer should there be any challenges to the patent. Poor documentation can lead to the loss of the patent in the case that a competitor has begun at a later time, yet kept flawless records.



Another CU patent: Device to align a human knee after knee surgery.

At some point in an engineering career, the subject of patents is certain to present itself. Though handled by others in the workforce, personal knowledge of your precise rights and responsibilities under the law cannot be detrimental. Whether patenting an idea of your own, improving an already patented idea, or simply licensing an idea you need, a passing acquaintance with patent law is invaluable to today's engineer.

Diagrams courtesy of CU's Technology Transfer Office

Kevin is a freshman who thinks he wants to be a computer scientist.

Intellectual PROPERTY @ C.U.

The University of Colorado has at least partial ownership of all patents created with university facilities and staff. Income from licensing of patents averages about $1.2 million annually, though 1996 was somewhat above normal with $2.5 million in returns. Policy dictates that 25% of this revenue is reserved for the inventor or inventors, 25% for further development and research into applications of the patent, 25% for the department of the inventor, and 25% for overhead costs.

Though quite explicit on the matter of staff and school facilities, University policy is rather vague regarding students' creations. So long as they are not Teaching Assistants or Research Associates, chances are the ownership of a student invention would not revert to the university. However, should a research facility be constructed on university grounds by students, rights would probably go to the university.

The most prolific area for today's patents is the biotechnology industry, and CU is no exception. Biological inventions represent a large portion of the University's intellectual acreage in addition to more traditional areas such as electrical, mechanical and chemical engineering. Current unlicensed patents include treatments for Type I Diabetes, prosthetic gloves, and a silicon laser capable of dynamic color changes.

More information is available from the Technology Transfer Office, a small, vital link between the university's research staff and businesses across the world. The office handles the dissemination of information about university patents. Although available to everyone on campus, it is specifically geared towards companies interested in licensing the products of the university. The office also facilitates relations between business and university researchers in its 4+4 Breakfast program, where researchers and local entrepreneurs discuss similar research needs. The Technology Transfer Office is located in the Armory building on the Boulder campus, and can be contacted at (303) 492-5647.

web site: http://txfr35.colorado.edu/

feature

failure of a Virtual World

virtual reality's unrealistic expectations

By Erik Jasiak

In the fifties, the American automobile had become the obsession to awe a nation and world, and it seemed as if anything was possible for this great invention. A natural offshoot of a conventional car was one capable of flight. Reel films and early television shows promised that one day, a flying car would be in everyone's future.

No such car exists, obviously, and if you asked most people today, they would see it as something pretty unlikely to appear in their lifetime. In the end, it wasn't so much about anyone ever needing a flying car, as much as everyone loved the idea of it.

Memories are short when it comes to realizing the limitations of science. The U.S., and much of the world, has entered an age where science appears to have no bounds, the age of the personal computer. With phenomenal speed, the PC has begun to involve every aspect of our daily lives. And with each passing day, new promises are made for what we will see in our future. Personal Computer Televisions, with movies at the touch of a button. Cellular computers, already on the market, allowing a person to access email from anywhere. And almost semi-annually, someone has a new idea about how to replace the book forever.

From "Batman" serial 15

One of those promises, not so long ago, was for virtual reality. Shopping in a virtual mall without leaving home. Viewing your virtual living room before you decide to buy it. Meeting with your friends in a three-dimensional virtual room, chatting with an "Avatar" or computer version of whatever you friend wanted to appear as in the room. Perhaps even having an entire virtual world to yourself. From the pages of William Gibson novels and Wired magazine, to popular news publications like Newsweek, everyone made predictions for the future powers of virtual reality.

So where is virtual reality? Or where has it gone? Instead of virtual worlds, we are left with virtual games, the toys of expensive arcades. A place, with all the right hardware and a clumsy helmet, you can "simulate" a shoot-out or drive a tank. The dream of what virtual reality was supposed to become has been nearly abandoned. Many 2-D screen worlds are now termed "virtual" because of their interactive nature, including some internet chat rooms.

Where is virtual reality?

Where has it gone?

The truth is, the virtual reality experts predicted is not feasible at this time, nor is it as desired as once though. While virtual kitchens and games may be possible, virtual worlds and meeting rooms are not. The cost, complexity, and difficulty in producing adequate equipment has made it nearly unfeasible to create products for the general public. Even more significant than this, is that for as great as a "virtual" reality was supposed to be, nothing close to true reality has been good enough to hold the attention of users.

There is no doubt about the cost of computing. Anyone who has purchased a computer knows that the hardware with any piece of equipment, particularly the processor, is relatively expensive. The computer you do buy does several tasks reasonable well, but it is probably not designed for any one "specific" task. That is part of its beauty. Virtual reality equipment as it exists today, however, is highly specialized to achieve the functionality necessary for its tasks. Not only does this make the computer equipment useless for other tasks, it also make such a proposition very expensive.


Courtesy of Denne Developments Ltd., UK

"Virtual reality currently is confined to military and gaming tasks simply because most people cannot afford the investment" says Casey Boyd, a former CU doctorate student whose research included using virtual reality for education purposes.

A virtual reality platform requires a highly sophisticated computer with a helmet containing video throughput superior to most any video card and monitor available on the market. What makes the cost of the equipment skyrocket is the amount of sensor technology needed within the helmet and some other external interface (usually a glove) that relates a real world position to the virtual world. The helmet interprets your real world head movements to the virtual world. In arcade games and Boyd's experiments, this is done using a set of remote sensors that determine where the user has moved relative to the sensor's position.

Even more daunting is the sheer complexity and number of calculations required to make a virtual world look realistic. Even for two dimensional objects, the art of making an object appear to look and behave "realistically" is an astronomical task. First of all, computers do most of these calculations using linear algebra, acting on a set of vectors that define what an object looks like to the computer. Many times, in truly 3-D created landscapes for flat screens, a user will notice objects take on a distinct "block-like" appearance. This eases the calculations for your home PC and video card, as each rendering requires a phenomenal number of calculations for even a simple 3-D creation. The more polygons, and consequently sides, that are added to an object the more realistic it appears. But this comes at a huge cost in calculations. Add in any animation, and you have a daunting task for even today's fastest processors.

Now imagine trying to create a truly user interactive version of such a world, one that would allow the user to look around in a fair approximation of what they do in the real world. The number and speed of calculations required to look at even simple objects is astronomical. Each object the person "sees" has to be redrawn with every movement they make, as each turn represents a different view of the object. Even the most basic virtual worlds created thus far involve only the most state-of-the-art processors, and equipment that allows information to be relayed to the video headsets fast enough to make something look real. Simultaneously, the computer must receive the feedback of the individual's new movement in the 3-D space. No personal computer will be available in the near future that can handle this volume of calculations fast enough for a person to be able to actually "see" a realistic object in a virtual world. If such calculations were done by a supercomputer and then put over the Internet, the amount of data flowing for real-time viewing would greatly exceed what a phone line, or even an ISDN connection, is capable of, given even a little complexity to the virtual world. Even worse than the calculations, the amount of data that would have to be relayed to a person's headset after these calculations were complete exceeds even the greatest data throughputs of the video cards on the market today.

But despite the improbability of virtual reality becoming affordable or even possible in the future, a new force has led to its disappearance as part of our future. Namely, the realization of virtual reality as a novelty in the face of true reality. What exactly is the illusion, indeed the "virtual" in a virtual world really needed for anyway? The places where virtual reality has actually made a presence for itself, namely, games, military simulators, and even education, are not areas that can be reproduced in the real world. The mall, the coffeehouse, the showroom at your local department store, they already exist, so where is the drive to recreate them virtually?

With the Internet as we now know it, one of the areas predicted for the biggest growth possibilities was on-line shopping. Many businesses that were lured by this prospect gave huge discounts just to try to attract on-line customers. What happened? While some people did begin shopping on-line, many more preferred to leave their homes. It was an escape from their personal computers. This has been seen over and over again in many attempts at virtual reality. The cost of running and maintaining a two person virtual shooting game is still several times more expensive than what it would cost for several people to go play paint ball and, in the end, the paint ball experience can still be regarded as "real" while the virtual experience cannot. A fair approximation of reality is still not reality. In the end, for as novel an idea as walking in a virtual park may have sounded, more people would still prefer to do the real thing. This is similar to Internet chats and email. Wile a proliferation of this has shown up of late, the only circumstances under which email or on-line chats are preferred is when physical distances prevent telephone calls or personal meetings.

As a result, very little that can be done "virtually" can also be done in reality, in a way that people are more comfortable with.

In the end, for as novel an idea as walking in a virtual park may have sounded, more people would still prefer to do the real thing.

So virtual reality has mostly disappeared over the horizon. It wasn't a bad idea and still has several real world applications. Dr. Boyd's research showed several skills could be learned in a virtual environment. Virtual communities, such as the Well, have grown steadily on-line as a place for users to gather and group through the traditional two dimensions of a computer screen. And several sights on the Internet still promise the arrival of true virtual reality.

As for me, I'll be looking for that virtual world the day cars fly.

Eric is a senior in Applied Math. He enjoys playing hockey and taking road trips.

SEEING double

The rewards and trials of being a double major

By Joe Guerricabeitia

Upon my graduation from high school, everything was clear to me. I knew where I was going and why. I wanted to be a mechanical engineer, and I thought that CU-Boulder would be a great place to study. After a semester of school, however, I wasn't as sure of myself. Things just hadn't clicked the way I had thought they would. I considered the possibility of changing majors and of transferring but eventually decided that I would give things another semester and try to figure out where I was headed. For the spring semester I again took the recommended ME curriculum, but this time I added a Spanish class "just for the hell of it." At the end of the semester, I found that I was not only happier, but my grades were actually better. For the fall of my sophomore year I included another Spanish course in my schedule. It wasn't until the following spring that I officially declared Spanish Language and Literature as my second major.

Many people ask me why I am a double-degree student, and specifically why I decided to study Spanish Language and Literature as my second major. The simple answer is that I like both disciplines. My reasoning, however, goes beyond that. ME has always allowed me the opportunity to learn about and analyze how things work. Spanish Language and Literature, on the other hand, has allowed me to learn another language, and to discover how humans think and express themselves through language and speech. The two are so different that they are perfect compliments. For example, when my left brain is tired of equation after equation, I cuddle up with my literature book and let my right brain go for a spin. Skeptics see this as a waste of time, since I admittedly want to work as an engineer, not a literary analyst, upon graduating. It is not a waste, however. The sanity and balance that a double-degree brings is immeasurable. From a career oriented viewpoint, I cannot see a better experience that allows me to learn to communicate in both English and a foreign tongue. These skills can only enhance my career opportunities, as I enter the global job market of today.

The sanity and balance that a double degree brings is immeasurable.

Double-degreeing is not for everyone. It is, however, an important option to consider. College is about getting an education, after all. Isn't that why engineering students are required to take humanities courses and business majors are required to take science courses? As students we should take advantage of these opportunities to broaden our college experience. Make the time to enroll in an interesting class outside of your major. You may enjoy it, and maybe you'll learn something about yourself . I know I did. Now if I could just figure out how to pay for my fourth senior year...

Joe doesn't believe in sleep. When he's not studying, he is leading ASME on building race cars with SAE. Hailing from Boise, Idaho, Joe enjoys soccer and broomball.

feature

JAVA Not Just for Breakfast Anymore

By Matthew Ball

Recently, programmers have been raving about the newest addition to their development toolbox: Java. Most people recognize it from Java applets (programs imbedded in web pages) found on the Internet. What most new software developers don't realize is that Java provides a powerful programming language they should consider learning and using instead of C++. Many hard-core C++ programmers hesitate to believe that any language could replace their de facto standard because C++ gives them superb execution speed and versatility. Although lacking exceptional strength in these two fields, Java compensates by suiting itself to future programming needs. For example, Java's interpreted code provides platform independence and increased error checking to compensate for C++'s faster compiled code. Additionally, Java produces robust byte-code that eliminates the problems with bad pointers and memory leaks common in C++. Furthermore, Java creates small and secure code ideal for Internet usage. In short, Java provides a programming language geared more towards the future than does C++.

Java offers the advantage of platform independence by requiring an interpreter to run the program. C++, like all compiled languages, offers a fast-running executable program via platform-specific instructions. However, with today's high-performance computers, execution speed is becoming less important. For instance, a user won't notice the difference between a window taking half a second to open, as opposed to a tenth of a second. Interpretation slows down the execution speed, but offers the Java program platform independence. In other words, a Java program can run on any computer system, such as a Mac, PC, or UNIX Workstation, without requiring the software developer to first port the application to this new system. For a C++ programmer, porting a program to a different computer system requires rewriting much of the code, which unnecessarily costs precious development time. Although Java provides platform independence, the interpreted versions of Java are significantly slower than C++, sometimes by a factor of 10. To solve this problem, several companies, such as Symantec, have created run-time compilers that take Java's platform-independent instructions and convert them directly into machine-specific instructions before execution. These run-time compilers give Java most of a compiled language's speed, but maintain all the benefits of an interpreted language, such as platform independence.

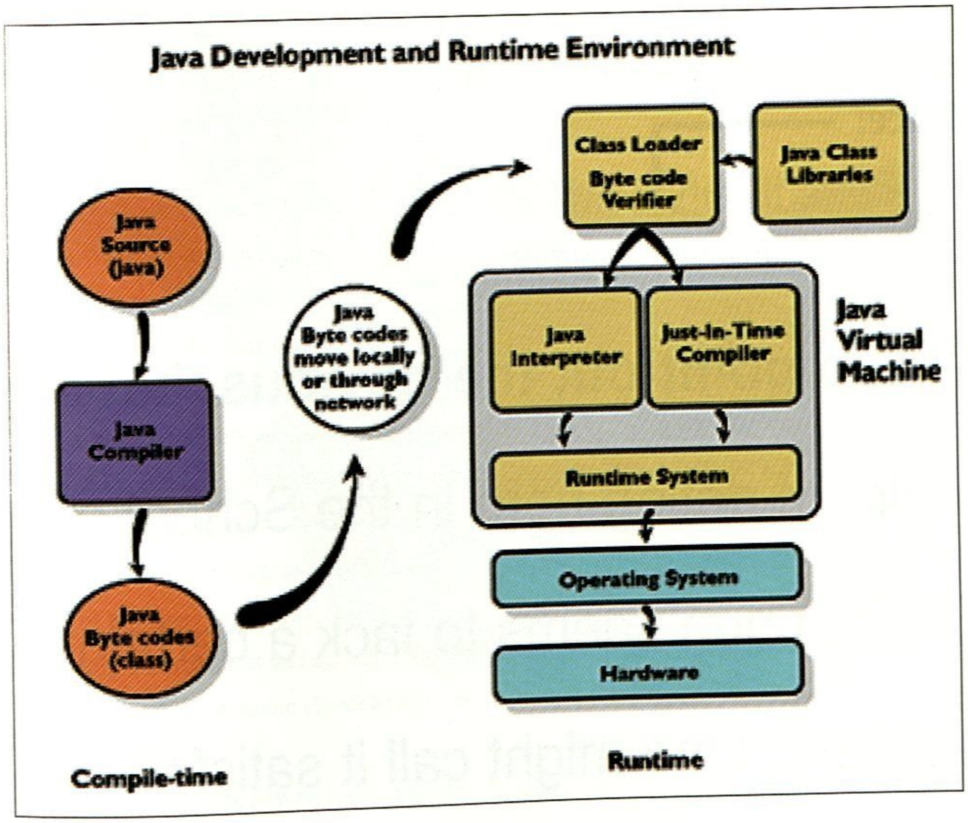
Another benefit of interpretation is that Java, unlike C++, provides automatic memory management and pointer checking during runtime. Pointers are variables used by the program to locate data. If a C++ program somehow uses a "bad pointer" (one pointing to the wrong data), then the program will crash unless the programmer manually includes error checking. In some operating systems a bad pointer might compromise system integrity or even cause a system crash. Java solves this problem by stopping the program before a bad pointer can harm the system. Furthermore, Java shows the programmer the location of the offending source code line, helping to speed up debugging. By including run-time error checking, Java creates more robust programs.

Along with its pointer problems, C++ has the disadvantage of allowing "memory leaks". A memory leak occurs if a program allocates memory from system resources, then "forgets" about this memory, much like a squirrel who buries a nut, then forgets where he put it. When the program finishes with a piece of memory, it needs to tell the operating system (OS) that it has finished, allowing the OS to redistribute this memory to other programs. Excessive memory leaks will cause the system to slow down and eventually lockup because the OS does not have enough free memory with which to work. Java resolves this problem by providing a "garbage collector" that searches for unused memory and gives it back to the system. If a Java program "forgets" about allocated memory, the garbage collector cleans away the unused memory.

> A Java program can run on any computer system, such as a Mac, PC, or UNIX Workstation, without requiring the software developer to first port the application.

Sun Microsystems created Java with the World Wide Web (WWW) in mind. By including platform independence, robustness, and bad pointer checking, Java provides a safe programming language for the WWW. For a program to run over the Internet, it must be platform independent because all types of computers use the Internet. Java's interpreter allows WWW browsers to provide additional security checking, preventing network-based applets from damaging local system resources, such as disk space or memory. C++ has no hope of providing a generic, web-based programming language because it is machine-dependent, has large code size, and can run on the local computer unchecked, possibly damaging system resources. Java's intrinsic network safety allows web browsers to automatically load Java programs because Java programs can't hurt the local system.

Through interpretation Java provides platform independence, bad pointer protection, garbage collection, and Internet support, all of which C++ cannot easily match, if at all. Programmers in the past believed that compiled languages, such as C++, dominated interpreted ones in all aspects, largely because of their speed and flexibility. They would not dream of delivering an interpreted program when they could make a compiled one. However, Java shows the powers of interpretation through its growing list of advantages. For instance, a Java program can provide interactive Internet shopping, networked chess games, or even a full-blown word processor. New applications appear every day, each lending itself more and towards Java. The time has come for the traditional programmer to learn the powers of Java.



The mythical Matthew Ball is a junior in Electrical and Computer Engineering. He enjoys experimenting with different hair colors.

Dateless and an engineer?

Here's some advice:

By Tera Newman

Not to point out the obvious, but the realm of dating here in the School of Engineering seems to lack a certain element. One might call it satisfaction.

And, in typical analytical engineer fashion, this author thought she might enumerate the main reasons for such noticeable characteristics. First, one might point out the difficulty of meeting someone that might be worth the time and effort. I'm sure the males here might have noticed a certain inequality between the numbers of one sex to the other. In fact I believe it would be difficult to dispute the evolutionary trends at work when the ratio of males to females is somewhere around 50:1. In fact, it makes one wonder whether or not some genes in the E-School just won't be passed on. (This seems unfortunate considering how many really intelligent genes are represented here.) Then when you fellows might have a chance to visit a classroom on the other side of campus, you find out that every girl in the room thinks "clueless" is "the best movie ever!" Sometimes the pickins are slim.

Female engineers also have a serious dilemma to resolve. Frankly, a proliferate collection of RAM jokes are not usually attractive to women, no matter how suave the delivery and how hard the guys laughed in the lab earlier that day. In other words, perhaps men should keep their hardware humor to themselves. On the other hand, when venturing to the other side of campus, females are all too likely to fall for one of the many individuals that believes wearing a lacrosse hat and driving a Toyota 4-Runner are his defining characteristics as an individual.

Let us presume however, that one can find a worthy person to be interested in. Now you have to get a date. First, there will be the conflict of schedules. "Oh, I can't tonight. I have a meeting with my sociology group in Norlin." Or perhaps, "How about next week. You'll call me then?" Meanwhile, the number is mysteriously changed by the monopoly U.S. West. "Who knows what they do to the phones. I just pay the bill." Then, when all of those possibilities are exhausted, mainly because it's a Friday or Saturday night, the real excuses will reign. "You know, I really can't tonight. I have to stay home and wax my cat."

Frankly, a proliferate collection of RAM jokes are not usually attractive to women, no matter how suave the delivery and how hard the guys laughed in the lab earlier that day.

Or, "You know, I forgot, I scheduled my toenail surgery for every night next week. Yeah, ten toes, ten nights." Or as one friend experienced, "Well, I can't because I'm going to Vail. No, not to ski. Just to visit. I'll be back tomorrow."

So what are the options here? Well, many turn to the computer. But we all know that this article would be way too boring if we tried to discuss the issue of "Love on the Internet" so I shall happily ignore the whole point. Onwards...

And maybe, just maybe if you are lucky, you land your self a relationship. And then maybe you have to make time in your schedule for some really nice things likes movies and dinner and getting ice cream from Josh and John's in February. Perhaps you tell someone things you never told anyone before and it is still okay. Maybe..well okay, so the truth is we should all buy dogs, or make up imaginary girlfriends and boyfriends that live in Alaska. Alas, instead, as in all things as engineers, we strive for perfection. And don't we deserve it. The only possible conclusion: God help us all.

P.S. Not to sound too pathetic: Some engineers date and do it well. If you're one of those people, ... STOP reading this. Put down the magazine. Go write your own article on how to get a date. We need your help immediately in the Colorado Engineer Magazine office.

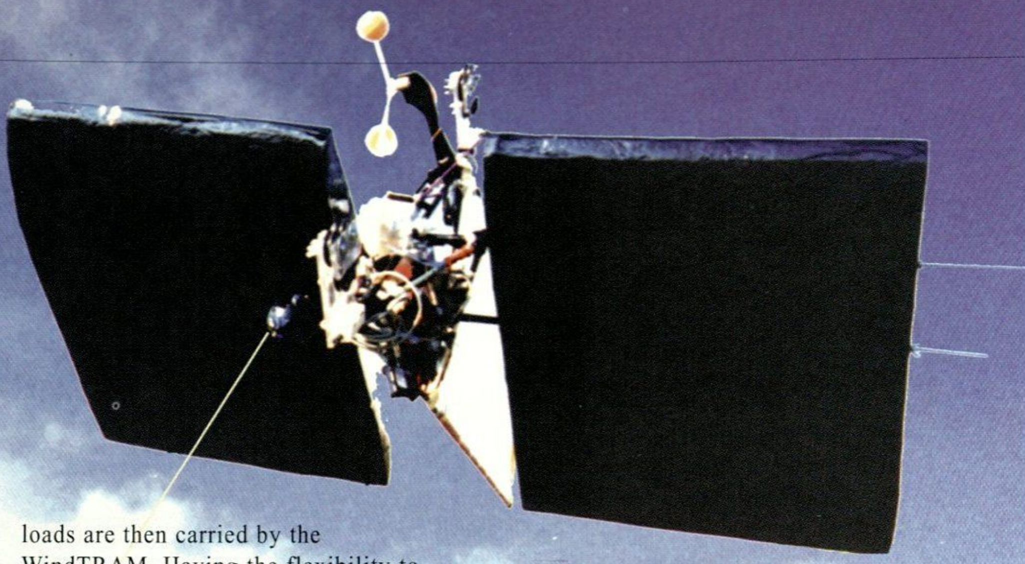
Tera is a senior in computer science. She has a boyfriend who is not an engineer and she enjoys going on dates with him.

feature

the Air Up There

Imagine the sun is out and steady winds are blowing from the west. "This is a great day to fly a kite," you might think. That is just what researchers at the Cooperative Institute for Research in the Environmental Sciences (CIRES) would be doing. As fun as kite flying may be, Research Associates Ben Balsley, Michael Jensen and Rod Frehlich have turned this pastime into a powerful instrument for measuring atmospheric conditions. While kites have been employed for thousands of years for entertainment, their use for atmospheric research has come in the last two centuries. Around the turn of the twentieth century, near-daily kite flights were gathering measurements to build the first systematic study of the lower atmosphere. By collecting enough atmospheric data, CIRES hopes to be able to refine global weather pattern models and prediction techniques. Today the work at CIRES is complementing other collection techniques such as balloons, satellites and aircraft.

By Ted Zeiger



As early as 1749, Professor Alexander Wilson and student Thomas Melville, of the University of Edinburgh, Scotland, were using kites for lower atmosphere temperature measurements. Using simple equipment, thermometers attached to paper kites, they were able to get a rough estimate for the temperature profile of heights up to one thousand feet. In 1752, Benjamin Franklin conducted his famous atmospheric electricity experiment. Franklin's materials were also quite simple, ust a paper kite. Nearly a century later, in 837, Admiral Black used kite born ther-ometers to help survey his Arctic expedi-ion. By towing the kites by ship, heights of 200 feet were reached, an amazing height or the time. At this height, Black recorded n unexpected 8 degree Fahrenheit decrease n temperature relative to sea level. Similar hip and land based experiments were car-ied out throughout the world up until the arly 1930's. The highlight being the single ite altitude record of 12,507 feet, by Blue ill Observatory, outside of Boston, which ill holds today.

The use of kites for atmospheric mea-urements declined in the 1930's due to the dvent of aircraft and inexpensive balloons. the late 1980's, the researchers at CIRES scued the kite technology when faced ith a special problem. The CIRES searchers were studying the fair weather obal electric field over Christmas Island, the south Pacific Ocean. In order to antify the global electric field's influence lighting conditions accurate data was cessary. To obtain the best measurements, series of electrometers needed to be laced at height intervals over the lower tmosphere. Tethered balloons could only e used for the first kilometer at best, ecessitating aircraft. However, aircraft were not able to collect the sensitive data needed. In addition, un-tethered balloons, with their difficulty in recovering, could not be used due to the cost of the equipment. What the CIRES team needed was a stable stationary anchor point, several kilometers up.

To fulfill this need, CIRES developed the WindTRAM system. The WindTRAM is a basic system consisting of two parts; a large parafoil kite and a tram to go up and down the kite string. The tram is connected to the kevlar string, and by using its large airfoil wings it can traverse the length of the string. Any desired instrumentation payloads are then carried by the WindTRAM. Having the flexibility to stop at any height, measurements can be taken at varying altitudes. This feature is very useful when a profile over different altitudes is needed. Past kite based instrumentation had one major drawback being that the kite launching procedure is time consuming. Ground wind conditions must be strong and stable so the parafoil shape can catch the wind. The WindTRAM is a preferable system because instrument payloads can be brought back to the ground for adjustment without having to lower the kite.

What the CIRES team needed was a stable stationary anchor point, several kilometers up.

To give the WindTRAM the ability to stop at different heights and fly up and down the tether, wing position is controlled by remote control. To aid downward flight, an inverted airfoil wing is used to provide lift. The WindTRAM is designed to act as a crane, but also carries several of its own instruments. These include a tachometer (to measure speed along the line), an anemometer (to measure relative wind speed), a tilt sensor (to measure the tether angle), a potentiometer (to measure wing angle relative to the tether), and a pressure sensor (to measure altitude). For additional sensors, payloads are carried, but their weights are restricted to 3 to10 kilograms. Additional lift can be achieved by adding wing extensions, thus increasing wing area. However, large payloads are less desirable as payload capabilities are strongly dependent on local wind conditions. Some of the current instruments designed by CIRES to be lifted by the WindTRAM include, an ozone sensor to detect ozone gas levels and a thermocouple probe to measure micro changes in temperature. Payloads from other organizations may be used so long as the meet the weight and size requirements.

The Cooperative Institute for Research in the Environmental Sciences has shown great promise with the WindTRAM kite born instrument system. Examples of data collected prove that the WindTRAM will have a bright future in measuring the world's atmospheric conditions for years to come. Using the WindTRAM measurements have been recorded over periods of days, time spans previously unattainable. The only current limitation for time aloft is the lifetime of the onboard battery packs. Alternative power sources such as wind or solar power that will extend time aloft indefinitely are currently being developed. Once these obstacles are overcome the only thing that can hold the CIRES researchers back is the need for good wind conditions. So as long as the wind is blowing, the WindTRAM will continue to yield unprecedented results.

Photos Courtesy of CIRES

Ted is a senior studying Mechanical Engineering.

In today's workplace,

you will be expected to be a competent engineer. And your engineering courses are excel-lent preparation for that workplace.

But today's engineer must also be a **manager, communicator, decision-maker, and c league** to co-workers from a variety of cultures. Many of today's engineers are finding courses in the liberal and fine arts help them to manage people, make good decisions, c municate effectively, and understand the people who are the "global economy."

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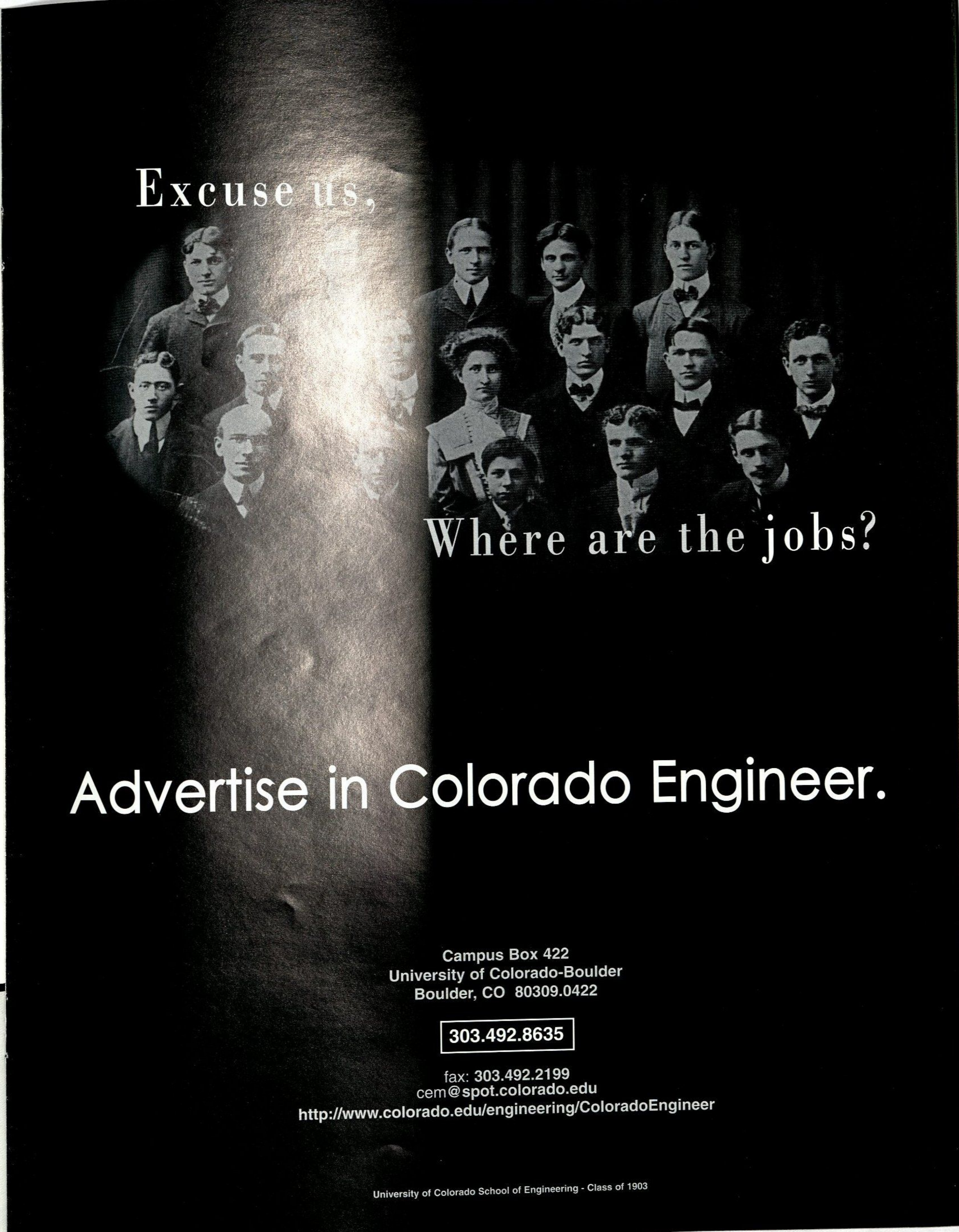
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Shakespeare's Poetry Corner

Na Cl

Just a little atom of chlorine, valence minus one
Swimming through the sea, digging the scene, just having fun
She's not worried about the shape or size of her outside shell
It's fun to ionize
Just a little atom of Cl with an unfilled shell

But somewhere in that sea lurks handsome sodium
With enough electrons on his outside shell plus that extra one
Somewhere in this deep blue sea there's a negative
For my extra energy
Yes, somewhere in this foam my positive will find a home

Now the sea evaporates to make the clouds for the rain and snow
Leaving her chemical compounds in the absence of H2O
But the crystals that wash upon the shore are happy ones
So, if you never thought before
Think of the love that you eat when you salt your meat!

-K. McGarriggle, 1978

Through the smoke and ozone fumes
The student slowly rises,
His hair is singed, his face is black,
His partner he despises.
He shakes his head and says to him
In words softly spoken,
"The last thing that you said to me
Was 'Sure, the switch is open.'"

-Anonymous

Keep on studying, get no sleep,
Soon you're looking like a creep,
Coffee flows, aspirin too,
Seems your eyes are full of glue,
Stress and strain, calculus,
Find unknowns, must not fuss,
Temper short, wall with droop,
Keep on feeling like a stupe,
Paper spread upon the floor,
"Quiet Please" pinned on the door,
Books are stacked in towering pile,
Wonder if it's worth the while,
Toss a coin, decide the crams,
Heads. the Army; tails, exams.

-Colorado Engineer
November, 1959

As I sit amongst my soil,
I feel with in myself, a boil;
not of animosity or fear,
but a love beyond my years.

I can feel the swell within my heart,
my plastic limits all seem to fall apart,
I long for your care like a doctor
bring me joy, like the pounding of a proctor.

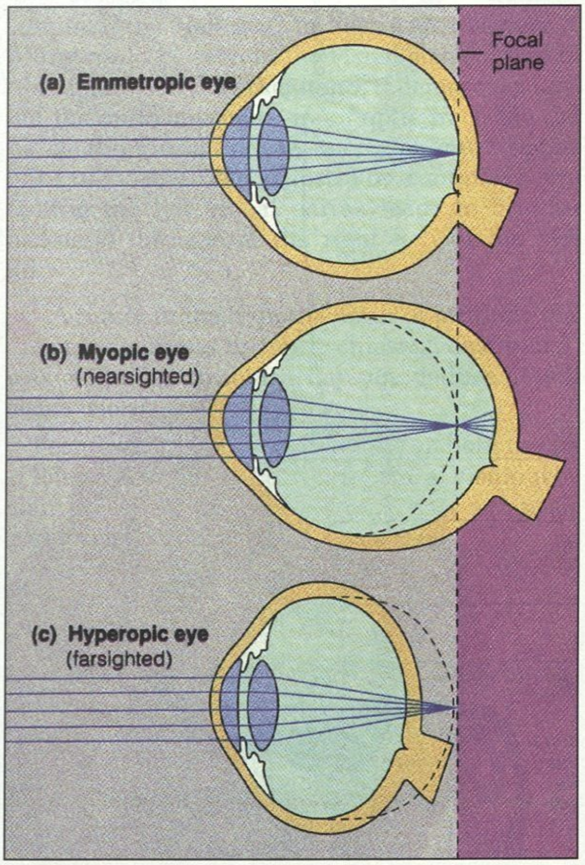
-Anonymous

PHOTOREFRACTIVE KERATECTOMY

The Eyes Have It

By Deanna DeMarco

You are an engineer. You stare at computer screens way too much. You spent long hours focusing on tiny words in huge textbooks. You squint at blackboards in too-dark rooms covered with some professor's illegible handwriting. All of these activities take a toll on your eyesight, and you, like a quarter of the world's population, suffer from refractive errors so severe that you are functionally handicapped without the use of corrective lenses.



Ordinarily, patients with refractive errors rely on glasses or contact lenses to correct their vision problems. New refractive surgical procedures, however, make it possible for patients suffering from mild to moderate myopia, or nearsightedness, to have near-perfect vision.

When Glasses Aren't Good Enough

Using excimer lasers to reshape the cornea, photorefractive keratectomy (PRK) is an important development in vision correction for both medical and economic reasons. For people with high refractive errors, glasses are troublesome because of the weight of the lenses, even if they are made with materials that have a high index of refraction. Many wearers of contacts and glasses are also concerned with breaking or losing their lenses and consequently being unable to function. Still others are attracted to the idea of refractive surgery because of occupational or recreational needs: many law enforcement occupations require an uncorrected visual acuity of 20/40. Globally, four billion dollars are expended annually for optical appliances and corrective eye care for people with refractive errors. The medical and economic desire to see better drives the technological developments in laser refractive surgery.

Why Can't I See?

So what exactly are ophthalmologists correcting when they point lasers into patients' eyes? In order for a person to see clearly, the cornea and the lens focus light rays entering the eye so that they fall precisely on the retina. Refractive errors occur when the focal point and the retina are not aligned. This is a result of a misshaped eyeball: myopia, or nearsightedness, occurs when the eye is too long and the cornea overfocuses entering light. Images focus in front of the retina resulting in poor distance vision (Figure 1). Conversely, hyperopia, or farsightedness, occurs when the eyeball is too short and images focus at a point beyond the retina, causing close up objects to appear blurry.

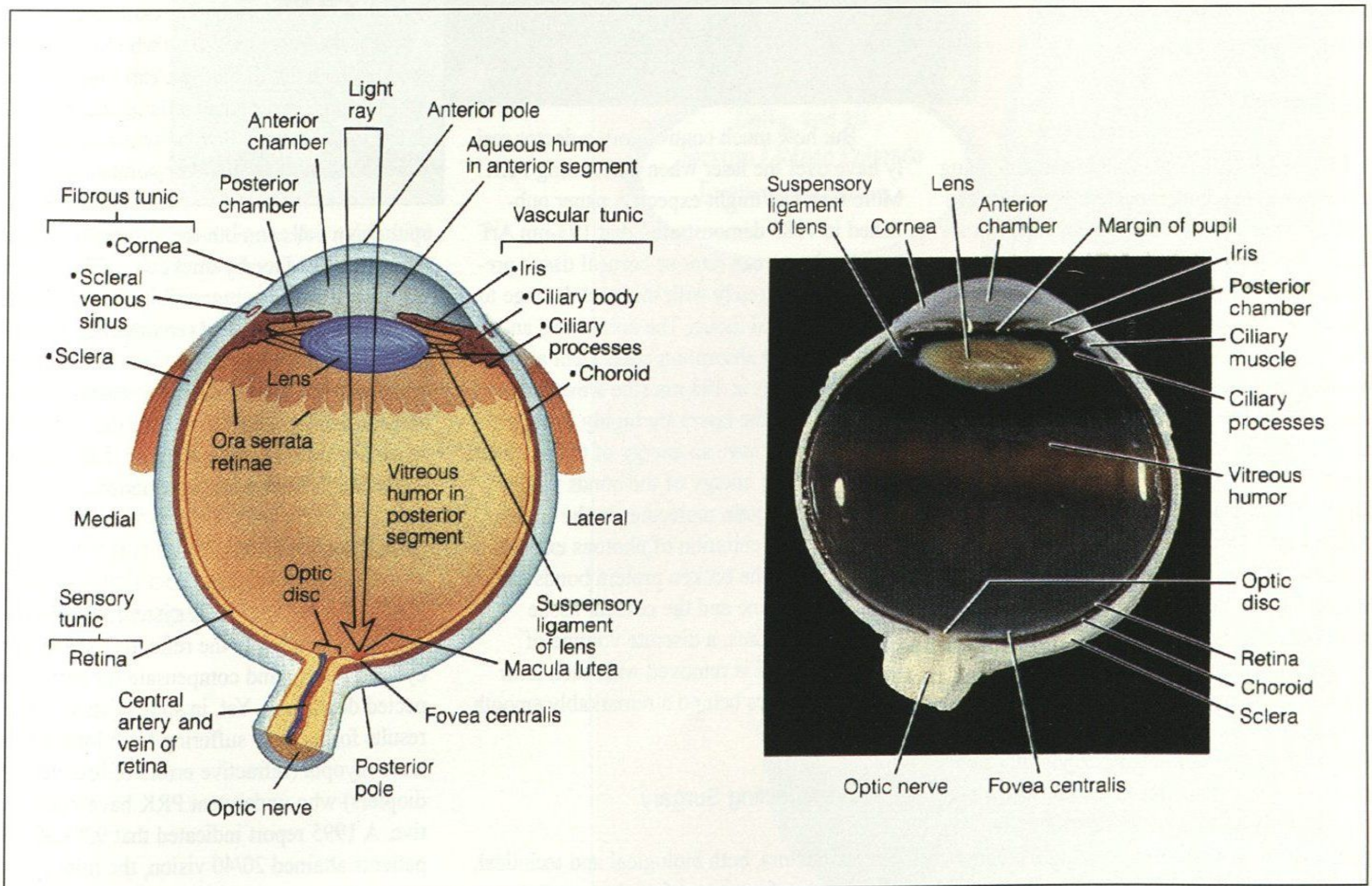
Astigmatism is a more complicated condition and results from a misshaped cornea. The cornea should curve evenly from side to side and top to bottom, but the cornea of astigmatism patients is shaped more like the back of a spoon, with more curvature in one direction than another. This causes light rays to have more than one focal point and results in an overall blurriness of vision regardless of distance.

Ophthalmologists measure refractive error in terms of diopters. A normal eye has a focal length of about 16.7 mm or about 60 diopters. Prescriptions indicate the amount of refraction necessary to correct errors with a negative prescription corresponding to nearsightedness and a positive prescription corresponding to farsightedness.

Ordinarily, glasses and contacts correct refractive errors by bending the light entering the eye such that focusing power is either added or subtracted depending on the patient's condition. PRK, however, uses a different approach to compensate for the eye's weaknesses. PRK refocuses the light entering the eye by reshaping the cornea. An irreversible procedure, PRK uses an excimer laser to sculpt an area of about 6 mm in diameter on the surface of the eye.

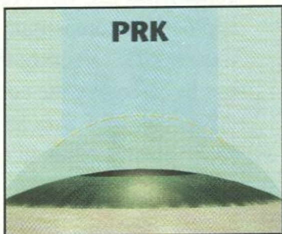
PRK versus RK

The refractive eye surgery procedure that first received approval from the Food and Drug Administration in the 1980's was radial keratotomy (RK). It is important, however, to understand the difference between PRK and RK.



Requiring a scalpel and a steady hand, an ophthalmologist performing RK changed the curve of the cornea by making several incisions in a radial or spoke-like pattern. These incisions are fairly deep, sometimes to 90% of the thickness of the cornea. This procedure has several major shortcomings, however, as it can only correct low amounts of myopia and cannot correct hyperopia. The most significant problem with RK is the 90% thickness weakening of the cornea frequently leads to progressive flattening of the cornea and increasing farsightedness.

Because of the problems with RK, the Food and Drug Administration (FDA) has been slow to approve PRK for widespread use in the United States. The FDA first granted approval to Summit Technology to market its excimer laser in October, 1995. Since then, only one other manufacturer, Visx, has received FDA approval for presenting sufficient information regarding success rates, number of adverse events, and critical engineering safety data to show that their devices are safe and effective. Also, although PRK can correct hyperopia, it has only received approval in the U.S. for correcting myopia.



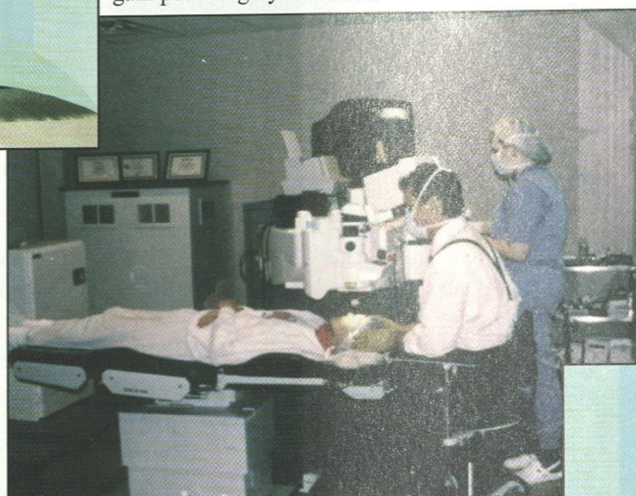
The Cornea

So PRK seems safe, but what is actually being altered when one undergoes the procedure? In reshaping the cornea, PRK exploits the refractive powers of the eye. There are three key refractive elements of the eye: the cornea, the lens, and the axial length. Of these, only the cornea is surgically accessible for both measurement and modification. The cornea provides 80% of the optical power of the eye with the lens providing the remainder. The tear film, the outermost layer of the cornea, is the major refractive element of the eye. A small change in the tear film's curvature has a large corrective effect on the total optical power of the eye. This is the major principle utilized in refractive surgery.

Altering the corneal surface is not a trivial matter. The organ the surgeon in operating on is quite small: the cornea is 550 mm thick centrally and 700 mm thick peripherally and has a horizontal diameter of 12 mm and a vertical diameter of 11 mm. Furthermore, any opacity of the cornea, like scarring from laser surgery, scatters light, degrading both the geometric image and decreasing contrast sensitivity.

Going Under the Knife

With all of these issues to consider, how does PRK work? The first step is to accurately determine the shape of the cornea using a computer-assisted corneal topographic system. This device determines the local radius curvature of the cornea and converts it into dioptric powers, a measurement of the local refractive error. The topographical data is then presented in a graphical format with colors corresponding to the particular diopter range. With this information, ophthalmologists can not only determine the refractive correction necessary before surgery, but can also use it to gain post-surgery feedback.

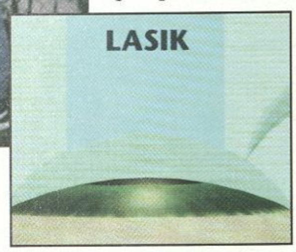


Courtesy of Dr. Jimmy Jackson, TLC

But how much control does a doctor really have over the laser when performing PRK? More than one might expect. A paper published in 1983 demonstrated that 193-nm ArF excimer lasers can remove corneal tissue precisely and discretely with minimal damage to adjacent corneal tissue. The cornea has an extremely high absorption coefficient at 193 nm and photons at 193 nm (the wavelength of the light from the laser) are highly energetic. These photons have an energy of 6.4 eV, more than the 3.5 eV energy of the bonds in the interlinking protein molecules in the cornea. When the concentration of photons exceeds a critical value, the broken protein bonds can no longer recombine and the corneal tissue decomposes. Thus, a discrete volume of cornea material is removed with each laser pulse and leaves behind a remarkably smooth surface.

Factors Affecting Surgery

Several factors, both biological and technical, affect the performance of the laser and the outcome of the surgery. Reshaping the curvature of the cornea requires the removal of tissue from the top three layers of the cornea. This inevitably invokes a wound-healing response which causes some unpredictability in the final outcome of the surgery. Technically, accurately measuring and determining the refractive status of the eye is essential for a successful operation. Although corneal topography provides useful information regarding the pre- and post-operative shape of the cornea, it does not reveal the local refraction of the eye, crucial for optimizing surgical results. Also, there are currently no means of measuring corneal topography during the surgery. A second technical issue affecting PRK outcomes is the design of the laser. Regular maintenance is essential to insure a uniform beam density and an accurate tissue removal algorithm. Thirdly, a misalignment of the procedure and/or excessive eye motion during surgery may result in irregular astigmatism, decreased best corrected vision, and contrast sensitivity. Biologically, there are also several factors that contribute to the final outcome of PRK. During PRK, changes in corneal hydration as a result of the length of operating time, preoperative treatment, or air exposure affects the efficiency with which the laser can remove tissue. The way the eye recovers from surgery also causes variations: epithelium cells smooth the abrupt changes in the corneal surface by thickening. This thickening may promote regression. Employing a technique called stromal remodeling, where a graduated transition zone is used between the untreated surface and a large (>6mm) treated corneal surface, helps to reduce the thickening as well as minimize the glare or "halo" effect that some PRK patients experience.



How Effective is it?

Ideally, the excimer PRK system would measure intraoperatively the refractive status of the eye and cornea and compensate for any unexpected deviations. Yet, in spite of this, clinical results for patients suffering from low to moderate myopia (refractive errors of less than -6.0 diopters) who underwent PRK have been positive. A 1995 report indicated that 92% of these patients attained 20/40 vision, the minimum standard for driving without corrective lenses in the U.S. Seventy-four percent of these patients achieved 20/25 vision or better. The predictability of PRK was also quite good, with more than 77% of patients getting within 1.0 diopters of intended correction and 44% getting within 0.5 diopters. Results appeared stable in follow-up exams six months after the procedure and complications such as loss of best-corrected vision, overcorrection, corneal scarring, glare, and regression were rare for this group.

For patients suffering from high myopia (refractive errors greater than -6.0 diopters), results were not as encouraging. Only 60% of these patients achieved 20/40 vision after one surgery. Ophthalmologists instead recommend a different surgery for high myops. LASIK (Laser in Situ Keratomileusis) involves first slicing the cornea from the side, producing a flap, and then reshaping the cornea with an excimer laser. The flap is then repositioned over the cornea and held in place until the flap can reattach itself to the rest of the cornea. Besides making surgery more effective for patients with more extensive refractive errors, LASIK also has a much shorter recovery time and fewer post-operative complications than PRK.

Seeing the Bottom Line

Offering patients the opportunity to correct myopic vision, refractive eye surgery is an exciting and growing field in the medical community. Although the technology continues to advance, its high cost will keep it out of the reach of most people. The laser alone costs $500,000 and requires $40,000 of monthly maintenance. Consequently, the procedures are rather pricey: PRK costs about $1900 and LASIK about $2300 per an eye, bills that insurance companies do not cover. But for those tired of dealing with glasses and contacts, it may be worth it.

Deanna DeMarco is a senior in electrical engineering and music. She is proud to be a member of the quarter of the world's population that is blind when without glasses.

THE fun PAGE

Colorado Engineer
Eye Gear

Always a reflection of the E-center...

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a geek tradition

Comprehending Engineers

Three engineers and three mathematicians are traveling by train to a conference. At the station, the three mathematicians each buy tickets and watch as the three engineers buy only a single ticket.

"How are three people going to travel on only one ticket?" asks s mathematician.

"Watch and you'll see," answers an engineer.

They all board the train. The mathematicians take their respective seats, but all three engineers cram into a restroom and close the door behind them. Shortly after the train has departed, the conductor comes around collecting tickets. He knocks on the restroom door and says, "Ticket, please." The door opens just a crack and a single arm emerges with a ticket in hand. The conductor takes it and moves on.

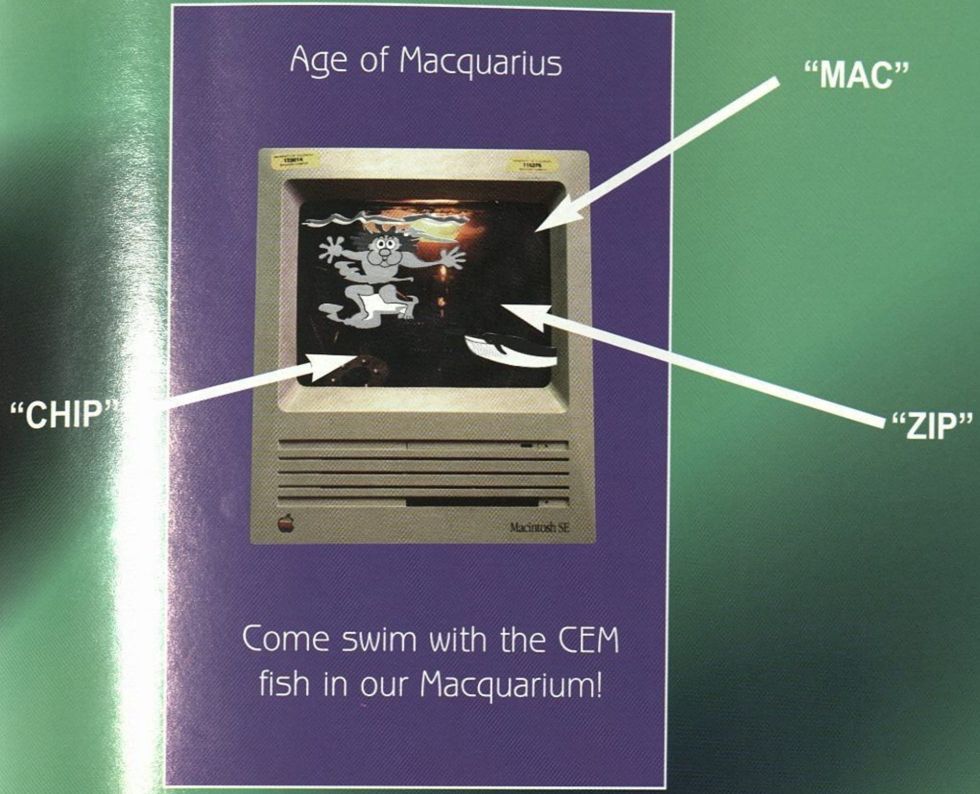
The mathematicians see this and agree it is quite a clever idea. So after the conference, the mathematicians decide to copy the engineers on the return trip and save some money (being clever with money, and all that). When they get to the station, they buy a single ticket for the return trip. To their astonishment, the engineers don't buy a ticket at all.

"How are you going to travel without a ticket?" asks one perplexed mathematician.

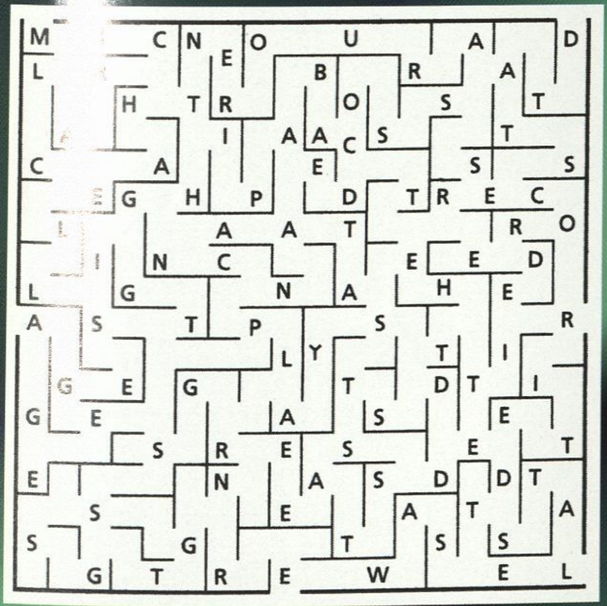
"Watch and you'll see," answers a engineer.

When they board the train, the three mathematicians cram into one restroom and the three engineers cram into another one nearby. The train departs. Shortly afterward, one of the engineers leaves his restroom and walks over to the restroom where the mathematician are hiding. He knocks on the door and says, "Ticket, please."

Come on, Luke. Why can't you fix it?
It's a Mac for Pete's sake!



CEM RAFFLE: Win **$100** certificate by guessing when the first fish in the Macquarium will **die**. Yes, it's a raffle involving death and money, who could ask for anything more. Stop by the Colorado Engineer Magazine office (ECCR 205) and enter for free.



THE WONDROUS MAZE:
Select one of the six locations to start the maze. Only one of these locations will allow you to choose a complete sentence that will eventually exit the maze. When you complete the maze the sentence will reveal a fascinating fact.
<hint: One of the words is an abbreviation>

There are only two kinds of parking left on campus--illegal and no.

He who laughs last, probably didn't get the joke.

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Women Seeking Men

Brainy, Exuberant, Full Tilt

Sexy, sharp engineer, seeks SWM age 18-25. Must enjoy problem solving, computers and quiet nights with a good text book. I believe the real excitement of magnetism is the tension between objects of like polarity.
RESPONSE # 165

Wanted: Engineer

Must be intelligent, lacking good communication skills and love a good calculus problem. Whether you are a junior engineer or be the next Bill Gates, then I am the woman for you!
RESPONSE # 208

Men Seeking Women

Narcissistic Nerd

I need to leave the engineering center-can you take me away? SHM seeking active, sensual, non-engineering major. Must be ready to laugh at computer jokes and love to surf the Web.
RESPONSE # 184

Overeducated Cowboy

Pale, lacking muscles and enjoys the indoors. Looking for a future of equations and intelligent conversation. I like to listen and often need coaxing to get me away from my books. Do you see yourself with this guy?
RESPONSE # 102

Men Seeking Men

First Contact

You would think it would be easy to find a man being an engineering major, but no luck. Responsible, stable, GM, 5'11", 175 lbs, brown hair, and green eyes. Looking for romantic prince to rescue this solitary engineer.
RESPONSE # 254

Women Seeking Women

Extraordinary Geek

Attractive, professional, highly motivated, GW needs romance. Help me rediscover the thrill of life outside of a testing laboratory. Enjoy a good video game and movies like Heavy Metal.
RESPONSE # 138

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