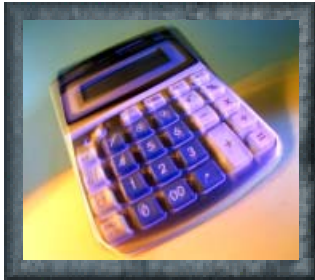




Career Cornerstone News

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Career Cornerstone News is a Publication of the Sloan Career Cornerstone Center, the Premier Online Resource for Exploring Career Paths in Science, Technology, Engineering, Mathematics, Computing, and Medicine.

Inside this issue:

<i>Visualize Science & Engineering</i>	1
<i>Careers in Medicine</i>	1
<i>Tree Rings Provide Hurricane Record</i>	2
<i>Degree Profile: Mechanical Engineering</i>	2
<i>Mathematical Tools Predict Surgery</i>	3
<i>Square Kilometer Array Telescope</i>	4
<i>Silent, Eco-friendly Plane</i>	4

Visualize Science & Engineering

Sometimes the best way to express a scientific idea is through an image that grabs the eye and invites viewers to wonder what they're seeing. Fourteen images and multimedia presentations, each using innovative approaches to encapsulate a scientific story, have won the 2006 Science and Engineering Visualization Challenge, a competition sponsored jointly by the National Science Foundation and the journal *Science*, which is published by the American Association for the Advancement of Science. Currently in its fourth year, the contest

recognizes outstanding achievement in the use of visual media to promote understanding of research results and scientific phenomena. The judges' criteria for evaluating the entries included visual impact, innovation and accuracy, among others. Winning entries communicate information about complex mathematical concepts, the intricacies of the human body, air-flight patterns, the latest



"Still Life: Five Glass Surfaces on a Tabletop"

Credit: Richard Palais, Luc Benard, University of California - Irvine

scientific imaging technologies to analyze Leonardo da Vinci's art, and more.

Find out more at www.nsf.gov/news/special_reports/scivis.

Careers in Medicine

The Sloan Career Cornerstone Center (SCCC) is a continually expanding resource for exploring careers in science, technology, engineering, mathematics, computing



-- and now medicine too!

Find out about what it is like to be a dentist, physician/surgeon, nurse, or veterinarian. Explore how to earn a degree in medicine, and why an accredited program is so important. Learn about salary and employment options. And, explore professional associations linking members of the medical community. SCCC also provides



links to all accredited medical schools, and to programs in nursing, dentistry, and veterinary science.

Find out more at www.careercornerstone.org/medicine/medicine.htm.

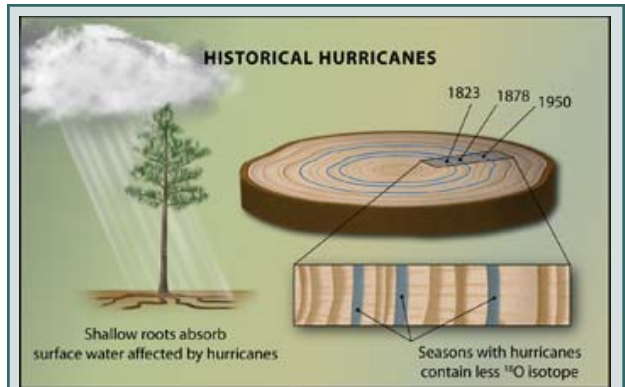
Tree Rings Provide Hurricane Record

New research by two University of Tennessee professors could help us better understand hurricanes by looking to an unusual source: tree rings.

UT professors Claudia Mora and Henri Grissino-Mayer have found that an age-old "database" -- tree rings -- contains surprisingly accurate information about hurricane activity that occurred hundreds of years ago. By measuring different chemical forms of oxygen present in the rings, researchers identified periods when hurricanes hit areas of the Southeast more than 100 years before modern records were kept.

The technique allows scientists to extend from decades to centuries the time-frames of intense hurricane cycles and may help determine if the increase in the number of hurricanes hitting the Southeast since the mid-1990s is part of a regularly occurring cycle or due to causes such as global climate change.

Find out more about the research and the science of dendrochronology at <http://web.utk.edu/~grissino>.



The shallow roots of the longleaf pine absorb surface water, which is affected by precipitation. Hurricanes produce large amounts of precipitation with a distinctly lower oxygen isotope composition than that in dew or smaller storms. Tracing tree-rings that contain these lower isotope compositions unveils a record of hurricanes that both supports and surpasses the present historical record. The current study looks at a 220-year-old record and suggests data up to 400 years can be accessed in future studies.

Credit: Zina Deretsky, National Science Foundation

Degree Profile: Mechanical Engineering

Mechanical engineers use the principles of energy, materials, and mechanics to design and manufacture machines and devices of all types. They create the processes and systems that drive technology and industry.

The career paths of mechanical engineers are largely determined by individual choices, a decided advantage in a changing world. Mechanics, energy and heat, mathematics, engineering sciences, design and manufacturing form the foundation of mechanical engineering.

Mechanics includes fluids, ranging from still water to hypersonic gases flowing around a space vehicle; it involves the motion of anything from a particle to a machine or complex structure.

Mechanical engineers research, develop, design, manufacture, and test tools, engines, machines, and other mechanical devices. They work on power-producing machines such as electric generators, internal combustion engines, and steam and gas turbines, as well as power-using machines such as refrigeration and air-conditioning equipment, machine tools, material handling systems, elevators and escalators, industrial production equipment, and robots used in manufacturing.

Mechanical engineers also design tools that other engineers need for their work. Mechanical engineering is one of the broadest engineering disciplines.



Mechanical engineers may work in production operations in manufacturing or agriculture, maintenance, or technical sales; many are administrators or managers. Find out more about careers in Mechanical Engineering at www.careercornerstone.org/

Mathematical Tools Predict Surgery Results

Cranio-maxillofacial surgery is a medical specialty focusing on facial and skull reconstruction. This surgery can help patients with such disorders as cleft palate, malformations of the upper or lower jaw, and problems with the facial skeleton due to injury. Intensive pre-operative planning is needed to ensure that the medical purposes of the surgery are achieved.

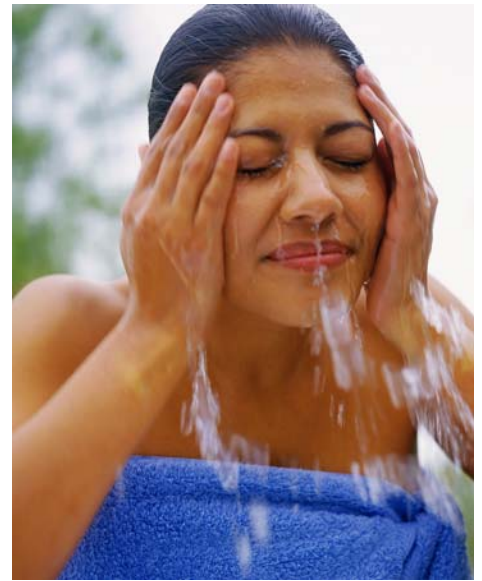
In their article "Mathematics in Facial Surgery," Peter Deuflhard, Martin Weiser, and Stefan Zachow (of the Konrad Zuse Zentrum, Berlin) describe the mathematical techniques they have used to assist cranio-maxillofacial surgeons to predict the outcomes of surgery.

The first step in the planning paradigm for such surgery is to use medical imaging data of the patient to construct a 3-dimensional computer model, called the "virtual patient." The second step, uses the data to create a "virtual lab" in

which various operative strategies can be tested. The last step is to play back to the patient the outcomes of the various strategies.

The second step in the paradigm requires modeling and solving partial differential equations (PDEs), which are equations that represent changing physical systems. One must identify which PDEs are appropriate for biomechanical modeling of soft facial tissue and bone. Standard methods for handling the equations need to be adapted for this particular application. One must also formulate ways to represent the interface between tissue and bone, as well as their interactions. Generally such PDEs cannot be solved exactly in closed form, so mathematics enters the picture once again to provide numerical techniques for producing approximate solutions.

With the "virtual patient" data as input, one can use the approximate



solutions to generate an individualized model for that particular patient. The surgeons can then use the model as a "virtual lab" to predict the effects of surgical procedures and options, and patients can get a picture of approximately how they will look after the surgery.

Find out more at www.ams.org/notices/200609/fea-surgery.pdf.

Career Cornerstone Explores Career Paths in...

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- Architectural Engineering
- Bioengineering
- Biology
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- Chemistry
- Civil Engineering
- Computer Engineering
- Computer Science
- Dentistry
- Electrical Engineering
- Engineering Technology
- Environmental Engineering
- Geosciences
- Industrial Engineering
- Manufacturing Engineering
- Materials Science and Engineering
- Mathematics
- Mechanical Engineering
- Medicine
- Mining Engineering
- Nuclear Engineering
- Nursing
- Petroleum Engineering
- Physics
- Software Engineering
- Statistics
- Veterinary Science
- - - and more to come...



Find out more at www.careercornerstone.org

Square Kilometer Array Telescope

Australia and South Africa have been short-listed as the countries to host the Square Kilometer Array (SKA), a giant next-generation radio telescope being developed by scientists in 17 countries. The SKA will use its million square metres of collecting area to gather weak radio waves from the far reaches of the early Universe.

This huge surface will give the telescope the sensitivity it will need to see far back in time – to the point, astronomers hope, where it can detect the conditions that existed during the 'dark ages,' before the first stars burst into life.

SKA observations will also lead to new understanding of the nature of "dark energy" and "dark matter" -- both still mysterious. Astronomers will be able to test radical theories of gravity, map magnetic fields in space, see planets forming around other stars, and perhaps detect transmissions from extraterrestrial intelligence.

The SKA will be a set of thousands of antennas spread over 3000km, with half the antennas located in a 'core' site of 5km x 5km. The proposed core site in Australia is Mileura station, 100km west of Meekathara in Western Australia. Other antennas would be distributed over the continent; still more might be placed in New Zealand.

A key requirement of the core site is very low levels of man-made radio signals, which could mask the faint cosmic radio waves the telescope is designed to detect. Both the Australian and South African sites can see much of the same sky as the world's other major telescopes. Both have a good view of the southern sky, which is where the centre of our Galaxy goes overhead. And both have stable ionospheric conditions, important for low-frequency observations.



A visualization of the SKA core site. Small dishes will receive short radio waves while static. Credit: CSIRO Australia

The project, currently being developed by an international SKA consortium of countries, is expected to cost about US\$1 billion and be built during the second decade of this century. This cost will be shared among the participating countries: currently, these are Australia, Canada, China, Europe (France, Germany, Italy, the Netherlands, Poland, Russia, Spain, Sweden, and the UK), India, South Africa and the USA. Find out more at www.skatelescope.org.

Silent, Eco-friendly Plane

MIT and Cambridge University researchers have unveiled the conceptual design for a silent, environmentally friendly passenger plane, which is part of the Silent Aircraft Initiative. "Public concern about noise is a major constraint on expansion of aircraft operations. The 'silent aircraft' can help address this concern and thus aid in meeting the increasing passenger demand for air transport," said Edward M. Greitzer, the H.N. Slater Professor of Aeronautics and Astronautics at MIT. While originally conceived to make a huge reduction in airplane noise, the team's ultimate design also has the potential to be more fuel-efficient. In a typical flight, the proposed plane, which is designed to carry 215 passengers, is predicted to achieve 124 passenger-miles per gallon, almost 25% more than current aircraft. The conceptual design addresses both the engines and the structure, or airframe, of a plane. Half of the noise from a landing plane comes from the airframe. Find out more at www.cambridge-mit.org/project/home/?objid=1409.



Conceptual design for a silent, environmentally friendly passenger plane designed by researchers at the Cambridge-MIT Institute's Silent Aircraft Initiative. Image courtesy: Silent Aircraft Initiative