

# Computers Lend Healing Hand

BY SHARON PEARCE

Hidden in a back room of the University of Calgary's electrical and computer engineering department is an office overgrown with books and files that speak a strange language. Words like patients, X-rays, knee disease, mammography and ligaments spill out of reports co-authored by physicians specializing in orthopedic surgery and radiology.

Behind the desk is Rangaraj Rangayyan P.Eng., PhD, a professor and associate department head who also plays the part of adjunct professor of surgery and radiology. He represents a unique species of engineer, having spent the last 17 years trying to reconcile the often stormy relationship between computer technology and medicine. If he succeeds it may lower your health care bill.

Dr. Rangayyan believes information technology, the change agent that has helped so many companies get leaner, smarter and closer to the customer, may be just

what the doctor ordered to help the ailing health care system tighten its economic belt. Computer concepts that are already being successfully applied to electrocardiograms and blood cell image analyses, he says, can be harnessed to improve the efficiency of other medical diagnoses by as much as

*Calgary's Rangaraj Rangayyan, P.Eng., PhD, addresses the high cost of health care with computer assisted diagnosis.*

ten per cent and significantly reduce the need for expensive follow-up tests. In his work with medical practitioners Dr. Cy Frank, of the Calgary Foothills Hospital and Dr. Doug Bell, of the University of Calgary's Sport Medicine Centre, Dr. Rangayyan already has come a long way toward developing a simpler and less expensive method for detecting chondromalacia, a knee disease common to arthritis patients. He uses minuscule microphones to



pick up knee sounds that are fed to a computer for analysis and diagnosis within minutes.

"It's a safe, non-invasive way of detecting the presence or absence of articular cartilage damage," says Dr. Bell. "X-rays don't show it unless the cartilage is completely gone and specialized tests using dyes or the MRI (magnetic resonance imaging) are not very helpful."

The only alternative is an arthroscopy, but that requires a physician to cut into the knee joint at a cost of \$1,200-to-\$1,500 and that procedure requires some two hours to arrive at a verdict. Dr. Bell feels some 20 per cent of the 1,000

*Detecting Cartilage Damage — in a knee is an example of engineering and medicine seeking ways to use computers to cut costs and cut out surgery. Photo shows Calgary team (left to right) Dr. Doug Bell, Katherine Ladly (patient), Rangaraj Rangayyan, P.Eng., PhD, Dr. Cy Frank and Dr. Yuan Ting Zhang.*

arthroscopies performed in Calgary each year could be avoided through the use of Dr. Rangayyan's cheaper knee sound computer program. Dr. Rangayyan estimates it will be three-to-five years before the software and system is refined and developed. The package is expected to cost purchasers about \$10,000.

Another research project involving Dr. Leo Desautels, staff radiologist for the Foothills

Hospital and clinical professor for the U of C's faculty of medicine, promises to help radiologists diagnose breast cancer at an earlier stage and reduce the need for some biopsies. Dr. Rangayyan's research team is one of a handful in the world racing to develop a computer program that will make the usually hazy mammograms more clear and assist radiologists in

*(continued on page 15)*

# Computers in Medicine

(Continued from page 1)

determining whether various patterns and calcifications are malignant or benign. By applying the same type of technology as is used to clarify satellite pictures of Mars — which digitize and manipulate the mammograms — the radiologist can better define what's going on and either diagnose cancer and initiate treatment at an earlier stage, or eliminate the need for repeated mammograms or biopsies in obviously benign cases.

For potential savings Dr. Desautels points to a recent research project where only 35 out of some 300 biopsies found cancer. The biopsies were ordered based on suspicious mammograms. "In North America the cancer detection rate for mammograms ranges from one-in-three, to one-in-18," he says. "If it's higher than one out of five, either the mammograms are poor quality, or the person reading them does not have enough experience." He thinks computer-enhanced mammographies could have eliminated the need for 225 of the



Rangaraj Rangayyan, P.Eng., Ph.D.  
*Computer investments now could reap savings on health-care spending in the future.*

biopsies included in this study, for a saving of about \$65,000 in medical fees.

But more efficient medical diagnosis is just part of what Dr. Rangayyan's engineering research can accomplish. He's also working on a teleradiology project that will make it possible for doctors in remote communities to transmit X-rays to their urban colleagues in minutes instead of via the more traditional and time-consuming courier system. Teleradiology

would be particularly valuable in emergency accident cases, says Dr. Desautels, where rural doctors need to confer with specialists in urban centres on difficult-to-detect conditions like abdominal injuries, or a ruptured bowel or liver. It would also save on the cost of transferring patients with complicated conditions such as chest disease, a tumor or infection, from rural hospitals to large tertiary care centres for diagnostic workups. The doctor would simply transmit the X-rays, saving the patient the trauma of transfer, as well as higher urban hospital room rates, —a savings of some \$500 a day.

Using digital communications technology, Dr. Rangayyan has created software that reduces the data on X-rays by a factor of four without a loss of information. He feels the quality of his system is superior to those commercially available from various companies. His next step will be to try transmitting X-rays via satellite from a rural clinic to a primary health care centre and evaluate the quality of the service. If the field trial works out, he estimates it will cost a rural centre about \$45,000 for the transmission equipment, plus

rental fees for a satellite dish. The urban centres will have to put out about \$120,000-to-\$180,000 for a satellite receiver and printer.

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The man with the engineering doctorate, who stands behind behind the stack of medical-sounding research reports, is

confident his engineering technology one day may save the health-care system a bundle, but he admits it won't come cheap. The digitizing camera, display monitors, computer and machine used to print back the computerized film for his mammography project carry a price tag of close to half a million dollars, a sum he's still struggling to raise. One hope on the horizon is the possibility of a joint project with Alberta Screen Test, the early detection of breast cancer program. But cost-benefit is always the toughest argument, Dr. Rangayyan concludes. "If we can prevent a few biopsies or diagnose cancers earlier, how much value do you put on that?" ☆