



Faster, more efficient searching of medical images



A Danish-led research project has made encouraging progress toward using advanced mathematics as the basis of an improved method for indexing and searching medical images in the huge digital databases of clinics and hospitals.

Completed in November 2005, the DSSCV consortium's long-term goal was to contribute to software tools allowing doctors and hospital technicians to quickly search and match X-rays, magnetic resonance images and computed 3D tomography scans, particularly of the craniofacial region.

"Let's say a doctor has a new patient with a broken bone," says coordinator, Mads Nielsen, a professor of computer science at the IT University of Copenhagen. "He remembers seeing a similar fracture and wants to recall how he treated that patient, but doesn't remember the case number. By inputting the X-ray of the new patient, this computer system would allow finding the relevant, digitally stored image of that kind of fracture."

"Anybody that needs to compare or search images for specific features could use the technology," says Nielsen. However, he estimates that practical use will require five to 10 more years of development.

Funded under the European Commission's FET (Future and Emerging Technologies) initiative of the IST programme, the DSSCV project gathered mathematicians and computer scientists from four European universities with the objective of developing more efficient algorithms for comparing shapes, in this case images. "A shape is a very complicated thing to describe mathematically," explains Nielsen. "To efficiently compare shapes, you need something that doesn't compare every feature."

The researchers refined the practical application of singularity and scale-space theories to develop algorithms that describe the deep structure of a shape, which Nielsen explains as a collection of details, called singularities. Such an algorithm makes it possible to disregard singularities that do not match the particular shape sought.

"An analogy would be a stadium full of 20,000 spectators, and you want to find your brother", he says. "You are not going to look at every wrinkle, eyebrow and strand of hair. You eliminate the details that are irrelevant in order to zoom in on your brother."

The team worked with theories of how singularities emerge and disappear in an image. For example, catastrophe theory can explain how one slight change to part of an image can drastically change the overall picture. Says Nielsen, "Zoom in on a tree, and branches and leaves appear. The algorithm we've developed allows such a coarse-to-fine way to break shapes into parts, compare them and determine how they relate to each other."

DSSCV partners have been awarded five grants, for the projects 'Natural shape', from the Danish Research Agency; 'Quantitative shape modelling in biomedical imaging', from the Danish Technical Research Council; 'The problem of scale in biomedical image analysis' and 'Robust multi-scale methods for optic flow', from the Dutch Science Foundation; and a grant from the British Research Council for Science and Engineering.

Nielsen says computer vision is still an exploratory field, moving in many different directions. Still, due to pressure from major medical equipment manufacturers, some areas are beginning to standardise—especially in the medical area.

Scientific communication is key to progress, says Nielsen. DSSCV has presented results in several scientific journals and conferences and held an open workshop with participants from the US and Japan. "We gained and provided valuable insights. The feedback has been good."

Looking ahead, Nielsen says, "We've done the deep mathematics. Now we'd like to do another project with other partners more involved in the practical issues, such as doctors and hospitals."


Contact:


Mads Nielsen
IT University of Copenhagen
Rued Langgaards Vej 7
DK-2300 Copenhagen S
Denmark
Tel: +45-72-185075
Fax: +45-72-185001
Email: malte@itu.dk

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