From *SIAM News*, Volume 45, Number 7, September 2012

A Talent for Making Things Happen

FROM THE SIAM PRESIDENT

By Nick Trefethen

Tony Chan is not your average university president. For a start, it's hard to imagine any other who could have given such a fascinating technical presentation at a SIAM Annual Meeting. The talk, "Image Processing and Computational Mathematics," was presented July 10 in Minneapolis.

Chan began by telling us that he and SIAM both turned 60 this year, but he didn't know whose birthday came first. I've looked into the matter, and it turns out SIAM, having been incorporated on April 30, 1952, is three months younger.

I first met Tony Chan on my arrival in graduate school at Stanford in 1977. I remember a cool Caltech graduate with long hair and exceptional enthusiasm. Pretty soon he was organizing the weekly Serra House volleyball game, to which my contribution was designing the t-shirts.

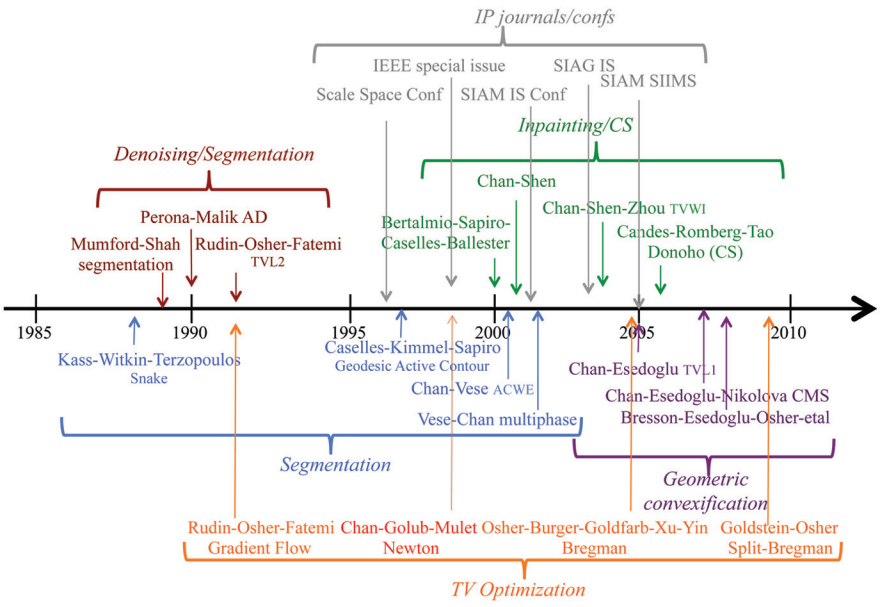
Even back then, in his thesis on finite difference methods for PDEs, Chan showed a special interest in how mathematics can really be used. He had a knack for spotting what was limiting the speed or accuracy of an algorithm and finding the right modification to fix it. Image processing hardly existed in those days, but Chan was growing expert in the tools that would draw him into the field.

In his talk in Minneapolis he showed striking figures illustrating the power of today's imaging algorithms, nicely contextualized by historical timelines. One long-established theme of the field is denoising of images, which is sometimes done by solving PDEs like the Perona–Malik equation and its relatives. Another is segmentation—identifying automatically the geometric components that make up an image. A third is inpainting, in which imperfections in an image (telephone wires, scratches, superimposed text, . . .) can often be eliminated with no visible trace. We've come a long way from the day when Stalin airbrushed Trotsky out of Communist Party photos.

As the field of image processing was developing, so was Chan's career. After a postdoc at Caltech and a junior faculty position at Yale, his hair now a little shorter, he took up a permanent position at UCLA, and his talent for making things happen began to show itself on a larger scale. He was a principal investigator on the NSF proposal for the creation of IPAM, the Institute for Pure and Applied Mathematics. The proposal was successful, and Chan became one of the early directors of IPAM, which has helped establish UCLA as one of the top universities for mathematics in the world. Chan was not to run IPAM for long, however, for in 2001, not yet 50, he became dean of physical sciences at UCLA.

Did I mention SIAM? The future university president was a mainstay of our society from the beginning. Chan has served as an editor of SIREV and SISC and a member of the SIAM Council and Board, and most importantly, he and Kirk Jordan were the authors of a proposal to found a new SIAM journal, *SIAM Journal on Imaging Sciences*. In his talk he proudly pointed out that SIIMS is the only SIAM journal whose title spotlights an area of science rather than mathematics. Under the editorship of Guillermo Sapiro, it ranks second only to *SIAM Review* in impact factor ratings in applied mathematics. Readers of this column know that I trust at most the first digit of an impact factor, but SIIMS's success is resounding enough to show up even on this measure!

As his administrative scope kept widening, it is remarkable how active Chan remained in research with students, postdocs, and colleagues—including Luminita Vese (UCLA), Xavier Bresson (now at City University of Hong Kong), and Ernie Esser (now at UC Irvine), whom he credited as contributors to his talk. Chan is among the most highly cited of Highly Cited Researchers on the Thomson Reuters list, and you will see his algorithms anywhere you look in image processing, including in his 2005 SIAM textbook with Jackie Shen.



In an invited talk in Minneapolis, with a historical timeline as backdrop, Tony Chan illustrated the power of many imaging algorithms now in use.

In 2006, Chan rose to national prominence in the USA when he was appointed head of the Mathematical and Physical Sciences Directorate at the National Science Foundation, with a budget of more than $1 billion per year.

And then in 2009, he moved to his current position as president of Hong Kong University of Science and Technology. For two years running, HKUST has been ranked in the Quacquarelli Symonds University Rankings as the No. 1 university in Asia.

But let's get back to image processing, because I haven't mentioned the most exciting theme of Chan's talk. This was the link, or I should say the many links, between imaging sciences and structured non-smooth optimization problems related to the total variation (TV) and the L^1 norm. Even Tony Chan is human, and by the end of his talk, he was running a little short of time. So he wasn't able to give proper attention to a remarkable table he had put together, "Algorithm connections, old and new," displaying a column of algorithms in mathematical optimization lined up against a column of related algorithms in image processing. Among the optimization ↔ imaging connections listed were these:

Method of multipliers ↔ Bregman iteration

Uzawa's method ↔ Linearized Bregman iteration

Alternating direction method of multipliers ↔ Split Bregman iteration

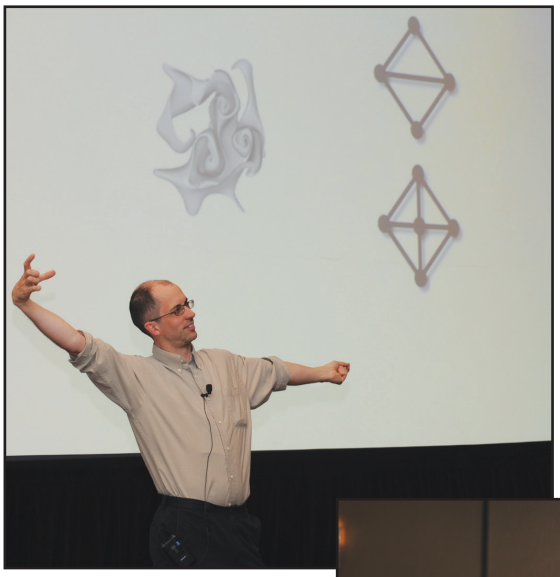
Forward–backward splitting ↔ Fixed point continuation

Arrow–Hurwicz algorithm ↔ Primal–dual hybrid gradient iteration

Newton-like methods ↔ Semismooth Newton for TV

There is much more going on here than I can possibly indicate in a few lines, and I am grateful to Jorge Nocedal and Steve Wright for teaching me a little about the many resonances in the field of optimization excited by Chan's table.

The L^1 norm is everywhere these days. The compressed sensing people perform miracles of sparsity with it; in machine learning it helps make better predictions; and when it comes to image processing, Stan Osher likes to say that L^1 "forgives and forgets errors." Our children may not know what's going on when they bend reality in Photoshop, but it's all about algorithms developed by optimization and image processing leaders like Tony Chan. Motion picture analogs were presented in another memorable hour in Minneapolis, in the Block Community Lecture by Robert Bridson. These are exciting times in non-smooth optimization and image processing. Happy Birthday, Tony! Happy Birthday, SIAM!



I.E. Block Community Lecturer Robert Bridson ("Creating Reality: The Mathematics Behind Visual Effects") is a computer scientist at the University of British Columbia and co-founder and chief scientist of the graphics company Exotic Matter. Like many exciting speakers, he concluded with a look at open challenges: more physics (for simulating foam), more scale (stormy oceans), more coupling (wet hair and clothing as an actor dives into water); more interaction with artists. In short: More Math!

Audience members lined up to ask questions; shown here, Benjamin Seibold of Temple University.