BENTHAM SCIENCE

Tribute to Prof. Gerald Farin

Remembering A Geometric Modeling Researcher and Educator

Prof. Gerald Farin

On the 14th of January, 2016, our close friend and colleague Gerald Farin, Professor of Computer Science and Engineering at Arizona State University (ASU) passed away at the age of 62. Gerald served as the senior member of the advisory board since the inception of the Journal Neuroscience and Biomedical Engineering (NBE). He is survived by his wife and colleague Dianne Hansford (dianne@farinhansford.com). A Celebration of Life tribute was held for Gerald at ASU's University Club on 29 January 2016. It included colleagues and leaders from ASU, international leaders in his research field, devoted students, and his family. The comments about Gerald's and Dianne's devoted partnership and support for him were extremely moving. A link to the video of the tribute is available at http://www.farinhansford.com/gerald/index.html. Please also see ASU's remembrance of Gerald at https://asunow.asu.edu/20160128-life-and-career-gerald-farin-geometric-modeling-pioneer-generous-mentor. The Society for Industrial and Applied Mathematics (SIAM) reported his death and paid their respects to Gerald at their official website on the first of April, 2016.

To honor Gerald's contribution to the whole field of Computer-Aided Design (CAD), the journal CAD will also publishes its Tribute as well as the journal of Computer Aided Geometric Design. We will continue to cherish our memories of Gerald and recognize his lasting impact on the field and on his students.

Gerald was internationally recognized for his leadership and pioneering works in the field of Computer Aided Geometric Design (CAGD, the mathematical analysis of curves and surfaces). He was a dedicated mentor to numerous students, many of whom have gone on to play leadership roles in academia and industry, and whose careers and lives he affected in important ways. He was the longstanding co-editor-in-chief of the CAGD Journal (Elsevier), the primary journal in his field, and he was well known for his methodological rigor, kindness, candor, and sense of humor.

Eric Reiman first got to know Gerald (and his CAGD colleagues Tom Foley, Alyn Rockwood, and Robert Barnhill, founder of this field) nearly 25 years ago. He worked with Gerald on providing medical and neuroimaging guidance to several of his Ph.D students working in our then called Samaritan PET Center, Good Samaritan Medical Center, the predecessor of Banner Alzheimer's Institute (BAI). Among the students were Zhiyong Xie and Lang-sheng Yun. Eric was then interested in finding better ways to mold brain images, linear and non-linear registration/deformation, from different people into the same size and shape to improve the power of brain mapping studies, and Gerald was already well known for using his geometric modeling and knowledge and skills to design the shape of Mercedes vehicles and customize the shape of shoes according to the size and shape of a person's foot. Indeed, adequate image pre-processing such as image registration is fundamental to Eric's medical research goals [1]. Image registration, in its generic sense, is to spatially align, linearly and/or non-linearly, images from different subjects (e.g., to a common brain template especially for multi-subject studies), visits, and from different modalities. Under the guidance of Gerald, Zhiyong applied a free from deformation method to map one brain image to another using a B-spline transformation calculated based on point/curve landmarks, structure shape, or the intensity of two images. To avoid the over fitting issue and reduce the computing load, hierarchical B-splines with smooth constraint were employed to adaptively match two images [2]. The method has been applied in Alzheimer's disease studies [3] as well as other disease [4, 5]. Gerald's dedication to education and training was obviously exemplified by the quality of the students he attracted, the training they received, and some of his students' thesis defenses that Eric and Kewei attended.

At that time, various neuroimaging techniques especially positron emission tomography (PET) and magnetic resonance imaging (MRI) started to be used in the studies of human brain functions and diseases. While conducting basic research on emotion, memory and other high level brain functions, Eric was especially interested in the use of these imaging techniques to examine the abnormalities related to Alzheimer's disease (AD) in people who are still cognitively normal. Eric recalls the fun he had with Gerald learning about each other's areas of interest, complementary skills, knowledge, and thinking about ways to address certain problems in a more effective way. Eric recalls Gerald's never-failing kindness, enthusiasm, laughter, and support for the application of his computational techniques for Eric's medical researches. Not long after they became close friends and research collaborators, Gerald joined Eric in getting their study "Brain Imaging and Behavioral Sciences Program" sponsored by Flinn Foundation, Arizona (http://www.flinn.org/about/). This Flinn sponsored program was a competitive multi-institutional, multi-disciplinary research and training program that capitalized on complementary strengths in brain imaging, computer science, and the behavioral sciences. It trained quite a number of productive computer science students such as Zhiyong and Lang-sheng, and led to quite a few important studies and papers. Among these publications was the first PET study that Eric, Richard Caselli, Lang-sheng, Kewei (who joined Eric after his Biomathematical training at UCLA) and our other colleagues conducted in the homozygotes and non-carriers of apolipoprotein ε4 (APOE4), a genetic risk gene for AD. It reported the FDG-PET measured hypometabolism of glucose in cognitively normal individual who carried two-copies of the apolipoprotein ε4 allele as compared to non-carriers. This study, published in New England Journal of Medicine (NEJM), was among the important ones that let people think about the possibility of detecting the earliest abnormal changes and even the intervention before the onset of the Alzheimer's disease.

Neuroscience and Biomedical Engineering

This Flinn Foundation grant, in which Gerald played a leadership role, that particular NEJM study, and the other complementary strengths we had in Arizona led us to develop the Arizona Alzheimer's Consortium (AAC) in late 1998. AAC is an Arizona statewide collaboration that capitalizes on its participating institutions' complementary strengths in brain imaging, computer science (especially with the leadership of Gerald), genomics, the basic and cognitive neurosciences and clinical and neuropathology research to promote the scientific understanding and early detection of Alzheimer's disease and find effective disease-stopping and prevention therapies (http://azalz.org/). In this consortium, Gerald represented ASU for a number of years and coordinated the efforts from different departments within ASU. He was a founding and longstanding member of the AAC's Internal Scientific Advisory Committee (ISAC). He and Dianne enjoyed the science and social aspects of our annual retreats. We will remember him in the Consortium's Annual Conference and Annual Report in the coming May.

Gerald's influence to medical field is not limited in his direct involvement in the research with us in Arizona as exemplified above. With his dedicated research, people from various industry and academic fields understand the concepts of geometrical modelling and started to use them in their respective practices. After getting his PhD from Gerald and starting his first job, Zhiyong joined Radiology department of University of Pennsylvania. The first day in the lab, he found Gerald's book "Curves and Surfaces for CAGD" on the bookshelf. Not surprisingly, Gerald's books were cited in numerous publications in the medical field [6-9]. In fact, computational geometrical methods were not only used in data visualization and modeling the anatomical structures, but also in image registration, image segmentation, intensity correction, and image reconstruction, among others. Although he is not with us now, Gerald's work will continue to contribute the medical field and to directly and/or indirectly make a difference in better way to treat and even prevent diseases.

Gracious, kind, supportive and enthusiastic, Gerald died too soon. We have lost a member of our professional family. We will miss him greatly.

The "Gerald Farin Memorial Fellowship" has been created to support deserving graduate students studying at ASU. Anyone who wishes to contribute to this fellowship can find details at http://www.farinhansford.com/gerald/index.html

1. E. M. Reiman, R. J. Caselli, L. S. Yun, K. Chen, D. Bandy, S. Minoshima, S. N. Thibodeau, D. Osborne. Preclinical evidence of Alzheimer's disease in persons homozygous for the epsilon 4 allele for apolipoprotein E. N Engl J Med. 1996 March 21; 334(12): 752–758.
2. Z. Xie and G. Farin. Image registration using hierarchical B-splines. IEEE Transactions on visualization and computer graphics, vol. 10, no. 1, pp. 85-94, 2004.
3. J. Gee, L. Ding, Z. Xie, M. Lin, C. DeVita and M. Grossman. Alzheimer's disease and frontotemporal dementia exhibit distinct atrophy-behavior correlates: A computer-assisted imaging study, Academic Radiology, vol. 10, no. 12, pp. 1392-1401, 2003.
4. P. Yushkevich, A. Dubb, Z. Xie, Ruben Gur, Raquel Gur, J. C. Gee. Regional Structural Characterization of the Brain of Schizophrenia Patients. Academic Radiology; vol. 12, no. 10, pp. 1250-1261, 2005.
5. Z. Xie, S. Liachenko, P. Chiao, S. Carvajal-Gonzalez, S. Bove, T. Bocan. *In vivo* MRI Assessment of Knee Cartilage in the Medial Meniscal Tear Model of Osteoarthritis in Rats. Med Image Comput Comput Assist Interv. 2010.
6. Tim McInerney, Demetri Terzopoulos, Deformable models in medical image analysis: a survey, Medical Image Analysis, Volume 1, Issue 2, June 1996, Pages 91-108.
7. Bajaj C, Goswami S. Modeling Cardiovascular Anatomy from Patient-Specific Imaging data. Computational methods in applied sciences (Springer). 2009;13:1-28.
8. W. Annicchiarico, G. Martinez, M. Cerrolaza, Boundary elements and β-spline surface modeling for medical applications, Applied Mathematical Modelling, Volume 31, Issue 2, February 2007, Pages 194-208.
9. Wahle A, Prause PM, DeJong SC, Sonka M.Geometrically correct 3-D reconstruction of intravascular ultrasound images by fusion with biplane angiography--methods and validation.IEEE Trans Med Imaging. 1999 Aug; 18(8):686-99.

Kewei Chen, Ph.D.

Sr. Scientist and Sr. Bio-mathematician
Director of Core Resources
Neuroimaging Research and Analysis Lab.
Banner Alzheimer's Institute
Banner Health
901 E. Willetta Street
Phoenix AZ 85006
USA
E-mail: Kewei.Chen@bannerhealth.com

Zhiyong Xie, Ph.D.

Associate Director
WRD Imaging & Engineering
Pfizer Inc
610 Main St. Cambridge
MA 02139
USA
E-mail: Zhiyong.xie@pfizer.com

Eric M. Reiman, MD

Executive Director
Banner Alzheimer's Institute & CEO
Banner Research
Professor of Psychiatry, University of Arizona
University Professor of Neuroscience
Arizona State University
Clinical Director of Neurogenomics
Translational Genomics Research Institute
Director, Arizona Alzheimer's Consortium
901 East Willetta Street
Phoenix, AZ, 85006
USA
E-mail: eric.reiman@bannerhealth.com