

# Gregory C. Sharp

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## Work address:

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8 Leather Lane  
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## Education and Appointments

- 2008-present Harvard Medical School, Assistant Professor, Radiation Oncology, Massachusetts General Hospital.
- 2004-2008 Harvard Medical School, Instructor, Radiation Oncology, Massachusetts General Hospital.
- 2002-2004 Harvard Medical School, Postdoctoral Research Fellow, Radiation Oncology, Massachusetts General Hospital.
- 1997-2002 University of Michigan, Doctor of Philosophy, Electrical Engineering and Computer Sciences.  
Thesis advisor: Sang Wook Lee  
Thesis topic: "Automatic and Stable Multiview 3D Surface Registration."
- 1998-2002 University of Michigan, Master of Science, Mathematics.
- 1995-1996 University of Wisconsin, Master of Science, Computer Sciences.
- 1985-1991 University of Wisconsin, Bachelor of Science, Electrical Engineering.

## Employment

- 2004-present Assistant Radiation Physicist, Department of Radiation Oncology, Massachusetts General Hospital, Boston, Massachusetts.
- Board certified in Medical Physics (ABR, 2011).
- Lead physicist for thoracic radiation therapy (2010-).
- Lead physicist for image-guided radiation therapy (2008-).
- Clinical: Varian and Elekta linear accelerators; CT and 4D-CT simulators; SBRT; on-board imaging; CBCT; EPID; respiratory gating; radiation measurement; quality assurance; computer systems; DICOM; OIS.
- Research: motion management; fluoroscopic tracking; deformable image registration; image segmentation; 4D-CT; cone-beam CT; software engineering; parallel computing; software reliability and testing.

Administrative: thoracic clinical collaborative committee co-chair (2010-), proton accelerator architectural oversight committee (2014-); technology assessment group (2012-2014), proton accelerator selection committee (2012-2014), proton accelerator design committee (2013-2014), proton accelerator executive committee (2013-2014); paperless task force (2008-2010).

- 2002-2004    Research Fellow, Department of Radiation Oncology, Massachusetts General Hospital, Boston, Massachusetts.  
Research and clinical implementation of image guided radiation therapy. Development of fluoroscopic guided respiratory gating for the IRIS system. Real-time imaging and tracking. Prediction of organ motion. Software reliability and testing. Deformable image registration.
- 1998-2002    Research Assistant, University of Michigan, Ann Arbor, Michigan.  
Computer vision and robotics research. Research surface registration methods for constructing three-dimensional models from range data for building facility maps in hazardous environment. Research methods in applied mathematics for solving large-scale multiview registration problems. Design custom range image acquisition hardware, calibration software, and registration software. Research empirical models for photometry in image-based rendering.
- 1992-1995    System Engineer, Intergraph Japan, Product Development Dept., Tokyo, Japan.  
Product development. Develop and maintain Japanese versions of commercial PC and UNIX software products, including Microstation (3D surface CAD), I/EMS (3D solid CAD), PC-NFS (networking), ModelView (ray tracing), and I/RAS (scanning and image processing). Design software for machine-assisted translation of graphical user interfaces and on-line help from English to Japanese.
- 1990         Intern, Kodak R&D Japan, Software Development Dept., Yokohama, Japan.  
Develop Japanese localized version of image database software for VAX VMS.
- 1988-1989    Intern, IBM, I/O Subsystems Dept., Rochester, MN and Fujisawa, Japan.  
Develop embedded SCSI device drivers for peripheral CD-ROM and magneto-optical devices for AS400 computers.

## Teaching

- 2013- “Medical Physics Imaging Course,” Harvard Medical School Residency Program, Boston, MA.  
Post-graduate seminar course to teach Medical Physics residents about medical imaging physics for radiotherapy.
- 2012- “PHYS 4651 – Medical Physics Seminar 1,” Northeastern University, Boston, MA.  
Junior level seminar course, 1 semester, 6-8 students per semester, 20 hours in-class.
- 2013- “HST.S14 – Optimization problems in radiation therapy and medical imaging,” MIT, Cambridge, MA.  
Graduate level course, 1 semester, 10 students per semester, 8 hours in-class per semester.
- 2009-2013 “MS-L315 – Radiation Physics Laboratory,” Suffolk University, Boston, MA.  
Sophomore level lab course, 4 semesters, 8-21 students per semester, 20 hours in-class per semester.
- 2012 “2-D simulation,” “Image-guided radiation therapy,” and “Image fusion”  
Post-graduate training of medical physics residents, 1 year, 4 residents per semester, about 20 hours per year.
- 2010-2011 “C++ programming,” Massachusetts General Hospital, Boston, MA.  
Senior level course, 1 semester, 15 students, 20 hours in-class teaching.
- 2007 “CSG144 – Pattern Recognition and Computer Vision,” Northeastern University, Dept. of Computer and Information Sciences, Boston, MA.  
Graduate level course, 1 semester, 15 students, 40 hours in-class teaching.
- 2006 “CSG142 – Digital Image Processing,” Northeastern University, Dept. of Computer and Information Sciences, Boston, MA.  
Graduate level course, 1 semester, 8 students, 40 hours in-class in-class teaching.
- 1997 “CSE 402 – Introduction to Operating Systems,” University of Michigan, Dept. of Electrical Engineering and Computer Science, Ann Arbor, MI.  
Senior level class: 1 semester, 40 students, 25 hours in-class teaching.
- 1995-1996 “CS 302 – Introduction to Programming,” University of Wisconsin, Dept. of Computer Sciences, Madison, WI.  
Freshman level class: 3 semesters, 110 students, 180 hours in-class teaching.

## **Mentoring**

- 2015- Undergraduate research advisor, Xuhua Ren, Tianjin University.
- 2014- Undergraduate research advisor, Inna Gerstenshteyn, Boston University.
- 2014- PhD thesis committee, Pingge Jiang, Drexel University.
- 2012- Postdoctoral advisor, Justin Phillips, MGH.
- 2012- PhD research advisor, Maxime Desplanque, Politecnico di Milano.
- 2012- PhD thesis committee, Rajath Soans, Drexel University.
- 2009- PhD thesis advisor, Gueorge Gueorguiev, University of Massachusetts, Lowell.
- 2014 Masters thesis advisor, Robert Hommes, Eindhoven University of Technology.
- 2013-2014 Masters thesis advisor, Joris Radermacher, Eindhoven University of Technology.
- 2012-2014 Postdoctoral advisor, Yang-Kyun Park, MGH.
- 2010-2014 Postdoctoral advisor, Nadya Shusharina, MGH.
- 2013 Masters research advisor, Dolla Toomeh, University of Massachusetts, Lowell.
- 2012-2013 PhD research advisor, Mengjiao Wang, Tsinghua University.
- 2012 Undergraduate research advisor, Andre Miguel Monteiro, Lisbon University.
- 2012 Undergraduate research advisor, Willem Rohl-Hill, University of Buffalo.
- 2011-2012 Postdoctoral advisor, James Shackleford, MGH.
- 2011-2012 Resident research advisor, Kent Riley, MGH.
- 2011-2012 Masters research advisor, Amelia Arbisser, MIT.
- 2011 Undergraduate research advisor, Ana Monica Lourenco, Lisbon University.
- 2011 Masters thesis advisor, Qi Yang, University of Heidelberg.
- 2010-2011 Research advisor, Esra Cansizoglu, Northeastern University.
- 2009-2011 Masters thesis advisor, Robert Schneider, University of Massachusetts, Lowell.
- 2009-2011 Postdoctoral advisor, Rui Li, MGH.
- 2008-2011 PhD research advisor, Sila Kurugol, Northeastern University.
- 2008-2011 PhD research advisor, James Shackleford, Drexel University.
- 2009 Undergraduate research advisor, Edward Kim, MGH.

**Mentoring (cont.)**

- 2008 Masters thesis advisor, Patrick Hoyer, University of Heidelberg.
- 2008 PhD qualifying examiner, Northeastern University.
- 2008 Masters thesis committee, Burak Eram, Northeastern University.
- 2008 PhD thesis committee, Ying Cui, Northeastern University.
- 2006-2007 Postdoctoral advisor, Ziji Wu, Massachusetts General Hospital.
- 2005 PhD thesis committee, Vlad Boldea, Universite Lumiere Lyon 2.
- 2003 Masters thesis committee, Jason Ruel, Boston University.

## Consulting

- 2013      Consultant, Northwestern University, Evanston, Illinois.  
Develop a CMake cross-platform build configuration system for the AIM library.
- 2002      Consultant, University of Michigan, Ann Arbor, Michigan.  
Develop a computer vision calibration, tracking and measurement system for performance evaluation of a hexapod robot. Develop segmentation-based and correlation-based pattern matching methods. Develop and tune multiple-hypothesis Kalman filter tracking methods.  
This software is available for free on the web at <http://gtms.sourceforge.net>.
- 2002      Consultant, University of Michigan, Ann Arbor, Michigan.  
Develop a computer vision calibration, tracking and measurement system for high-speed kinematic estimation of a running cockroach. Develop direction-dependant sub-pixel corner finding methods.
- 1999      Consultant, University of Michigan, Ann Arbor, Michigan.  
Develop another computer vision calibration, tracking and measurement system for performance evaluation of a hexapod robot.
- 1998      Consultant, Selectware, Livonia, Michigan.  
Develop computer vision calibration, tracking and curve fitting algorithms for real-time position estimation and visualization of a thrown bowling ball.
- 1997      Consultant, Goknar Behavioral Maps, Oak Park, Michigan.  
Develop expert system software for computer assisted psychiatric diagnosis and treatment.

### **Professional Service**

- 2015 Workshop organizer: Autoseg 2015, Toronto, ON.
- 2014- Secretary: New England AAPM chapter.
- 2013- Member: AAPM Therapy Imaging Subcommittee.
- 2011- Workshop organizer: 3D-Slicer user group, at AAPM annual meeting.
- 2007- Session chair: AAPM annual meeting.
- 2014 Workshop organizer: MICCAI IGART workshop, Boston, MA.
- 2013 Workshop organizer: Autoseg 2013, Boston, MA.
- 2012-2014 Member: ITIC, National registry of radiation oncology.
- 2012-2014 Corresponding member: ICRP Task Group 88: Radiological protection in cone-beam CT.
- 2007 Seminar series organizer: MGH physics research lecture series, Boston, MA.
- 2005 Member: Ad hoc Study Group on Safety Requirements Relating to Installation, Configuration and Maintenance of Networkable Medical Devices, Food and Drug Administration, Washington DC.
- 2005 Member: Working Group on Foundations of Integration, High Confidence Medical Devices System and Software, NCO/ITRD/NSF, Philadelphia PA.
- 2001-2002 President: Computer Science and Engineering Graduate student organization, University of Michigan.
- 2000-2001 Vice-President: Computer Science and Engineering Graduate student organization, University of Michigan.
- 1999 Session chair: IEEE International Conf. of Robotics and Automation, Detroit MI.

### **Community Service**

- 2005-2013 Mentor: Just ASK Mentorship program, University of Michigan Department of Engineering.
- 2000 Mentor: Michigan Mentoring Program for gifted high school children.
- 1999 Mentor: University of Michigan Tutoring Services program for gifted middle school children.

### **Languages**

English and Japanese.

**Awards**

- 2013-2014 Principle Investigator, Ira J. Spiro translational research award, “The development of a biologically-guided target definition for localized and locally advanced non-small cell lung cancer,” (Sharp, PI)
- 2012-2014 Principle Investigator, NIH/MGH Federal Share Grant, “An open-source software for proton treatment planning,” (Sharp, PI)
- 2011-2013 Principle Investigator, NIH/MGH Federal Share Grant, “Reducing uncertainties in SBRT for Pancreatic Cancer,” (Sharp, PI)
- 2011-2014 Investigator, NIH-2-R01-CA111590-05A1, “Four-dimensional Monte Carlo dose calculation,” (Paganetti, PI)
- 2010-2014 Site PI, NIH-U54 2-U54-EB005149-06, National Alliance for Medical Image Computing, (Kikinis, PI)
- 2010-2011 Principle Investigator, Ira J. Spiro translational research award, “Adaptive radiotherapy for head and neck cancer,” (Sharp, PI)
- 2008-2010 Principle Investigator, NIH/MGH Federal Share Grant, “GPU-Accelerated Proton Dose Calculation,” (Sharp, PI)
- 2007-2012 Investigator, NIH-P01 CA021239-29A1, “Proton Therapy Radiation Research,” (DeLaney, PI)
- 2007-2012 Investigator, NIH-R01 CA118200-01A2, “Management of Breathing Effects in Radiotherapy Planning,” (Bortfeld, PI)
- 2005-2007 Investigator, NIH-R21 CA110177-01, “A Tumor Tracking System for Image Guided Radiotherapy,” (Jiang, PI)
- 2001 NSF Summer Institute in Korea, Sogang University, Seoul Korea. Research in facial animation for computer graphics.
- 1985-1991 Japanese Engineering Leadership Scholarship

**Honors**

- 2014 Editors Pick, Medical Physics.
- 2013 Featured article, Physics in Medicine and Biology (twice!).
- 2008 Physics in Medicine and Biology Citation Award (7th most cited paper '03-'08)
- 2001 Rackham Scholar Nominee
- 1996 University of Wisconsin Outstanding Teaching Assistant Nominee
- 1991 Graduation with Distinction
- 1990 Certificate in Japanese Studies for Engineers
- 1985-1991 Dean’s Honor List



### **Peer Review (Current)**

British Journal of Radiology  
International Journal of Radiation Oncology, Biology, Physics  
Medical Physics (also Associate Editor)  
Physics in Medicine and Biology  
Radiological Physics and Technology  
Radiotherapy and Oncology

AAPM (American Association of Physicists in Medicine)  
ASTRO (American Society for Radiation Oncology)  
BIOIMAGING (Joint Conference on Biomedical Engineering Systems and Technologies)  
ISBI (IEEE International Symposium on Biomedical Imaging)  
World Congress on Medical Physics

### **Peer Review (Historic)**

ACM Transactions on Graphics  
BMC Medical Informatics and Decision Making  
Computer Vision Image Understanding  
IEEE Transactions on Image Processing  
IEEE Transactions on Pattern Analysis and Machine Intelligence  
IEEE Transactions on System, Man and Cybernetics  
IEEE Transactions on Multimedia  
IEEE Transactions on Information Technology in Biomedicine  
Journal of Applied Clinical Medical Physics  
Journal of Radiation Research  
Machine Vision and Applications  
Medical Image Analysis  
Nuclear Instruments and Methods in Physics Research Section A  
Pattern Recognition  
Pattern Recognition Letters

CVPR (IEEE Conference of Computer Vision and Pattern Recognition)  
ICCR (International Conference on the Use of Computers in Radiotherapy)  
ICECS (IEEE Circuits and Systems)  
ICRA (IEEE International Conference of Robotics and Automation)  
MICCAI (Medical Image Computing and Computer Assisted Intervention)

### **Professional Affiliations**

1997-present Member, IEEE and IEEE Computer Society.

1997-present Member, Association for Computing Machinery.

2005-present Member, American Association of Physicists in Medicine.

### Peer Reviewed Journal Articles

Park Y-K, Sharp GC. "Gain correction for an X-ray imaging system with a movable flat panel detector and intrinsic localization crosshair," *Technol Cancer Res Treat. Online before print.*

Doolan PJ, Testa M, Sharp G, Bentefour EH, Royle G, Lu HM. "Patient-specific stopping power calibration for proton therapy planning based on single-detector proton radiography," *Phys Med Biol.* 2015 Mar 7;60(5):1901-17.

Moteabbed M, Sharp GC, Wang Y, Trofimov A, Efstathiou JA, Lu HM. "Validation of a deformable image registration technique for cone beam CT-based dose verification," *Med Phys.* 2015 Jan;42(1):196-205.

Shusharina N, Sharp GC, Choi NC. "Correlation of 18F-FDG PET avid volumes on pre-radiation therapy and post-radiation therapy FDG PET scans in recurrent lung cancer. In reply to Saraiya et al," *Int J Radiat Oncol Biol Phys.* 2014 Nov 15;90(4):969-70.

Phillips J, Gueorguiev G, Shackelford JA, Grassberger C, Dowdell S, Paganetti H, Sharp GC. "Computing proton dose to irregularly moving targets," *Phys Med Biol.* 2014 Aug 7;59(15):4261-73.

Grassberger C, Daartz J, Dowdell S, Ruggieri T, Sharp G, Paganetti H. "Quantification of proton dose calculation accuracy in the lung." *Int J Radiat Oncol Biol Phys.* 2014 Jun 1;89(2):424-30.

Fritscher KD, Peroni M, Zaffino P, Spadea MF, Schubert R, Sharp G. "Automatic segmentation of head and neck CT images for radiotherapy treatment planning using multiple atlases, statistical appearance models, and geodesic active contours," *Med Phys.* 2014 May;41(5):051910.

Sharp G, Fritscher KD, Pekar V, Peroni M, Shusharina N, Veeraraghavan H, Yang J. "Vision 20/20: perspectives on automated image segmentation for radiotherapy." *Med Phys.* 2014 May;41(5):050902.

Wang M, Sharp GC, Rit S, Delmon V, Wang G. "2D/4D marker-free tumor tracking using 4D CBCT as the reference image." *Phys Med Biol.* 2014 May 7;59(9):2219-33.

Shusharina N, Cho J, Sharp GC, Choi NC. "Correlation of (18)F-FDG avid volumes on pre-radiation therapy and post-radiation therapy FDG PET scans in recurrent lung cancer." *Int J Radiat Oncol Biol Phys.* 2014 May 1;89(1):137-44.

Saleh ZH, Apte AP, Sharp GC, Shusharina NP, Wang Y, Veeraraghavan H, Thor M, Muren LP, Rao SS, Lee NY, Deasy JO. "The distance discordance metric-a novel approach to quantifying spatial uncertainties in intra- and inter-patient deformable image registration," *Phys Med Biol.* 2014 Feb 7;59(3):733-46.

**Peer Reviewed Journal Articles (cont.)**

Peroni M, Golland P, Sharp GC, Baroni G, “Stopping Criteria for Log-Domain Diffeomorphic Demons Registration: An Experimental Survey for Radiotherapy Application,” *Technol Cancer Res Treat*, 2013, Aug 31.

Wang Y, Efstathiou JA, Lu HM, Sharp GC, Trofimov A, Hypofractionated proton therapy for prostate cancer: dose delivery uncertainty due to interfractional motion,” *Medical physics*, 2013 Jul;40(7):071714.

Dowdell S, Grassberger C, Sharp GC, Paganetti H. “Interplay effects in proton scanning for lung: A 4D Monte Carlo study assessing the impact of tumor and beam delivery parameters,” *Physics in Medicine and Biology*, 2013 Jun 21;58(12):4137-56.

Peroni, M., Spadea, M.F., Riboldi, M., Falcone, S., Vaccaro, C., Sharp, G.C., Baroni, G. “Validation of Automatic Contour Propagation for 4D Treatment Planning using Multiple Metrics,” *Technol Cancer Res Treat*, Vol 12, pp 501-510, Jun 2013.

Jason Efstathiou, et al., “Practice-based evidence to evidence-based practice: building the National Radiation Oncology Registry,” *J Oncol Pract*, 2013 May;9(3):e90-5.

Esra Ataer-Cansizoglu, Erhan Bas, Jayashree Kalpathy-Cramer, Gregory C. Sharp, Deniz Erdogmus, “Contour-based shape representation using principal curves,” *Pattern Recognition*, Volume 46, Issue 4, April 2013, Pages 1140-1150.

Li R, Sharp G. “Robust fluoroscopic tracking of fiducial markers: exploiting the spatial constraints,” *Physics in medicine and biology*, 2013 Mar 21;58(6):1789-808.

Grassberger C, Dowdell S, Lomax A, Sharp G, Shackelford J, Choi N, Willers H, Paganetti H., Motion interplay as a function of patient parameters and spot size in spot scanning proton therapy for lung cancer, *Int J Radiat Oncol Biol Phys*. 2013 Jun 1;86(2):380-6.

Chiara Paganelli, Marta Peroni, Marco Riboldi, Gregory C Sharp, Delia Ciardo, Daniela Alterio, Roberto Orecchia and Guido Baroni, “Scale invariant feature transform in adaptive radiation therapy: a tool for deformable image registration assessment and re-planning indication,” *Physics in Medicine and Biology*, 2013 Jan 21;58(2):287-99.

Nadezhda Shusharina, Gregory C Sharp, “Image registration using radial basis functions with adaptive radius,” *Medical Physics*, Vol 39, No 11, pp 6542-9, Nov 2012.

Ben M Clasié, Gregory C Sharp, Joao Seco, Jacob B Flanz, Hanne M Kooy, “Numerical solutions of the gamma index in two and three dimensions,” *Physics in Medicine and Biology*, Vol 57, No 21, pp 6981-97, Nov 7, 2012.

**Peer Reviewed Journal Articles (cont.)**

Guy Warmerdam, Philipp Steininger, Marcus Neuner, Gregory C Sharp, Brian Winey, "Influence of imaging source and panel position uncertainties on the accuracy of 2D/3D image registration of cranial images," *Medical Physics*, Vol 39, No 9, pp 5547-56, Sep 2012.

Philipp Steininger, Marcus Neuner, Harald Weichenberger, Gregory C Sharp, Brian Winey, Gerhard Kametrise, Felix F Sedlmayer, Heinz Deutschmann, "Auto-masked 2D/3D image registration and its validation with clinical cone-beam computed tomography," *Physics in Medicine and Biology*, Vol 57, No 13, pp 4277-92, Jul 7, 2012.

Josh L Hallman, Shinichiro Mori, Gregory C Sharp, Hsiao-Ming Lu, Theodore S Hong, George TY Chen, "A four-dimensional computed tomography analysis of multiorgan abdominal motion," *International Journal of Radiation Oncology, Biology, Physics*, Vol 83, No 1, pp 435-41, May 1, 2012.

Nadezhda Shusharina, Gregory C Sharp, "Analytic regularization for landmark-based image registration," *Physics in Medicine and Biology*, Vol 57, No 6, pp 1477-98, Mar 21, 2012.

Keelin Murphy, et al., "Evaluation of registration methods on thoracic CT: The EMPIRE10 challenge," *IEEE Transactions on Medical Imaging*, Vol 30, No 11, pp 1901-20, Nov 2011.

Yi Wang, Jason A Efstathiou, Gregory C Sharp, Hsiao-Ming Lu, IF Ciernik, Alexei V Trofimov, "Evaluation of the dosimetric impact of interfractional anatomical variations on prostate proton therapy using daily in-room CT images," *Med Phys*, Vol 38, No 8, pp 4623-33, Aug 2011.

Brian Winey, Greg Sharp, Marc Bussi re, "A fast double template convolution isocenter evaluation algorithm with subpixel accuracy," *Med Phys*, Vol 38, No 1, pp 233-237, Jan 2011.

Spadea MF, Baroni G, Gierga DP, Turcotte JC, Chen GT, Sharp GC. , "Evaluation and commissioning of a surface based system for respiratory sensing in 4D CT," *J Appl Clin Med Phys*. 2010 Dec 4;12(1):3288.

Shinichiro Mori, Nobuyuki Kanematsu, Hiroshi Asakura, Gregory C Sharp, Motoki Kumagai, Suguru Dobashi, Mio Nakajima, Naoyoshi Yamamoto, Susumu Kandatsu, Masayuki Baba, "Four-dimensional lung treatment planning in layer-stacking carbon ion beam treatment: comparison of layer-stacking and conventional ungated/gated irradiation," *International Journal of Radiation Oncology, Biology, Physics*, Oct 23, 2010.

James A Shackelford, Nagarajan Kandasamy, Gregory C Sharp, "On developing B-spline registration algorithms for multi-core processors," *Physics in Medicine and Biology*, Vol 55, No 21, pp 6329-6351, Nov 7, 2010.

**Peer Reviewed Journal Articles (cont.)**

Michael F Gensheimer, Torunn I Yock, Norbert J Liebsch, Gregory C Sharp, Harald Paganetti, Neel Madan, P Ellen Grant, Thomas Bortfeld, "In vivo proton beam range verification using spine MRI changes," *International Journal of Radiation Oncology, Biology, Physics*, Vol 78, No 1, pp 268-275, Sep 1, 2010.

Maria Francesca Spadea, Marta Peroni, Eleonora Preve, Marco Riboldi, Guido Baroni, George TY Chen, Gregory Charles Sharp, "Uncertainties in lung motion prediction relying on external surrogate: a 4DCT study in regular vs. irregular breathers," *Technology in Cancer Research & Treatment*, Vol 9, No 3, pp 307-316, Jun 2010.

Joyatee Sarker, Alan Chu, Kit Mui, John A Wolfgang, Ariel E Hirsch, George T Y Chen, Gregory C Sharp, "Variations in tumor size and position due to irregular breathing in 4D-CT: a simulation study," *Medical Physics*, Vol 37, No 3, pp 1254-1260, Mar 2010.

Kristy K Brock, et al., "Results of a multi-institution deformable registration accuracy study (MIDRAS)," *International Journal of Radiation Oncology, Biology, Physics*, Vol 76, No 2, pp 583-596, Feb 1, 2010.

Shinichiro Mori, Takeshi Yanagi, Ryusuke Hara, Gregory C Sharp, Hiroshi Asakura, Motoki Kumagai, Riwa Kishimoto, Shigeru Yamada, Hiroto Kato, Susumu Kandatsu, Tadashi Kamada, "Comparison of respiratory-gated and respiratory-ungated planning in scattered carbon ion beam treatment of the pancreas using four-dimensional computed tomography," *International Journal of Radiation Oncology, Biology, Physics*, Vol 76, No 1, pp 303-312, Jan 1, 2010.

Marco Riboldi, Gregory C Sharp, Guido Baroni, George TY Chen, "Four-dimensional targeting error analysis in image-guided radiotherapy," *Physics in Medicine and Biology*, Vol 54, No 19, pp 5995-6008, Oct 7, 2009.

M Kumagai, S Mori, GC Sharp, H Asakura, S Kandatsu, M Endo, M Baba, "Dosimetric variation due to CT inter-slice spacing in four-dimensional carbon beam lung therapy," *Physics in Medicine and Biology*, Vol 54, No 10, pp 3231-46, May 21, 2009.

Christian Vrančić, Alexei Trofimov, Timothy C Y Chan, Gregory C Sharp, Thomas Bortfeld, "Experimental evaluation of a robust optimization method for IMRT of moving targets," *Physics in Medicine and Biology*, Vol 54, No 9, pp 2901-2914, May 7, 2009.

S Mori, R Hara, T Yanagi, GC Sharp, M Kumagai, H Asakura, R Kishimoto, S Yamada, S Kandatsu, T Kamada. "Four dimensional measurement of intrafractional motion of pancreatic tumors using a 256 multi-slice CT scanner," *Radiotherapy and Oncology*, Vol 92, No 2, pp 231-237, Aug 2009.

**Peer Reviewed Journal Articles (cont.)**

Alexei Trofimov, Christian Vrancic, Timothy C. Chan, Gregory C. Sharp, Thomas Bortfeld, "Tumor trailing strategy for intensity-modulated radiation therapy of moving targets," *Medical Physics*, Vol 35, No 5, pp 1718-33, May 2008.

David P Gierga, Marco Riboldi, Julie C Turcotte, Greg C Sharp, Steve B Jiang, Alphonse G Taghian, George T Y Chen, "Comparison of target registration errors for multiple image-guided techniques in accelerated partial breast irradiation," *International Journal of Radiation Oncology, Biology, Physics*, Vol 70, No 4, pp 1239-1246, Mar 15, 2008.

Vlad Boldea, Gregory C. Sharp, Steve B. Jiang, David Sarrut, "4D-CT lung motion estimation with deformable registration: quantification of motion nonlinearity and hysteresis," *Medical Physics*, Vol 35, No 3, pp 1008-1018, March 2008.

Ziji Wu, Eike Rietzel, Vlad Boldea, David Sarrut, Gregory C. Sharp, "Evaluation of deformable registration of patient lung 4DCT with sub-anatomical region segmentations," *Medical Physics*, Vol 35, No 2, pp 775-81, February 2008.

Joao Seco, Gregory C. Sharp, Ziji Wu, David P. Gierga, Florian Buettner, Harald Paganetti, "Dosimetric impact of motion in free-breathing and gated lung radiotherapy: a 4D Monte Carlo study of intrafraction and interfraction effects," *Medical Physics*, Vol 35, No 1, pp. 356-66, January 2008.

Gregory C. Sharp, Sang W. Lee, David K. Wehe, "Maximum likelihood registration of range images with missing data," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, Vol 30, No 1, pp 120-30, January 2008.

Ying Cui, Jennifer G Dy, Gregory C Sharp, Brian Alexander, Steve B Jiang, "Multiple template based fluoroscopic tracking of lung tumor mass without implanted fiducial markers," *Physics in Medicine and Biology*, Vol 52, No 20, pp 6229-42, October 21, 2007.

Gregory Sharp, Nagarajan Kandasamy, Harman Singh, Michael Folkert, "GPU-based streaming architectures for fast cone-beam CT image reconstruction and demons deformable registration," *Physics in Medicine and Biology*, Vol 52, No 19, pp 5771-83, October 7, 2007.

E Kanoulas, J A Aslam, G C Sharp, R I Berbeco, S Nishioka, H Shirato, S B Jiang, "Derivation of the tumor position from external respiratory surrogates with periodical updating of internal/external correlation," *Physics in Medicine and Biology*, Vol 52, No 17, pp 5443-5456, Sep 7 2007.

**Peer Reviewed Journal Articles (cont.)**

H Wu, GC Sharp, Q Zhao, H Shirato, SB Jiang, “Statistical analysis and correlation discovery of tumor respiratory motion,” *Physics in Medicine and Biology*, Vol 52, No 16, pp 4761-74, Aug 21 2007.

Hsiao-Ming Lu, Robert Brett, Gregory Sharp, Soiros Safai, Steve Jiang, Jay Flanz, George Chen, Hanne Kooy, “A respiratory-gated treatment system for proton therapy,” *Medical Physics*, Vol 34, No 8, pp. 3273-3278, August 2007.

Xiaoli Tang, Gregory C. Sharp, Steve B. Jiang, “Fluoroscopic tracking of multiple implanted fiducial markers using multiple object tracking,” *Physics in Medicine and Biology*, Vol 52, No 14, pp 4081-98, Jun 11 2007.

Joao Seco, Gregory C. Sharp, Julie Turcotte, David P. Gierga, Thomas Bortfeld, Harald Paganetti, “Effects of intra-fraction motion on IMRT treatment with segments of few monitor units,” *Medical Physics*, Vol 34, No 3, pp. 923-934, March 2007.

Ying Cui, Jennifer G. Dy, Greg C. Sharp, Brian Alexander, Steve B. Jiang, “Robust fluoroscopic respiratory gating for lung cancer radiotherapy without implanted fiducial markers,” *Physics in Medicine and Biology*, Vol 52, No 3, pp 741–755, Feb 7 2007.

Stella Flampouri, Steve B. Jiang, Gregory C. Sharp, John Wolfgang, Abhijit A Patel, Noah C. Choi, “Estimation of the delivered patient dose in lung IMRT treatment based on deformable registration of 4D-CT data and Monte Carlo simulations,” *Physics in Medicine and Biology*, Vol 51, No 11, pp. 2763-79, June 7 2006.

Khaled Aljarrah, Greg C. Sharp, Toni Neicu, Steve B. Jiang, “Determination of the initial beam parameters in Monte Carlo linac simulation,” *Medical Physics*, Vol 33, No 4, pp. 850-8, April 2006.

H Shirato, K Suzuki, GC Sharp, K Fujita, R Onimaru, M Fujino, N Kato, Y Osaka, R Kinoshita, H Taguchi, S Onodera, K Miyasaka, “Speed and amplitude of lung tumor motion precisely detected in four-dimensional setup and in real-time tumor-tracking radiotherapy,” *International Journal of Radiation Oncology, Biology, Physics*, Vol 64, No 4, pp. 1229-36, March 15, 2006.

Steve B. Jiang, Gregory C. Sharp, Toni Neicu, Ross I. Berbeco, Stella Flampouri, Thomas Bortfeld, “On dose distribution comparison,” *Physics in Medicine and Biology*, Vol 51, No 4, pp 759-776, February 21, 2006.

Gregory C. Sharp, Shashidhar Kollipara, Thomas Madden, Steve B. Jiang, Stanley J. Rosenthal, “Anatomic feature-based registration for patient setup in head and neck cancer radiotherapy,” *Physics in Medicine and Biology*, Vol 50, No 19, pp 4667-4679, October 7, 2005.

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**Peer Reviewed Journal Articles (cont.)**

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**Abstracts and Posters (cont.)**

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DP Gierga, J Turcotte, M Riboldi, GC Sharp, SB Jiang, GTY Chen, "Comparison of Target Registration Errors for Multiple Modalities in Image-guided Partial Breast Irradiation," ASTRO 48, Philadelphia, November 2006.

JA Wolfgang, K Mui, A Chu, GC Sharp, GTY Chen, "Analysis of Residual Geometric Artifacts From 4DCT," AAPM 48, Orlando, July 2006.

Z Wu, GC Sharp, E Rietzel, "Evaluation of Segmenting Anatomical Sub-Regions for Deformable Registration of Patient Lung 4DCT," AAPM 48, Orlando, July 2006.

J Seco, DP Gierga, GC Sharp, JC Turcotte, H Paganetti, "Effects of Intra-Fraction Motion On IMRT Treatment with Segments of Few Monitor Units," AAPM 48, Orlando, July 2006.

H Wu, GC Sharp, E Shmukler, H Shirato, SB Jiang, "Statistical Analysis of Respiratory Motion and Knowledge Discovery," AAPM 48, Orlando, July 2006.

X Tang, GC Sharp, SB Jiang, "Patient Setup Based On Lung Tumor Mass for Gated Radiotherapy," AAPM 48, Orlando, July 2006.

GC Sharp, A Jeung, X Tang, H Mostafavi, GTY Chen, SB Jiang, "Respiratory Gating with Gantry Mounted Fluoroscopic Imaging," AAPM 48, Orlando, July 2006.

E Kanoulas, JA Aslam, GC Sharp, RI Berbeco, S Nishioka, H Shirato, SB Jiang, "Derivation of the Tumor Position From External Respiratory Surrogates with Periodical Updating of External/internal Correlation," AAPM 48, Orlando, July 2006.

Y Cui, JG Dy, GC Sharp, B Alexander, SB Jiang, "Correlation Score Based Respiratory Gating for Lung Cancer Radiotherapy Without Implanted Fiducial Markers," AAPM 48, Orlando, July 2006.

Y Cui, JG Dy, GC Sharp, B Alexander, SB Jiang, "Fluoroscopic Tracking of Lung Tumor Mass Without Implanted Fiducial Markers," AAPM 48, Orlando, July 2006.

DP Gierga, JC Turcotte, GC Sharp, M Riboldi, A Franke, SB Jiang, GTY Chen, "Uncertainties in Target Volume Surrogates in Image Guided External Beam Partial Breast Irradiation," AAPM 48, Orlando, July 2006.

V Boldea, GC Sharp, SB Jiang, NC Choi, C Ginestet, C Carrie, D Sarrut, "Implementation and Evaluation of Automatic Contour Propagation in 4DCT of Lung," AAPM 48, Orlando, July 2006.

**Abstracts and Posters (cont.)**

AV Trofimov, GC Sharp, TR Bortfeld, "Variability of Waveforms and Probability Distributions in External Respiratory-Surrogate Marker Data," AAPM 48, Orlando, July 2006.

M Ibrahim, GC Sharp, GTY Chen, SB Weise, NM Alpert, "Correction of Motion Blurring in PET by Gated Acquisition and Image Registration," 53rd Annual Meeting of the Society of Nuclear Medicine.

GTY Chen, J Hawthorne, SB Jiang, M Riboldi, GC Sharp, JA Wolfgang, "Geometric and Dosimetric Gains from IGRT," ESTRO 24, September 2005.

V Boldea, D Sarrut, GC Sharp, SB Jiang, NC Choi, "Study of Motion in a 4D-CT Using Deformable Registration," ASTRO 47, Denver, October 2005.

GC Sharp, A Jeung, Y Ren, S Povzner, R Berbeco, H Mostafavi, GTY Chen, SB Jiang, "Respiratory-Gated Dual Fluoroscopic Imaging for Positioning and Verification," AAPM 47, Seattle, July 2005.

H Wu, G Sharp, B Salzberg, D Kaeli, H Shirato, S Jiang, "Model-Based Probabilistic Prediction of Tumor Respiratory Motion," AAPM 47, Seattle, July 2005.

S Flampouri, G Sharp, J Wolfgang, A Niemierko, N Choi, S Jiang, "Investigation of the Actually Delivered Patient Dose in Lung IMRT Treatment Based On Deformable Registration of 4D CT Data and Monte Carlo Simulations," AAPM 47, Seattle, July 2005.

S Jiang, R Berbeco, J Wolfgang, G Sharp, K Doppke, T Neicu, Y Chen, P Busse, G Chen, "Image-Guided Respiration-Gated Treatment," AAPM 47, Seattle, July 2005.

A Trofimov, M Fernald, B Martin, G Sharp, S Jiang, T Bortfeld, "Motion-Compensation in IMRT Employing Probability Distribution of Target Location: Phantom Tests and Computer Simulation," AAPM 47, Seattle, July 2005.

M Engelsman, G Sharp, T Bortfeld, S Shimizu, H Shirato, "How Much Margin Reduction is Possible through Gating or Breath-Hold?," ESTRO 23rd Annual Meeting, October 2004.

S.B. Jiang, G.C. Sharp, R.I. Berbeco, G.T. Chen, H. Mostafavi, A. Jeung, "Development of an integrated radiotherapy imaging system (IRIS)," ASTRO 2004.

GC Sharp, SB Jiang, S Shimizu, H Shirato, "Tracking Errors in a Prototype Real-Time Tumor Tracking System," AAPM 46, Seattle, July 2004.

GC Sharp, DP Gierga, SB Jiang, "Reliable Real-Time Tracking in Fluoroscopy for Image Guided Radiotherapy," AAPM 46, Seattle, July 2004.

**Abstracts and Posters (cont.)**

T Neicu, RI Berbeco, GC Sharp, S Flampouri, K Aljarrah, SB Jiang, "Patient Breathing Coaching Using The Real Position Management System," AAPM 46, Seattle, July 2004.

K Aljarrah, GC Sharp, T Neicu, SB Jiang, "A Systematic Study On The Determination of Initial Beam Parameters in Monte Carlo Linac Simulation," AAPM 46, Seattle, July 2004.

R Berbeco, W Zhao, H Mostafavi, G Sharp, SB Jiang, "Towards Tumor Tracking in the Absence of Implanted Radio-opaque Markers," AAPM 46, Seattle, July 2004.

SB Jiang, GC Sharp, RI Berbeco, T Neicu, T Bortfeld, "Normalized Dose Difference (NDD): A Simple Method for Dose Distribution Comparison," AAPM 46, Seattle, July 2004.

R Berbeco, G Sharp, H Mostafavi, A Jeung, GTY Chen, SB Jiang, "Construction, Calibration and Commissioning of the Integrated Real-Time Imaging System (IRIS)," AAPM 46, Seattle, July 2004.

H Wu, GC Sharp, B Salzberg, H Shirato, D Kaeli, SB Jiang, "A Hidden Markov Model for Tumor Motion Analysis," AAPM 46, Seattle, July 2004.

D Lo, V Vo, S Jiang, H Tseng, G Sharp, T Neicu, S Weinberg, "Development of a Computer-Controlled Phantom to Simulate Tumor Motions Applied to Image Guided Adaptive Radiotherapy," AAPM 46, Seattle, July 2004.

D Gierga, J Brewer, G Sharp, R Berbeco, M Betke, S Jiang, C Willett, G Chen, "The Correlation Between Respiratory Tumor Motion and External Marker Motion," AAPM 46, Seattle, July 2004.

D. P. Gierga, G. Sharp, J. Brewer, M. Betke, C. G. Willett, G. T. Y. Chen, "Correlation between External and Internal Markers for Abdominal Tumors: Implications for Respiratory Gating." ASTRO 45, Salt Lake City, October 2003.

GC Sharp, SB Jiang, D Ruan, D Castañon, H Shirato, "of Prediction Methods for Real-Time Tumor Tracking during Treatment," AAPM 45, San Diego, August 2003.

GC Sharp, SB Jiang, S Kollipara, SJ Rosenthal, "Toward an Automatic Method of Anatomical Landmark Localization for Daily Patient Positioning," AAPM 45, San Diego, August 2003.

RI Berbeco, SB Jiang, GC Sharp, H Mostafavi, GTY Chen, "Integrated Radiotherapy Imaging System (IRIS): Considerations of Tumor Tracking with Gantry-Mounted Kilovoltage X-Ray Systems," AAPM 45, San Diego, August 2003.

RI Berbeco, SB Jiang, GC Sharp, H Mostafavi, S Kollipara, GTY Chen, "Patient Setup with Respiratory Gated Electronic Portal Imaging," AAPM 45, San Diego, August 2003.

**Abstracts and Posters (cont.)**

SB Jiang, T Bortfeld, A Trofimov, E Rietzel, G Sharp, N Choi, GTY Chen, "Synchronized Moving Aperture Radiation Therapy (SMART): Plan Optimization and MLC Leaf Sequencing Based on 4D CT Data," AAPM 45, San Diego, August 2003.

Da Young Ju, Jin-Ho Yoo, Kyoung Chin Seo, Gregory Sharp, Sang Wook Lee, "Image-Based Illumination for Electronic Display of Artistic Paintings," SIGGRAPH Technical Sketch, San Antonio, July 2002.



## **Books**

James Shackelford, Nagarajan Kandasamy, Gregory C. Sharp, "High-Performance Deformable Image Registration Algorithms for Manycore Processors," Morgan Kaufmann, 2013.

## **Book Chapters**

Gregory C. Sharp, Rui Li, Nagarajan Kandasamy, "Theoretical Aspects of Target Detection and Tracking," and "Fault Detection in Image-Based Tracking," in *Adaptive Motion Compensation in Radiotherapy* (1st Edition), M.J. Murphy ed., CRC Press, 2012.

James Shackelford, Nagarajan Kandasamy, Gregory C. Sharp, "Deformable Volumetric Registration using B-splines," in *GPU Computing Gems Emerald Edition* (1st Edition), W. Hwu ed., Morgan Kaufmann, 2011.

George T.Y. Chen, Gregory C. Sharp, John A. Wolfgang, "Imaging in Radiotherapy," in *Treatment Planning in Radiation Oncology* (3rd Edition), F. Khan and B. Gerbi eds., Lippincott Williams & Wilkins, 2011.

Nagarajan Kandasamy, Sherif Abdelwahed, Gregory C. Sharp, John P. Hayes, "An Online Control Framework for Designing Self-Optimizing Computing Systems: Application to Power Management," in *Self-star Properties in Complex Information Systems: Conceptual and Practical Foundations* (1st Edition), O. Babaoglu, M. Jelasity, A. Montresor, C. Fetzer, and S. Leonardi eds., Springer 2005.

## **Invited Publications**

George T. Chen, Gregory C. Sharp, Shinichiro Mori, "A Review of Image Guided Radiotherapy," *Radiological Physics and Technology*, Vol 2, No 1, pp 1-12, January 2009.

Gregory C. Sharp, Hsiao Ming Lu, Alexei Trofimov, Xiaoli Tang, Steve B. Jiang, Julie Turcotte, David P. Gierga, George T.Y. Chen, Theodore S. Hong, "Assessing Residual Motion for Gated Proton-Beam Radiotherapy," *Journal of Radiation Research*, Vol 48, Supplement A, pp 55-59, 2007.

Mohit Dilip Khandekar, Nagarajan Kandasamy, Sherif Abdelwahed, Gregory C. Sharp, "An Online Predictive Control Framework for Designing Self-Managing Computing Systems," *Multiagent and Grid Systems*, Vol 1, No 2, 2005, pp 63-72.

### **Other Publications**

Da Young Ju, Jin-Ho Yoo, Gregory C. Sharp, Sang Wook Lee, "Image-Based Illumination for Electronic Display of Artistic Paintings," University of Michigan Tech Report CSE-TR-466-02, September 2002.

Gregory C. Sharp, Sang W. Lee, David K. Wehe, "Registration of Range Images in the Presence of Occlusions and Missing Data," University of Michigan Technical Report CSE-TR-453-02, Feb 2002.

Gregory C. Sharp, Sang W. Lee, David K. Wehe, "ICP Registration using Invariant Features," University of Michigan Technical Report CSE-TR-435-00, Sept 2000.

Gregory C. Sharp, Sang W. Lee, David K. Wehe, "An Apparatus and Method for the Complete Construction of Three Dimensional Models," Patent Disclosure to the University of Michigan Technology Transfer Office, September 2000.

### **Invited Presentations**

“Perspectives on Automatic Image Segmentation for Radiotherapy,” MICCAI IGART Workshop, Boston, MA, October, 2014.

“Open source software for medical physics research,” Brigham and Women's Hospital, Boston, MA, November, 2013.

“Perspectives on Automatic Image Segmentation for Radiotherapy,” NEAAPM Fall Meeting, Waltham, MA, October, 2013.

“Image-guided Radiation Therapy,” Suffolk University, Boston, MA, September, 2013.

“3D Slicer for Medical Physics Research,” PLUNC User group meeting at AAPM/COMP, Vancouver, BC, August, 2011.

“B-spline and landmark-based deformable image registration,” Memorial Sloan-Kettering Cancer Center, New York NY, July, 2011.

“Deformable image registration using B-splines,” NEAAPM Winter Meeting, Dedham, MA, February 2011.

“Image-guided Radiation Therapy,” Harvard Medical School Radiation Oncology Residency Program, MGH, Boston, MA, October 2010.

“Practical CT,” Medical Imaging, University of Massachusetts Boston, Boston, MA, September, 2010.

“An introduction to GPU computing,” AAPM Annual Meeting, Philadelphia, PA, July 2010.

“Deformable image registration for radiotherapy,” Workshop: GPU Computing for Biomedical Research, Boston, MA, October 2009.

“Image-guided Radiation Therapy,” Harvard Medical School Radiation Oncology Residency Program, MGH, Boston, MA, October 2009.

“GPU-accelerated conebeam reconstruction,” Politecnico di Milano, Milano Italy, January 2009.

“Plastimatch,” Varian iLabs Workshop, Baden Switzerland, January 2009.

“Image-guided Radiation Therapy,” Harvard Medical School Radiation Oncology Residency Program, MGH, Boston, MA, October 2008.

**Invited Presentations (cont.)**

“Deformable image registration,” Medical physics course for undergraduates, Northeastern University Medical Physics Seminar, Boston, MA, October, 2008.

“Image-guided radiation therapy,” Medical physics course for undergraduates, Northeastern University Medical Physics Seminar, Boston, MA, October, 2008.

“Respiratory Gated Radiation Therapy,” Memorial Sloan-Kettering Cancer Center, New York NY, July 2008.

“4D Targeting Error Analysis in Image-Guided Radiotherapy,” Varian Research Partners Workshop, Austin TX, April 2008.

“Image Guidance and Respiratory Gating in Radiation Therapy,” General Electric Global Research, Schenectady NY, April 2008.

“Marker-based and Markerless Fluoroscopic Image Guidance,” Varian iLabs Workshop, Baden Switzerland, February 2008.

“Image Guided Radiotherapy,” Mitsubishi Electric Research Laboratory, Cambridge, MA, December 2007.

“IGRT and Respiratory Gating,” Educational Series for Radiation Therapy Technicians, MGH, Boston, MA, October, 2007.

“Image guided radiotherapy,” Harvard-MIT Division of Health Sciences and Technology, Boston, MA, October, 2007.

“Fluoroscopic Image Guidance,” Real-Time Motion Adaptive Radiation Therapy Workshop, Georgetown University, May 2007.

“Image Guidance for Gated Radiotherapy,” NIRS-CNAO Joint Symposium on Carbon Ion Therapy, Milan, Italy, November 2006.

“Deformable Registration of Lung CT,” Medical Physics Seminar, Brigham and Woman’s Hospital, November 2005.

“Image-guided Radiation Therapy,” Computer Sciences Colloquium, Drexel University, April 2005.

**Invited Presentations (cont.)**

“Multimodality and Deformable Registration: Challenges in Radiation Oncology,” CENSSIS Research and Industrial Collaboration Conference, Northeastern University, October 2004.

“An Automatic Method of Anatomical Landmark Localization for Daily Patient Positioning,” NEAAPM Young Investigator Symposium, May 2004.

“Research in Image-guided Radiotherapy at MGH,” Tohoku University, July 2003.

“Tracking Radio-Opaque Markers in Fluoroscopic Video,” NEAAPM Young Investigator Symposium, April 2003.

“Modeling and Predicting Human Breathing,” Massachusetts General Hospital Image Guidance Workshop, Jan 2003.

“Automatic and Stable Multiview 3D Surface Registration,” MIT Graphics Seminar, April 2002.

“Toward Multiview Registration in Frame Space,” Sogang University Electrical Engineering Seminar, July 2001.

“Toward Multiview Registration in Frame Space,” KAIST Graphics Seminar, July 2001.

“Toward Multiview Registration in Frame Space,” Seoul National University Graphics Seminar, July 2001.