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Mandell Bellmore Professor
Department of Computer Science
The Johns Hopkins University
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March 24, 2017

EDUCATION

Ph.D. in Computer Science, University of Pennsylvania, 1988
Dissertation: Active Reduction of Uncertainty in Multi-Sensor Systems
Advisor: Dr. Max Mintz

M.S.E. in Computer Science, University of Pennsylvania, 1985
Thesis: Computational Aspects of Proofs in Modal Logic
Advisor: Dr. Dale Miller

B.A. *Summa Cum Laude*, Luther College, Decorah, Iowa, 1983
Thesis: Heuristic Programming

ACADEMIC POSITIONS HELD

Founding Director, Malone Center for Engineering in Healthcare
Johns Hopkins University, 2016-present

Mandell Bellmore Professor of Computer Science
Johns Hopkins University, 2015-present

Professor of Computer Science with secondary appointments in **Mechanical Engineering, Electrical and Computer Engineering, and Surgery**
Johns Hopkins University, 1999-present.

Chairman, Department of Computer Science
Johns Hopkins University, 2010-2015.

Deputy Director, Center for Computer-Integrated Surgical Systems and Technology
Johns Hopkins University, 2005-2015.

Faculty, Graduate School of Informatics and Science in Health
Technical University of Munich, 2009-2015.

Visiting Professor of Computer Science, Stanford University, 2007-2008.

Associate Professor of Computer Science with secondary appointment in **Electrical Engineering**
Yale University, 1996-1999.

Assistant Professor of Computer Science
Yale University, 1991-1996.

Post-doctoral Research Fellow
University of Pennsylvania, 1990.

Fulbright Fellow

Fraunhofer Inst., IITB & University of Karlsruhe, 1988-1990.

Summer Research Staff

SRI International, 1984.

Summer Research Staff

IBM T.J. Watson Research Center, 1983.

AWARDS AND HONORS

Fellow of AIMBE, 2017

KUKA Innovation Award, 2016

Fellow of the MICCAI Society, 2015

Hans Fischer Fellow, Institute for Advanced Studies, Technical University of Munich, 2014

Distinguished Alumni Award, Luther College, 2013

Fellow of the IEEE, 2006

Yale Junior Faculty Fellowship, 1995.

Fulbright Post-doctoral Junior Research Fellowship, 1988.

Rubinoff Dissertation Prize, University of Pennsylvania, 1988.

IBM Graduate Fellowship in Manufacturing and Automation, 1986.

National Science Foundation Graduate Fellowship, 1983.

Best Paper Awards:

Best Paper, M2CAI workshop, MICCAI, 2016

Best Paper, Runner up, SPIE Ultrasonics 2009

Best Poster, SPIE Ultrasonics 2006, 2009

Best Journal Paper, Computer-Aided Surgery 2005

Best Student Paper, MICCAI 2005

Best Paper Nominations:

MICCAI, 2016

MICCAI, 2011

Intelligent Robots and Systems, 2004

IEEE Transactions on Robotics and Automation, 1996.

International Symposium on Robotics Research, 1989.

PROFESSIONAL ACTIVITIES

Community Service:

Roundtable on AI and Foreign Policy

National Academies, Oct. 2016.

NSF Computer and Information Science and Engineering Advisory Committee (CISE AC), 2016-present

AI-100 Inaugural Study Panel Member, 2015

National Academies Panel on Mechanical Science and Engineering at the Army Research Laboratory, 2015

Co-Chair, Biannual NITRD Review Subcommittee, 2015

Steering Committee, AAAS Information, Computing, and Communication (T) Section, 2014-2016

Chair, Computing Community Consortium (CCC) Council, 2014-2016

Vice Chair, Computing Community Consortium (CCC) Council, 2013-2014

International Advisory Committee, Conference on Computer Vision in Remote Sensing, 2012-present
International Federation of Robotics Research (IFRR) Board, 2012-present
Computing Community Consortium (CCC) Council Member, 2011-present
Chair, Computer and Robot Vision Technical Committee of the IEEE Robotics
and Automation Society, 1996-2000.

Editorial Boards:

International Journal of Computer Vision, 2004-present
IEEE Transactions on Pattern Analysis and Machine Intelligence, 2008-2011
IEEE Transactions on Robotics and Automation, 1997-2000.
Pattern Analysis and Applications, 1997-present.

Editor:

Special Issue of PAMI – Best Papers of CVPR 2013
Special Issue of IJRR on Vision and Robotics, 2011
Special Joint Issue of IJRR and IJCV on Vision and Robotics, 2006
Special Issue of the IEEE Transactions on Robotics and Automation on Visual Servoing, 1996.

Organizing Committees:

] CCC, AAAI, and OSTP Symposium on AI for Social Good, 2016
CCC Symposium on Computing and Society, 2016
CCC Workshop on Academic Industry Collaboration, 2015
NSF Workshop on Robotics and Cyberphysical Systems, 2015
CCC BRAIN Workshop, 2014
CCC Health IT Workshop, 2012
Task Modeling and Recognition for Skill Assessment and Automation in Robotic Surgery, ICRA 2011.
M2CAI, MICCAI 2009-2013.
Advanced Sensing for Computer-Integrated Surgery, ICRA, 2009.
Tutorial on Computer-Integrated Surgery, ICRA, 2006.
Tutorial on Computer-Integrated Surgery, MICCAI, 2005.
Workshop on Programming Methods in Robotics, CIRA 2001.
Tutorial in Vision-Based Robotics, CIRA 2001.
Dagstuhl Workshop on Sensor-Based Robotics, 2000.
Tutorial on Dynamic Vision, AAAI 2000.
Workshop and Tutorials Chair, CVPR 2000.
Workshop on Robust Vision for Control of Motion, 1998.
Block Island Workshop on Vision and Control, 1997.
Tutorial on Visual Control of Motion, 1996.
Workshop on Visual Servoing, 1994.

Visiting Review Committees:

University of Utah School of Computer Science, 2016
Heidelberg Special Research Center on Cognitive Surgery, 2015
UPenn Department of Computer Science, 2013
German Aerospace Institute for Mechatronics and Robotics, 2005, 2009
UCSD Dept. of Computer Science, 2008
INRIA, Computer Vision Research, 2004

Advisory Boards:

Carey Business School, JHU, 2012-present
Medical Veterans Health Institute (MVHI), 2012-present

Armstrong Patient Safety Institute, 2011-present
JHU Systems Institute Executive Board, 2011-present
JHU Engineering for Professionals Computer Science Advisory Committee, 2010-present
Health Informatics Certificate Advisory Committee, 2010-present
STI Medical Systems, Inc. 2007-present.
Ikona Medical, Inc. 2004-present.

Program, Area, General Chair:

General Chair, International Symposium on Robotics Research, 2017
General Chair, International Conference on Computer Vision, 2015
General Chair, M2CAI Workshop, MICCAI, 2014
Program Chair, Computer Vision and Pattern Recognition, 2013
Area Chair, Computer Vision and Pattern Recognition, 2005, 2006, 2007, 2008, 2009, 2012
Area Chair, Medical Image Computing and Computer Assisted Intervention, 2005, 2012, 2014

Program Committees:

Computer Vision and Pattern Recognition, 2003, 2004
Medical Image Computing and Computer Assisted Intervention, 2002, 2003, 2006, 2007, 2012, 2014, 2015
Vision Interfaces, 2002, 2003
International Conference on Computational Intelligence in Robotics and Automation, 2001
International Symposium on Robotics with Applications 2000.
Vision Algorithms Workshop (with ICCV'99), 1999.
Third Haskell Workshop (with ICFP'99), 1999.
IEEE International Conference on Computer Vision and Pattern Recognition 1996-1999.
International Conference on Computer Vision 1999.
International Conference on Robotics and Automation 1997,1999-2002,2005.
World Manufacturing Congress, 1997.
AAAI Conference 1996.
International Symposium on Robotics and Manufacturing 1996.
Multisensor Fusion and Integration for Intelligent Systems, 1994, 1996.
IEEE International Conference on Intelligent Robotics Systems, 1994, 1996, 2001.
SPIE Sensor Fusion Workshop 1991-1997.

Keynote/Plenary Speaker:

From Mimicry to Mastery: Creating Machines that Augment Human Skill,
Plenary Speaker, AAAI Fall Symposium Series, October, 2015.
From Mimicry to Mastery: Creating Machines that Augment Human Skill,
Plenary Speaker, International Conference on Robot Systems, September, 2015.
Life in a World of Ubiquitous Sensing,
Invited Session Keynote, International Conference on Robot Systems, September, 2014.
Computational Modeling and Enhancement of Human Skill,
Invited Session Keynote, Design of Medical Devices Conference, University of Minnesota, April 2014.
Computer Vision and Interventional Medicine,
CVPR Workshop on Computer Vision in Medicine, June 2012

Policy Presentations and Testimony:

Report on the CCC Brain Workshop
NSF, Jan 2016.
Testimony before The House Committee On Science, Space And Technology
Subcommittee On Research And Technology:
A Review Of The Networking And Information Technology Research And Development Program

Oct. 2016.
Presentation of the 2015 NITRD Review
President's Council of Advisors on Science and Technology, July 2015.
Presentation of the 2015 NITRD Review
CISE AC, December 2015.

Recent Invited Speaker:

Creating Machines that Augment Human Capabilities
ICCV Workshop on Assistive Computer Vision and Robotics, December 2015.
Computational Modeling and Enhancement of Human Skill: A Step Towards Surgery as a Data Science
Vanderbilt University, November, 2015.
Computational Modeling and Enhancement of Human Skill: A Step Towards Surgery as a Data Science
Armstrong Patient Safety Institute, November, 2015.
Blending People, Technology, and Algorithms into Deployable Systems for Healthcare
5th Annual Hopkins Imaging Conference, October 2015.
Computer-assisted laparoscopy: achievements and challenges
5th Annual Hopkins Imaging Conference, October 2015.
Computational Modeling and Enhancement of Human Skill
University of Heidelberg, July 2015.
Building Robots To Work With People: Toward a Science of Interaction, Collaboration, and Instruction
University of Karlsruhe, June 2015.
Modeling, Augmenting and Replicating Human Skill
Technical University of Munich, Institute for Advanced Study, April, 2015.
Progressive Autonomy Through Apprenticeship, Observation, and Generalization
DARPA Workshop on Autonomy, April 2015
Computer Vision for Interventional Medicine: Progress and Opportunities
Hamlyn Center Distinguished Seminar, University College London, December 2014.
The Future of Computing Research: Enlightenment, Renaissance, or Diaspora
USC Distinguished Lecture, November 2014.
Computational Modeling and Enhancement of Human Skill:
Georgia Tech, October 2014.
Collaborative Computing in Interventional Medicine,
AAAS Symposium on Collaborative Computing, February 2014.
Quantifying and Enhancing Surgical Performance,
UT Arlington, October 2013.
Computational Modeling of Surgical Skill,
Stanford University, June 2013.
Computational Modeling and Enhancement of Human Skill: Toward Effective Human-Machine Collaborative Systems
Carnegie Mellon University, April 2013.
Collaborative Computing in the Physical World,
Microsoft Research, February 2013.
From Information to Action in a World of Data, Imaged-Guided Intervention Symposium,
Johns Hopkins University, December 2012
Computational Modeling and Enhancement of Human Skill: Toward Effective Human-Machine Collaborative Systems
Yale University, November 2012
Quantitative Endoscopy and Interventional Medicine,
GSISH Summer Symposium., July, 2012
Computational Modeling and Enhancement of Surgical Skill,
Harvard IDIES Symposium., March 2012
From Information to Action: A Perspective on the Past and Future of Robotics Research and Applications,

Western State College, Jan, 2012.
From Information to Action: A Perspective on Three Decades of Sensor-Based Robotics Research,
Challenges in Robotics: Down to Earth, DLR, Munich, Germany, Nov. 2011
From Information to Action: A Perspective on Three Decades of Sensor-Based Robotics Research,
Willow Garage, Dec. 2011
Computational Modeling and Enhancement of Surgical Skill,
Frontiers of Computer Science, Northwestern University, Oct. 2011
Video Guidance for Human-Machine Collaborative Intervention,
Workshop on Image-Guided Interventions, IROS, Oct. 2011
Tutorials on Computer Vision, Ultrasound, and Human-Machine Systems,
Dutch Institute on Systems and Control Summer School, June 2011
on Dynamics and Control Problems in Medical Robotics
Human Machine Systems for Interventional Medicine,
JHU Alumni Speaker Series, April, 2011
Computational Modeling and Enhancement of Surgical Skill,
Zurich Switzerland, ETH, February, 2011

Selected Past Invited Speaker:

2010 Distinguished Lecture, Scientific Computing Institute (SCI), University of Utah
2010 University of Washington Medical Robotics Summer School
2010 TU Munich International Graduate School in HealthCare
2010 Keynote Speaker, Medical and Interventional Robotics Association (MIRA)
2009 University of Minnesota
2009 University of Pennsylvania
2009 Technical University of Munich
2008 National Institutes of Health
2008 Keck Octane Panel on Medical Robotics
2007 Technical University of Munich

Consultant/Expert/Corporate Leadership:

Burns and Levison LLP
Morrison and Foerster LLP
Clear Guide Medical (founding CEO).
Strider Labs, Inc.
Smart Systems Technology
ABB Inc.
Siemens
United Technologies Research Center
Microsoft Inc.

University Service:

Carey Business School Dean search committee, 2011
University Academic Council, 2009-2010
University Provost Search Committee, 2008
Founding Advisor, JHU Robotics Club, 2008-present
Director of JHU-TUM International Exchange, 2007-present
Whiting School International Affairs Advisory Committee, 2008-2010
University Library Advisory Committee, 2003-2007

PUBLICATIONS

Journal Articles:

1. Vedula, S. Swaroop, Masaru Ishii, and Gregory D. Hager. "Objective Assessment of Surgical Technical Skill and Competency in the Operating Room." *Annual Review of Biomedical Engineering* 19.1 (2017).
2. N Ahmidi, L Tao, S Sefati, Y Gao, C Lea, B Bejar, L Zappella, S Khudanpur, R Vidal, GD Hager. A Dataset and Benchmarks for Segmentation and Recognition of Gestures in Robotic Surgery. *IEEE Transactions on Biomedical Engineering*, 2017
3. Yixin Gao, S Swaroop Vedula, Gysung I Lee, Mija R Lee, Sanjeev Khudanpur, and Gregory D Hager. Query-by-example surgical activity detection. *International journal of computer assisted radiology and surgery*, 11(6):987996, 2016.
4. Anand Malpani, Colin Lea, Chi Chiung Grace Chen, and Gregory D Hager. System events: readily accessible features for surgical phase detection. *International journal of computer assisted radiology and surgery*, 11(6):12011209, 2016.
5. S Swaroop Vedula, Anand Malpani, Narges Ahmidi, Sanjeev Khudanpur, Gregory Hager, and Chi Chiung Grace Chen. Task-level vs. segment-level quantitative metrics for surgical skill assessment. *Journal of surgical education*, 73(3):482489, 2016.
6. Swaroop Vedula, Anand O Malpani, Lingling Tao, George Chen, Yixin Gao, Piyush Poddar, Narges Ahmidi, Christopher Paxton, Rene Vidal, Sanjeev Khudanpur, et al. Analysis of the structure of surgical activity for a suturing and knot-tying task. *PloS one*, 11(3):e0149174, 2016.
7. Deshmukh, Nishikant P., Jesus J. Caban, Russell H. Taylor, Gregory D. Hager, and Emad M. Boctor. "Five-dimensional ultrasound system for soft tissue visualization." *International journal of computer assisted radiology and surgery* 10, no. 12 (2015): 1927-1939.
8. Malpani, Anand, S. Swaroop Vedula, Chi Chiung Grace Chen, and Gregory D. Hager. "A study of crowdsourced segment-level surgical skill assessment using pairwise rankings." *International journal of computer assisted radiology and surgery* 10, no. 9 (2015): 1435-1447.
9. Ahmidi, Narges, Piyush Poddar, Jonathan D. Jones, S. Swaroop Vedula, Lisa Ishii, Gregory D. Hager, and Masaru Ishii. "Automated objective surgical skill assessment in the operating room from unstructured tool motion in septoplasty." *International journal of computer assisted radiology and surgery* 10, no. 6 (2015): 981-991.
10. Chen, C. C. G., E. Tanner, A. Malpani, S. S. Vedula, A. N. Fader, S. A. Scheib, I. C. Green, and G. D. Hager. "Warm-Up Before Robotic Hysterectomy Does Not Improve Trainee Operative Performance: A Randomized Trial." *Journal of Minimally Invasive Gynecology* 22, no. 6 (2015): S34.
11. Roncal, William R. Gray, Dean M. Kleissas, Joshua T. Vogelstein, Priya Manavalan, Kunal Lillaney, Michael Pekala, Randal Burns et al. "An automated images-to-graphs framework for high resolution connectomics." *Frontiers in neuroinformatics* 9 (2015).
12. N. P. Deshmukh, H. J. Kang, S. D. Billings, R. H. Taylor, G. D. Hager, and E. M. Boctor, Elastography Using Multi-Stream GPU: An Application to Online Tracked Ultrasound Elastography, In-Vivo and the da Vinci Surgical System *PloS one* 9(12), e115881, 2014.
13. R. Richa, R. Linhares, E. Comunello, A. von Wangenheim, J.-Y. Schnitzler, B. Wassmer, C. Guillemot, G. Thuret, P. Gain, G. Hager, et al., Fundus image mosaicking for information augmentation in computer-assisted slit-lamp imaging *IEEE Transactions on Medical Imaging* 33(6) pp. 1304-1312, 2014.

14. D. J. Ramsey, J. S. Sunness, P. Malviya, C. Applegate, G. D. Hager, and J. T. Handa. Automated image alignment and segmentation to follow progression of geographic atrophy in age-related macular degeneration. *Retina* **34**, 1296, 2014.
15. H. Rivaz, E. M. Boctor, M. A. Choti, and G. D. Hager. Ultrasound elastography using multiple images. *Medical image analysis*, 18(2):314–329, 2014.
16. E. M. Meisner, G. D. Hager, S. L. Ishman, D. Brown, D. E. Tunkel, and M. Ishii. Anatomical reconstructions of pediatric airways from endoscopic images: A pilot study of the accuracy of quantitative endoscopy. *The Laryngoscope*, 2013.
17. L. Zappella, B. Béjar, G. Hager, and R. Vidal. Surgical gesture classification from video and kinematic data. *Medical image analysis*, 2013.
18. Chaudhry, Rizwan, Gregory Hager, and Ren Vidal. “Dynamic template tracking and recognition.” *International Journal of Computer Vision* 105.1:19-48, 2013.
19. Mirotta, D. J., A. Uneri, S. Schafer, S. Nithiananthan, D. D. Reh, M. Ishii, G. L. Gallia, R. H. Taylor, G. D. Hager, and J. H. Siewerdsen. “Evaluation of a system for high-accuracy 3D image-based registration of endoscopic video to C-arm cone-beam CT for image-guided skull base surgery.” *IEEE transactions on medical imaging* 32, no. 7: 1215, 2013.
20. Foroughi, Pezhman, Hyun-Jae Kang, Daniel A. Carnegie, Mark G. van Vledder, Michael A. Choti, Gregory D. Hager, and Emad M. Boctor. “A Freehand Ultrasound Elastography System With Tracking for In Vivo Applications.” *Ultrasound in Medicine & Biology* 39.2: 211-225, 2013.
21. Becker, Brian C., Robert A. MacLachlan, Louis A. Lobes Jr, Gregory D. Hager, and Cameron N. Riviere. “Vision-based control of a handheld surgical micromanipulator with virtual fixtures.” *IEEE Transactions on Robotics* 29:3:674 - 683, 2013.
22. R. Sznitman, R. Richa, R. Taylor, B. Jedynek, and G. Hager. Unified detection and tracking of instruments during retinal microsurgery. *IEEE PAMI*, 35(5):1263–1273, 2013.
23. Fleming, Ioana Nicolaescu, Carmen Kut, Katarzyna J. Macura, Li-Ming Su, Hassan Rivaz, Caitlin Schneider, Ulrike Hamper et al. “Ultrasound elastography as a tool for imaging guidance during prostatectomy: Initial experience.” *Medical science monitor: international medical journal of experimental and clinical research* 18, no. 11:CR635, 2012.
24. Ahmidi, Narges, Masaru Ishii, Gabor Fichtinger, Gary L. Gallia, and Gregory D. Hager. An objective and automated method for assessing surgical skill in endoscopic sinus surgery using eyetracking and toolmotion data. *International Forum of Allergy & Rhinology*. Volume 2, Issue 6, pages 507-515, 2012.
25. Richa, Rogerio, Marcin Balicki, Raphael Sznitman, Eric Meisner, Russell Taylor, and Gregory Hager. Vision-Based Proximity Detection in Retinal Surgery. *Biomedical Engineering, IEEE Transactions on* 59, no. 8: 2291-2301, 2012.
26. Mirotta, Daniel J., Hanzi Wang, Russell H. Taylor, Masaru Ishii, Gary L. Gallia, and Gregory D. Hager. A system for video-based navigation for endoscopic endonasal skull base surgery. *Medical Imaging, IEEE Transactions on* 31, no. 4: 963-976, 2012.
27. Kumar, Rajesh, Amod Jog, Anand Malpani, Balazs Vagvolgyi, David Yuh, Hiep Nguyen, Gregory Hager, and Chi Chiung Grace Chen. Assessing system operation skills in robotic surgery trainees. *The International Journal of Medical Robotics and Computer Assisted Surgery* 8, no. 1: 118-124, 2012.

28. Kumar, Rajesh, Amod Jog, Balazs Vagvolgyi, Hiep Nguyen, Gregory Hager, Chi Chiung Grace Chen, and David Yuh. Objective measures for longitudinal assessment of robotic surgery training. *The Journal of thoracic and cardiovascular surgery* 143, no. 3: 528-534, 2012.
29. Rajesh Kumar, Qian Zhao, Sharmishta Seshamani, Gerard Mullin, Gregory D. Hager, Themistocles Dassopoulos: Assessment of Crohn's Disease Lesions in Wireless Capsule Endoscopy Images. *IEEE Trans. Biomed. Engineering* 59(2): 355-362, 2012.
30. Hager, Gregory D., and Ben Wegbreit. Scene parsing using a prior world model. *The International Journal of Robotics Research* 30.12: 1477-1507, 2011.
31. Sharmishta Seshamani, Rajesh Kumar, Gerard Mullin, Themistocles Dassopoulos, Gregory D. Hager: A Meta Method for Image Matching. *IEEE Trans. Med. Imaging* 30(8): 1468-1479, 2011.
32. Zachary A. Pezzementi, Erion Plaku, Caitlin Reyda, Gregory D. Hager: Tactile-Object Recognition From Appearance Information. *IEEE Transactions on Robotics* 27(3): 473-487, 2011.
33. Hassan Rivaz, Emad Boctor, Michael A. Choti, Gregory D. Hager: Real-Time Regularized Ultrasound Elastography. *IEEE Trans. Med. Imaging* 30(4): 928-945, 2011.
34. Carol E. Reiley, Henry C. Lin, David D. Yuh, Gregory D. Hager. A Review of Methods for Objective Surgical Skill Evaluation. *Surgical Endoscopy*, 25(2):356-366, 2011.
35. Raphael Sznitman, Manaswi Gupta, Gregory D. Hager, Paulo E. Arratia, and Josu Sznitman. Multi-environment model estimation for motility analysis of caenorhabditis elegans. *CoRR*, abs/1007.1398, 2010.
36. Hanzi Wang, Daniel Mirota, and Gregory D. Hager. A generalized kernel consensus based robust estimator. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 32(1):178-184, 2010.
37. Van Vledder, Mark G., Emad M. Boctor, Lia R. Assumpcao, Hassan Rivaz, Pezhman Foughi, Gregory D. Hager, Ulrike M. Hamper, Timothy M. Pawlik, and Michael A. Choti. Intraoperative ultrasound elasticity imaging for monitoring of hepatic tumour thermal ablation. *HPB* 12, no. 10: 717-723, 2010.
38. Li-Ming Su, Balazs P. Vagvolgyi, Rahul Agarwal, Carol E. Reiley, Russell H. Taylor, and Gregory D. Hager. Augmented reality during robot-assisted laparoscopic partial nephrectomy: Toward real-time 3D-CD to stereoscopic video registration. *Journal of Urology*, 73(4):896-900, 2009.
39. Alexandre Krupa, Gabor Fichtinger, and Gregory D. Hager. Real-time motion stabilization with b-mode ultrasound using image speckle information and visual servoing. *International Journal of Robotics Research*, 28(10):1334-1354, 2009.
40. Jason Corso and Gregory D. Hager. Image description with features that summarize. *Computer Vision and Image Understanding*, 113, pp. 446-458, 2009.
41. Hassan Rivaz, Emad Boctor, Pezhman Foughi, R. Zellars, Gabor Fichtinger, and Gregory D. Hager. Ultrasound elastography: A dynamic programming approach. *IEEE Trans. Med. Imaging*, 27(10):1373-1377, 2008.
42. J. Corso and D. Burschka, and G. Hager. A Practical Paradigm and Platform for Video-Based Human-Computer Interaction. *IEEE Computer*, 2008, 42(5):48-55, 2008.
43. Maneesh Dewan, Gregory D. Hager, and Christine H. Lorenz. Image-based coronary tracking and beat-to-beat motion compensation: Feasibility for improving coronary MR angiography. *Magnetic Resonance in Medicine*, 60(3):604-615, 2008.

44. Hanzi Wang, Daniel Mirota, Gregory Hager, and Masaru Ishii. Anatomical reconstruction from endoscopic images: Toward quantitative endoscopy. *American Journal of Rhinology*, 22(1):47-51, January/February 2008.
45. B. Vagvolgyi, C. Reiley, G. Hager, R. Taylor, and L.M. Su. Augmented Reality Using Registration Of 3d Computed Tomography To Stereoscopic Video Of Laparoscopic Renal Surgery. *Journal of Urology*, 179(4):241-241, 2008.
46. Henry C. Lin, Izhak Shafran, David Yuh, Gregory D. Hager. Towards Automatic Skill Evaluation: Detection and Segmentation of Robot-Assisted Surgical Motions. *Computer Aided Surgery*, 11(5):220-230, September 2006.
47. Le Lu and Xiang-tian Dai and Gregory D. Hager. Efficient particle filtering using RANSAC with application to 3D face tracking. *Image Vision Computing*, 24(6):581-592, June 2006.
48. Darius Burschka and Ming Li and Russell Taylor and Gregory D. Hager and Masaru Ishii. Scale-Invariant Registration of Monocular Endoscopic Images to CT-Scans for Sinus Surgery. *Medical Image Analysis*, 9(5):413-439, October 2005. **(Best Paper Award)**
49. Jason J. Corso and Guangqi Ye and Gregory D. Hager. Analysis of Multi-Modal Gestures with a Coherent Probabilistic Graphical Model. *Virtual Reality*, 8(4):242-252, September 2005.
50. Darius Burschka, Jason J. Corso, Maneesh Dewan, William W. Lau, Ming Li, Henry Lin, Panadda Marayong, Nicholas A. Ramey, Gregory D. Hager, Brian Hoffman, David Larkin, and Christopher J. Hasser. Navigating inner space: 3-D assistance for minimally invasive surgery . *Robotics and Autonomous System*, 52(1):5-26, 2005.
51. D. Kragic, P. Marayong, M. Li, A.M. Okamura, and G.D. Hager. Human-Machine Collaborative Systems for Microsurgical Applications. *The International Journal of Robotics Research*, 24(9):731-741, 2005.
52. Guangqi Ye, Jason J. Corso, Darius Burschka, and Gregory D. Hager. Vics: A modular hci framework using spatio-temporal dynamics. *Machine Vision and Applications*, 16(1):13-20, 2004.
53. A. Bettini, P. Marayong, S. Lang, A. M. Okamura, and G. D. Hager, Vision Assisted Control for Manipulation Using Virtual Fixtures, *IEEE Transactions on Robotics*, Vol. 20, No. 6, pp. 953-966, 2004.
54. D. Rothbaum, J. Roy, G. Hager, R. Taylor, L. Whitcomb, H. Francis, and J. Niparko. Task performance in stapedotomy: Comparison between surgeons of different experience levels. *Otolaryngology - Head and Neck Surgery*, 2003.
55. Myron Z. Brown, Darius Burschka, and Gregory D. Hager. Advances in Computational Stereo. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 25(8):993-1008, 2003.
56. Joint Probabilistic Techniques for Tracking Multi-Part Objects (with C. Rasmussen). *IEEE PAMI*, 23(6): pp. 560-576, 2001.
57. Object Pose from Video Images (with C-P. Lu and E. Mjolsness). *PAMI* 22(6): pp. 610-622, 2000
58. What Tasks Can Be Performed with an Uncalibrated Stereo Vision System? (with J. Hespanha, Z. Dodds, and A.S. Morse). *The International Journal of Computer Vision*, 35(1): pp. 65-85, Nov. 1999.
59. Incremental Focus of Attention for Robust Visual Tracking (with K. Toyama). *The International Journal of Computer Vision*, 35(1): pp. 45-63, Nov. 1999.

60. Tracking in 3D: Image Variability Decomposition for Recovering Object Pose and Illumination (with P. Belhumeur). *Pattern Analysis and Applications*, March, 1999.
61. Efficient Region Tracking with Parametric Models of Geometry and Illumination (with P. Belhumeur). *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 20(10), pp. 1125-1139, 1998.
62. The XVision System: A General-Purpose Substrate for Portable Real-Time Vision Applications (with K. Toyama). *Computer Vision and Image Understanding*, 69(1), pp. 23–37, 1998.
63. A Modular System for Robust Hand-Eye Coordination Using Feedback from Stereo Vision. *IEEE Transactions on Robotics and Automation*, 13(4) pp. 582-595, 1997.
64. A Tutorial Introduction to Visual Servo Control (with S. Hutchinson and P. Corke). *IEEE Transactions on Robotics and Automation*, 12(5) pp. 651-670, 1996 (**one of five nominated for best transactions article of 1996**).
65. Online Computation of Exterior Orientation with Application to Hand-Eye Calibration (with C.P. Lu and E. J. Mjolsness). *Mathematical and Computer Modeling*, 24(5), pp. 121-143, 1996.
66. Robot Feedback Control Based on Stereo Vision: Towards Calibration-Free Hand-Eye Coordination (with W. Chang and A.S. Morse). *IEEE Control Systems Magazine*, 15(1), pp. 30-39, 1995.
67. Task-Directed Computation of Qualitative Decisions from Sensor Data. *IEEE Transactions on Robotics and Automation*, 10(4), pp. 415-429, 1994.
68. Solving Large Systems of Non-Linear Constraints with Application to Data Modeling. *Interval Computations*, 2, pp. 169-200, 1994.
69. Real-Time Vision-Based Robot Localization (with S. Atiya). *IEEE Transactions on Robotics and Automation*, 9(6), pp. 785-800, 1993.
70. Computational Methods for Task-Directed Sensor Data Fusion and Sensor Planning (with M. Mintz). *International Journal of Robotics Research*, 10(4), pp. 285–313, 1991.

Books:

71. *Task-Directed Sensor Fusion and Planning*. Kluwer, Boston, 1990.
72. *The Confluence of Vision and Control* (with D. Kriegman, and A.S. Morse, Editors) LNCIS series, Springer-Verlag, 1998.
73. *Robust Vision for Vision-Based Control of Motion* (with M. Vincze, Editor) IEEE Computer Society Press, 1999.
74. *Sensor-Based Robots* (with H. Christensen, Editor) LNCS series, Springer-Verlag, 2001.

Book Chapters:

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334. Gregory Hager, Balazs Vagvolgyi and David Yuh. Stereoscopic Video Overlay with Deformable Registration. *Medicine Meets Virtual Reality*, 2007.
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340. A constraint-based view of selective perception. In *AAAI Spring Symposium on Selective Perception*, pp. 61-65, 1992.
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White Papers and Reports for Government

343. Susan Graham and Greg Hager, (Co-Chairs), William Dally, Eric Horvitz, Sara Kiesler, Michael McQuade, Eric Schmidt. (2015). Report to the President and Congress Ensuring Leadership in Federally Funded Research and Development. Available at https://www.whitehouse.gov/sites/default/files/microsites/ostp/PCAST/nitrdr_report_aug_2015.pdf
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346. Corso J. C., Alahi A., Grauman K., Hager G. D., Morency L., Sawhney H., and Sheikh Y. (2015). Video Analysis for Body-worn Cameras in Law Enforcement: A white paper prepared for the Computing Community Consortium committee of the Computing Research Association. <http://cra.org/ccc/resources/ccc-led-whitepapers/>
347. Hager G. D., Rus D., Kumar V., and Christensen H. (2015). Toward a Science of Autonomy for Physical Systems: A white paper prepared for the Computing Community Consortium committee of the Computing Research Association. <http://cra.org/ccc/resources/ccc-led-whitepapers/>
348. Hager G. D. and Horvitz E. (2015). Toward a Science of Autonomy for Physical Systems: Healthcare: A white paper prepared for the Computing Community Consortium committee of the Computing Research Association. <http://cra.org/ccc/resources/ccc-led-whitepapers/>
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350. Polina Golland, Jack Gallant, Greg Hager, Hanspeter Pfister, Christos Papadimitriou, Stefan Schaal, Joshua T. Vogelstein. (2015). A New Age of Computing and the Brain. A workshop report prepared for the Computing Community Consortium committee of the Computing Research Association. <http://cra.org/ccc/wp-content/uploads/sites/2/2014/12/BRAIN-Report.pdf>

Other Publications:

351. Jason J. Corso, Maneesh Dewan, and Gregory D. Hager. Image Segmentation Through Energy Minimization Based Subspace Fusion. Technical Report CIRL-TR-04-01, The Johns Hopkins University, 2004.
352. Guangqi Ye, Jason J. Corso, Gregory D. Hager, and Allison M. Okamura. Augmented Reality Combining Haptics and Vision. Technical Report 03, The Johns Hopkins University, 2003. CIRL Technical Report.

353. Jason J. Corso, Nicholas Ramey, and Gregory D. Hager. Stereo-Based Direct Surface Tracking with Deformable Parametric Models. Technical Report 02, The Johns Hopkins University, 2003. CIRL Technical Report.
354. Le Lu, Xiangtian Dai, and Gregory D. Hager. Real Time Video Mosaicing - Technical Report. Technical report, The Johns Hopkins University, 2003. CIRL Technical Report.
355. Myron Z. Brown, Darius Burschka, and Gregory D. Hager. Shape and appearance in object recognition. 2003.
356. Tracking Objects by Color Alone (with Christopher Rasmussen), DCS-RR-1114, Yale University, New Haven, CT, 1997.
357. Tracking Tools for Vision-Based Navigation, DCS-RR-1060, Yale University, New Haven, CT, 1994.
358. Six DOF Visual Control of Relative Position, DCS-RR-1038, Yale University, New Haven, CT, 1994
359. A Framework for Real-Time Vision-Based Tracking Using Off-the-Shelf Hardware (with S. Puri and K. Toyama), DCS-RR-988, Yale University, New Haven, CT, 1993.
360. A C++ Interval and Constraint Solving Package, DCS-RR-953, Yale University, New Haven, CT, 1993.
361. Some Problems in Adaptive Visual Servoing, DCS-RR-948, Yale University, New Haven, CT, 1993.
362. Active Reduction of Uncertainty in Multi-Sensor Systems. Ph.D. thesis, University of Pennsylvania, 1988.
363. An Agent Specification Language, MS-CIS-87-08, The University of Pennsylvania, Philadelphia, PA, 1987.
364. Information Maps for Active Sensor Control, MS-CIS-87-07, The University of Pennsylvania, Philadelphia, PA, 1987.
365. Commonsense Summer: The Final Report (with J. Hobbs *et al.*), CSLI-85-35, SRI International, Palo Alto, CA, 1985.
366. Computational aspects of proof theory in modal logic. Masters thesis, University of Pennsylvania, 1985

Software Packages:

1. The XVision Tracking Toolkit, 1995, 1996, 1997.
2. A System for Solution of High-Dimensional Nonlinear Constraints, 1993.

Patents and Patent Applications

1. Hager, Gregory D., et al. "Imaging system and method for use of same to determine metric scale of imaged bodily anatomy." U.S. Patent No. 9,367,914. 14 Jun. 2016.
2. Hager, Gregory, and Nicolas Padoy. "Human-machine collaborative robotic systems." U.S. Patent No. 9,283,675. 15 Mar. 2016.
3. Hager, Gregory Donald, and Nicolas Padoy. "System and method for detecting and tracking a curvilinear object in a three-dimensional space." U.S. Patent No. 9,449,241. 20 Sep. 2016.

4. Taylor, R.H., Billings, S.D., Gehlbach, P.L., Hager, G.D., Handa, J.T., Kang, J.U., Vagvolgyi, B., Sznitman, R. and Pezzementi, Z., Programmable multispectral illumination system for surgery and visualization of light-sensitive tissues. U.S. Patent 9,320,428, 2016.
5. Stolka, Philipp Jakob, Ehsan Basafa, Pezhman Foroughi, Gregory Donald Hager, and Emad Mikhail Boctor. "System and method for fused image based navigation with late marker placement." U.S. Patent 9,436,993, issued September 6, 2016.
6. Guerin, Kelleher, Gregory D. Hager, and Sebastian Riedel. "System and method for flexible human-machine collaboration." U.S. Patent No. 9,272,418. 1 Mar. 2016.
7. Hager, Gregory D., Carol E. Reiley, Balakrishnan Varadarajann, Sanjeev Pralhad Khudanpur, Henry C. Lin, and Rajesh Kumar. "Systems and methods for training one or more training users." U.S. Patent 9,196,176, issued November 24, 2015.
8. Stolka, Philipp Jakob, Pezhman Foroughi, Matthew C. Rendina, Gregory Donald Hager, and Emad Mikhail Boctor. "Surgical needle for a surgical system with optical recognition." U.S. Patent 8,880,151, issued November 4, 2014.
9. Rivaz, Hassan, Gregory Hager, Emad M. Boctor, and Ioana Fleming. "Method and system for processing ultrasound data." U.S. Patent 8,824,762, issued September 2, 2014.
10. Rivaz, Hassan, Emad Moussa Boctor, Gabor Fichtinger, and Gregory Hager. "Robust and accurate freehand 3D ultrasound." U.S. Patent 8,559,685, issued October 15, 2013.
11. E. Boctor, G. Hager, D. Heisenberg, and P. Stolka. Interventional in-situ image-guidance by fusing ultrasound and video, Apr. 19 2013. WO Patent 2,013,055,707.
12. D. Das, M. O. Filipovich, J. J. Corso, and G. D. Hager. Systems and methods for motion and distance measurement in gastrointestinal endoscopy, Jan. 3 2013. US Patent 20,130,002,842.
13. G. Hager and N. Padoy. Human-machine collaborative robotic systems, Aug. 22 2013. US Patent 20,130,218,340.
14. G. D. Hager, M. Ishii, E. M. Meisner, D. J. Marota, and H. N. Tokgozoglu. Imaging system and method for use of same to determine metric scale of imaged bodily anatomy, May 16 2013. US Patent App. 13/895,813.
15. Balicki, Marcin A., Russell H. Taylor, Gregory D. Hager, Peter L. Gehlbach, James Handa, and Rajesh Kumar. Visual Tracking And Annotaton Of Clinically Important Anatomical Landmarks For Surgical Interventions. U.S. Patent 20,120,226,150, issued September 6, 2012.
16. Hager, Gregory D., Balakrishnan Varadarajann, Sanjeev Khudanpur, Rajesh Kumar, Carol E. Reiley, and Henry C. Lin. Method And System For Quantifying Technical Skill. European Patent EP 2409286, issued January 25, 2012.
17. Hager, Gregory, and Nicolas Padoy. Human-Machine Collaborative Robotic Systems. WIPO Patent 2012065175, issued May 19, 2012.
18. Hager, Gregory Donald, and Nicolas Padoy. System And Method For Detecting And Tracking A Curvilinear Object In A Three-Dimensional Space. WIPO Patent 2012116198, issued August 31, 2012.
19. Kumar, Rajesh, Gregory D. Hager, Amod S. JOG, and David D. Yuh. System And Method For The Evaluation Of Or Improvement Of Minimally Invasive Surgery Skills. WIPO Patent 2012060901, issued May 11, 2012.

20. Kumar, Rajesh, Themistocles Dassopoulos, Hani Girgis, and Gregory Hager. System And Method For Automated Disease Assessment In Capsule Endoscopy. U.S. Patent 20,120,316,421, issued December 13, 2012.
21. Kumar, Rajesh, Gregory D. Hager, Amod S. Jog, Yixin Gao, May Liu, Simon Peter DiMaio, Brandon Itkowitz, and Myriam Curet. Method And System For Analyzing A Task Trajectory. WIPO Patent 2012151585, issued November 9, 2012.
22. G. Hager, C. Reiley, B. Varadarajan, S. Khudanpur, H. Lin, R. Kumar, Method and System for Quantifying Technical Skill, US Patent Application 2010/028025.
23. H. Rivaz, E. Boctor, G. Fichtinger, G. Hager, Robust and Accurate Freehand 3D Ultrasound. US Patent Application 2010/0198068.
24. G. Hager and B. Wegbreit. System and method for constructing a 3D scene model from an image. US Patent Application 2010/0085358.
25. E. Boctor, G. Fichtinger, G. Hager, and H. Rivaz. Apparatus and Methods for Computing 3D Ultrasound Elasticity Images. US Patent Application 2008/0306384.
26. E. Boctor, G. Hager, G. Fichtinger, and A. Viswanathan. Ultrasound Calibration and Real-Time Quality Assurance Based on Closed Form Formulation US Patent Application 2008/0269604.
27. G. Hager and E. Wegbreit. System and method for recognition in 2D images using 3D class models US Patent Application 2006/0285755.
28. G. Hager and E. Wegbreit. System and method for computing grasps for a robotic hand with a palm US Patent Application 2006/0012198.
29. G. Hager and E. Wegbreit. System and method for 3D object recognition using range and intensity, 2005. USPTO Publication 2005/0286767 A1, Abandoned.
30. G. Hager and E. Wegbreit. Acquisition of three-dimensional images by an active stereo technique using locally unique pattern, US Patent 7103212, issued September, 2006.
31. A Vision-based Six-degree-of-freedom Computer Input Device (with K. Toyama), U.S. Patent 5889505 issued November, 1998.
32. Method and System for Cooperative Control of Manipulator Systems, (with R. Kumar, R. Taylor, A. Barnes and P. Jensen), preliminary patent filed, 2001, Abandoned.
33. Method for Robot Assisted Puncture of a Blood Vessel, (with R. Kumar, R. Taylor, A. Barnes and P. Jensen and E. deJuan), preliminary patent filed, 2001, Abandoned.
34. Method for Creating High Resolution Composite Images, (with R. Kumar, R. Taylor, A. Barnes and P. Jensen), preliminary patent filed, 2001, Abandoned.
35. Method for Manipulating Cells of a Cell Culture (with R. Kumar and R. Taylor), preliminary patent filed, 2001, Abandoned.

TEACHING and MENTORING:

Postdoctoral Students/Research Faculty:

Narges Ahmidi, Assistant Research Scientist, 2017-present
Anand Malpani, Assistant Research Scientist, 2017-present
Austin Reiter, Research Assistant Prof. 2014-present
Swaroop Vedula, Assistant Research Professor, 2012-present
Rogerio Richa, 2011-2013 (now at University of Santa Catarina, Brazil)
Nicolas Padoy, 2010-2013 (now at University of Strasbourg)
Eric Meisner, 2009-present (now at Faro Technologies)
Hani Girgis, 2009-2010 (now Research Scientist, NIH)
Erion Plaku, 2008-2010 (now Assistant Professor, Catholic University)
Sandrine Voros, 2007-2009 (now Assistant Professor, University of Grenoble)
Hanzi Wang, 2006-2008 (now Professor, Xaimen University)
Danica Kragic, 2002 (now Professor, KTH Sweden)
Darius Burschka, 1999-2005 (now Associate Professor, TU Munich)
Martin Jägersand, 1998-2000 (now Associate Professor, University of Alberta)
Eric Marchand, 1996-1997 (now Senior Researcher, INRIA Rennes)
Markus Vincze, 1996 (now Professor, TU Vienna)

Thesis Students:

Andrew Hundt, Ph.D. expected 2018.
Kapil Katyal, Ph.D. expected 2018.
Robert Dipietro, Ph.D. expected 2018.
Christian Rupprecht (TUM), Ph. D. expected 2017.
Christopher Paxton, Ph.D. expected 2017.
Chi Li, Ph.D. expected 2017.
Ayushi Sinha, Ph.D. expected 2017.
Xiang Xiang, Ph.D. expected 2017.
Purnima Rajan, Ph.D. expected 2017.
Colin Lea, Ph.D. 2017.
Anand Malpani, Ph.D. 2017.
Nishikant Deshmukh, Ph.D. 2016.
Will Gray, Ph.D. 2016.
Haluk Tokgozoglu, Ph.D. 2016.
Narges Ahmidi, Ph.D. 2015.
Carol Reiley, Ph.D. withdrew.
Kelleher Guerin, Ph.D. 2015.
Ioana Fleming, Ph.D., 2014.
Daniel Mirota, Ph.D, 2013.
Pezhman Foroughi, Ph.D, 2013.
Danel Abretske, withdrew.

Raphael Sznitman, Ph.D. 2011, (now faculty, University of Bern).
Zachary Pezzementi, Ph.D. 2011 (now Research Scientist, CMU).
Sharmishta Seshamani, Ph.D. 2011 (now postdoc, University of Washington).
Hassan Rivaz, Ph.D. 2010 (now faculty, Concordia University)
Henry Lin, Ph.D. 2009 (now Senior Engineer, Intuitive Surgical)
Tiffany Chen, MSE, 2008 (now researcher, Toyota Research)
Maneesh Dewan, Ph.D. 2007 (now at Google)
Le Lu, Ph.D. 2007 (now at NIH)
Guangqi Yeh, Ph.D. 2005 (now at Google)
Jason Corso, Ph.D. 2005 (now Associate Prof., University of Michigan)
Xangtian Dai, Ph.D. 2005 (now at Google)
Izzet Pembeci, Ph.D. 2003 (unknown)
Nicholas Ramey, M.S.E 2003 (now in practicing physician)
Samuel Lange, M.S.E, 2002 (unknown)
Zachary Dodds, Ph.D. 2000 (now Professor, Harvey Mudd)
Christopher Rasmussen, Ph.D. 2000 (now Professor, University of Delaware)
Aage Bendiksen, M.S. degree received 1995 (unknown)
Jesse Reklaw, M.S. received 1998 (unknown)
Kentaro Toyama, Ph.D received 1997 (former Vice President, Microsoft Research India; now Associate Prof, University of Michigan)
Jonathan Wang, M.S. degree received 1996 (unknown)
Sami Atiya, Ph.D. received 1995 (now high-level Siemens Management)

Listed Courses Taught or Co-Taught:

Algorithms for Sensor-based Robotics, 2006, 2009.
Data Structures, 2005, 2007, 2010, 2011.
Vision-Based Interaction in Man and Machine, 2000
Computer Vision, 1991 - present.
Artificial Intelligence, 1992-1993, 1996, 1997, 1999, 2000.
Analytical Introduction to Engineering Issues in Robotics (new course), 1994-1999.
Autonomous Systems (new course), 1993, 1995, 1997, 1999.
A Second Course in Programming (new course), 1993, 1994, 1997.
Programming in Fortran, 1992-1993.

Seminar Courses:

Topics in Intelligent Autonomous Systems, 1992
Topics in Sensing for Artificial Intelligence and Robotics Applications, 1991

FUNDING

1. NSF: “NRI:Collaborative:Experiential learning for robots: from physics to actions to tasks” for \$765,033 from 10/01/2016 to 09/30/2019 (PI).
2. NIH: “Objective assessment of surgical competence in a septoplasty model” for \$3,829,827 from 9/1/2016 to 8/31/2021 (key personnel).
3. NSF: “Building spatial skills in the 21st century” for \$1,340,672 from 7/1/2016 to 6/30/2020 (co-PI).
4. NSF: “NRI-Large: Collaborative Research: Multilateral Manipulation by Human-Robot Collaborative Systems” for \$586,942 from 7/1/12 to 6/30/16 (Co-PI).
5. NIH: “Enhanced Navigation for Endoscopic Sinus Surgery Through Video Analysis” for \$2,822,899 from 07/01/2012 to 06/30/2017.
6. NSF: “International: A US-Germany Research Collaboration on Systems for Computer-Integrated Healthcare” for 147,320 from April 6, 2011-April 5, 2014.
7. NIH SBIR “Precisely Shaped Acoustic Ablation of Tumors under 3D Ultrasound Image Guidance” (Burdette, PI) for 1,022,500 (total) July 1 2008 to June 30, 2013.
8. NIH: Automated Assessment of the Effects of System Limitations Based Upon Data Collected from Multiple Training Centers (Kumar PI), for 439,116 from July 1 2009 to June 30 2011.
9. NSF: “CPS: Medium: Hybrid Systems for Modeling and Teaching the Language of Surgery ” for 1,499,828 from July 1, 2009 to June 30, 2012.
10. NSF: “CDI Type-II: Language Models for Human Dexterity” for 1,685,877 July 1, 2009 to June 30, 2013.
11. NIH: “A Microsurgical Assistant System” (R. Taylor PI), for 5,500,000 from July 1, 2008-June 30, 2013.
12. NIH: “Quantitative Endoscopic Measurement of Anatomy Video,” (G. Hager, PI with M. Ishii), for 440,512 from July 1, 2008 to June 30, 2010.
13. NIH: “Toward Quantitative Disease Assessment from Capsule Endoscopy Images,” (G. Hager, PI with T. Dassopoulos), for 421,909 from July 1, 2007 to June 30, 2009.
14. Army/GDRS: “Recognition of Individual and Group Activities in Video,” for 121, 943 from July 24, 2008-Feb. 23, 2009.
15. TATRC: “Context Aware Surgical Assistance for Virtual Mentoring,” (G. Hager (PI), R. Taylor) for 155,216 from January 31, 2006 to May 29, 2007.
16. NSF: “Structure Induction for manipulative and Interactive Tasks,” (G. Hager, PI and S. Khudanpur), 480,000 from February 01, 2006 to January 31, 2009.
17. WSE/APL; “Vision-Aided Guidance, Navigation and Control of Small Unmanned Aerial Vehicles,” for 50,000 from September 01, 2005 - August 31, 2007.
18. NSF: “Manipulating and Perceiving Simultaneously (MAPS),” for 200,000 from Oct, 1. 2007-Sept. 30, 2009.
19. Paul Maritz Fund: “Learning to See: Structures for Data-Driven Computational Vision on a Massive Scale,” for 90,000 from February 01, 2006 - January 31, 2008.

20. NIH: "Direct Video-CT Registration for High Precision Endoscopic Interventions," (G. Hager, PI, M. Ishii and R. Taylor), for 440,348 from April 01, 2006 to March 30, 2008.
21. NSF: "A Flexible Human-in-the-Loop Microsystem Assembly Platform, (Phase I SBIR with Invenios, Inc) for 30000 from January, 2004 - July 01, 2004.
22. NIH: "Tracking and Mosaicking in the Endometrium,"(Phase I SBIR with Infinite Biomedical Tech. Inc.), for 72,000 from January 26, 2005 - July 26, 2005.
23. NSF: "ITR:Modeling, Synthesis and Analysis of Human-Machine Collaborative Systems," (G. Hager (PI), A. Okamura, R. Taylor and B. Hannaford) for 1,100,000 from 8/1/02-7/31/07.
24. NSF: "ITR/SY:Software Systems for Vision-based Spatial Interaction," for 450,000 from 8/1/01-7/31/04.
25. NSF: "ERC PER: A Quantitive Eye Atlas," (G. Hager (PI), B. Roysam (RPI)) for 150,000 from 8/1/01-7/31/03.
26. NSF: "Scale-Invariant Skill Augmentation for coperative Human-Machine Micromanipulation Systems,"(G. Hager (PI), A. Okamura and R. Taylor) for 380,000 from 8/1/01-7/31/04.
27. DARPA: "Composition and Adaptation of Goal-Oriented Robotic Systems" (G. Hager (PI), P. Hudak and D. McDermott) for \$2,304,083 from 4/1/00-4/1/04.
28. DARPA: "Environment-Independent Perception and Navigation for Tactical Mobile Robots: A Diktiometric Approach" (G. Hager (PI), D. Kriegman and D. McDermott) for \$750,000 from 6/98-6/00.
29. NSF: "A Compositional Approach to Vision-Based Manipulation" (G. Hager (PI) and M. Jägersand) for \$66,000 from 6/98-6/00 (CISE Postdoctoral Research Award)
30. ARO: "Visual Tracking as Stabilization" (G. Hager (PI) and D. Kriegman) for \$270,000 from 3/1/98-3/1/01.
31. ARO: "Next Generation Vision-Based Control Systems" (G. Hager (PI), A.S. Morse and D. Kriegman) for \$129,945 from 3/1/97-3/1/98 (DURIP equipment grant).
32. NSF: "Domain-Independent Vision-Based Navigation" (D. Kriegman (PI) and G. Hager) for \$419,184 from 9/1/97-10/31/00 .
33. NSF: "The Block Island Workshop on Vision and Control" (G. Hager, PI) for \$14,500 from 6/1/97-5/30/98.
34. NSF: " A Modular Toolkit for Vision and Robotics – An Experiment in Domain-Specific Software Architectures" (G. Hager (PI) and P. Hudak) for \$1,223,090 over 4 years from 6/1/97-6/1/01.
35. DARPA: "Point-Man Robot" (STTR subcontract through Nomadics Inc.) for \$45,000, over 1 year from 6/1/97 - 6/1/98.
36. Siemens Corp: "Light-Weight Vision for Enhanced Mobility" (G. Hager, PI)for \$40,000, over 1 year from 1/1/97 - 9/30/97.
37. NSF: "Calibration Insensitive Hand-Eye Coordination for Robotic Systems Based on Stereo Vision" (G. Hager, PI) for \$240,000 over 3 years from 8/95-8/98.
38. DARPA: "Equipment for Sensor-Based Navigation and Control of Autonomous Agents" (D. McDermott (PI) and G. Hager) for \$75,000 from 1/23/95-1/23/96.

39. DARPA: “Sensor-based and Geometry-based Planning for Autonomous Agents” (with D. McDermott (PI) and G. Hager) for \$971,489 from 10/1/93–5/31/96.
40. NSF: “Resource-Bounded Sensor-Based Decision Making in Unconstrained Environments” (G. Hager, PI) for \$170,245 from 9/1/91–2/28/94
41. NSF: “A Range Finder & Manipulator for Empirical Verification of Sensor-Based Decision Making” (D. Kriegman (PI) and G. Hager) for \$40,000 from 5/1/91–2/28/93 .
42. NATO: “NATO Collaborative Research Grant Between Yale University and the DLR” (G. Hirzinger, PI) for \$5000 from 9/1/92—9/1/94.
43. NATO: “NATO Collaborative Research Grant Between Yale University and the DLR” (G. Hirzinger, PI) for \$5000 from 9/1/91—9/1/92.