BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Golby, Alexandra Jacqueline

eRA COMMONS USER NAME (credential, e.g., agency login): AGOLBY

POSITION TITLE: Professor of Neurosurgery, Professor of Radiology, Harvard Medical School, Boston, MA, Neurosurgeon, Brigham and Women's Hospital, Boston, MA

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Yale University	B.A.	1989	Physics and Philosophy
Stanford Medical School	M.D.	1995	Medicine
Stanford University	Post-doc	1999-2001	Cognitive Neuroscience
Brigham and Women's Hospital	Fellowship	2003-2004	Image Guided Therapy/Neurosurgery
Harvard medical School	MA (Hon)	2016	Medicine

A. Personal Statement

I am a Neurosurgeon, Director of Image-guided Neurosurgery, and Co-director of AMIGO (Advanced Multi-Modality Image Guided OR), the translational research testbed for much of the Image Guided Therapy research at BWH. My academic appointment is as Professor of Neurosurgery and Professor of Radiology at Harvard Medical School. I also direct a Fellowship in Image Guided Neurosurgery. My research involves the development and application of preoperative and intraoperative imaging techniques to improve surgical care for patients with brain tumors and other lesions. My clinical practice is focused on cranial neurosurgery with special clinical interests in surgery for patients with brain tumors and epilepsy, particularly those whose pathology is intimately involved with critical brain regions. My research is translational and focuses on using both structural and functional imaging techniques to guide neurosurgical planning and intraoperative decision-making. We use multiple structural and molecular imaging and functional brain mapping techniques to better define individual anatomy, pathology and function in patients with neurosurgical diseases, and to cross-validate information acquired through different techniques. Our goal is to provide the surgeon with optimal information to perform less invasive, safer, and more effective interventions. I have collaborated with Drs. Agar, Wells, Hata, and Tempany for over a decade to apply advanced image analysis techniques to neurosurgical challenges. Our collaborations harness our diverse expertise and the opportunity to work in the unique translational research setting of AMIGO to improve the utility of imaging to guide surgical treatment as well as using the operating theater as a platform for the detailed characterization of tumor tissue

B. Positions and Honors

Positions and Employment

1995-1996 Intern in General Surgery, Stanford University Hospital, Stanford, CA
1996-2000 Resident in Neurosurgery, Stanford University Hospital, Stanford, CA
1997 Clinical attachment Neurology, Queen Square Hosp for Neurology and Neurosurgery, UK
1999-2001 Postdoctoral Fellow, Department of Radiology, Stanford University School of Medicine,
1999-2001 Visiting Scholar, Department of Psychology, Stanford University, Stanford, CA
2001-2002 Chief Resident in Neurosurgery, Brigham and Women's and Children's Hospital, Boston, MA
2003-present Associate Surgeon, Brigham and Women's and Children's Hospital, Boston, MA

2003-2005 Instructor, Brigham and Women's Hospital/Harvard Medical School, Boston, MA
2005-2010 Assistant Professor of Surgery, Harvard Medical School, Boston, MA
2007-present Director of Image-Guided Neurosurgery, Brigham and Women's Hospital, Boston, MA
2007-2015 Clinical Co-Director Advanced Multimodality Image Guided OR (AMIGO), BWH, Boston, MA
2008-2010 Assistant Professor of Radiology, Harvard Medical School, Boston, MA
2009-present Co-Director Clinical fMRI service Brigham and Women's Hospital, Boston, MA
2010-2014 Associate Professor of Surgery, Harvard Medical School, Boston, MA
2010-present Associate Professor of Radiology, Harvard Medical School, Boston, MA
2014-2016 Associate Professor of Neurosurgery, Harvard Medical School, Boston, MA
2015-present Co-Director Advanced Multimodality Image Guided OR (AMIGO), BWH, Boston, MA
2016-present Professor of Neurosurgery, Harvard Medical School, Boston, MA
2017-present Professor of Radiology, Harvard Medical School, Boston, MA
2017-present Haley Distinguished Chair in the Neurosciences, BWH, Boston, MA

Honors

1985-1989 National Merit Scholar
1985-1989 Scholl Foundation Scholar
1991-1992 Stanford Medical Scholar
1992 Foreign Language and Area Studies Fellowship, US Dept. of Education
1993-1994 Emge Traveling Scholar, Stanford University School of Medicine
1992-1993 American Heart Association, Student Scholarship in Cerebrovascular Disease
1999-2001 National Research Service Award, NIH
2002 Congress of Neurological Surgeons Dandy Clinical Fellowship
2004-2005 Temporary member BMIT NIH study section
2004-2006 Diplomate, American Board of Neurological Surgeons
2008 CIMIT Young Clinicians Award
2010-2011 Brigham and Women's Hospital inaugural recipient New Innovators Award
2010-2011 Member, NIH Neurophysiology, Devices, Auditory Devices and Neuroprosthesis Small Business Study Section
2011-2018 Best Doctors, US News and World Report
2016 NIH Neurophysiology, Devices, Auditory Devices and Neuroprosthesis Small Business Study Section
2018 NIH ZRG1 SBIB- Z (03) VAM Study Section

C. Contributions to Science

1) **Use of intra-operative imaging to guide neurosurgical interventions**

During surgery for brain tumors, especially gliomas which variably infiltrate the surrounding brain, it is extremely difficult for the surgeon to unambiguously identify areas which contain tumor, nor are critical functional brain cortex or white matter tracts visible during surgery. We have worked for many years to develop intra-operative imaging and image-to-patient registration to provide the neurosurgeon with the most accurate picture of the intraoperative situation so that brain lesions may be more completely removed without causing permanent neurologic injury.

a) Risholm P, Janoos F, Norton I, Golby AJ, Wells WM 3rd. Bayesian characterization of uncertainty in intra-subject non-rigid registration. Med Image Anal. 2013 Jul;17(5):538-55. PubMed PMID: 23602919; PMC3687087.
b) Risholm P, Golby AJ, Wells W 3rd. Multimodal image registration for preoperative planning and image-guided neurosurgical procedures. Neurosurg Clin N Am. 2011 Apr;22(2):197-206. PubMed PMID: 21435571; PMC3080117.
c) Poynton C, Jenkinson M, Whalen S, Golby AJ, Wells W 3rd. Fieldmap-free retrospective registration and distortion correction for EPI-based functional imaging. Med Image Comput Comput Assist Interv. 2008;11(Pt 2):271-9. PubMed PMID: 18982615; PMC2702772.
d) Ma Luo, Sarah F. Frisken, Jared A. Weis, Logan W. Clements, Prashin Unadkat, Reid C. Thompson, Alexandra J. Golby, Michael I. Miga. "Validation of model-based brain shift correction in neurosurgery via intraoperative magnetic resonance imaging: preliminary results," in the SPIE Digital Library as part

of the proceedings of the Medical Imaging 2017: Image-Guided Procedures, Robotic Interventions, and Modeling conference. DOI http://dx.doi.org/10.1117/12.2255845

2) **Development and validation of tissue markers to guide surgery for brain tumors**

The fundamental challenge of oncologic surgery is to remove the full extent of cancerous tumor while sparing surrounding tissue. This imperative is particularly acute in brain tumor surgery since the surrounding tissue may harbor critical brain function and tumor tissue often cannot be visually distinguished from healthy brain tissue. Thus, we are developing methods that are able to characterize the histologic and molecular features of the tissue in near real time to guide surgery.

a) Minbiao Ji, Daniel A. Orringer, Christian W. Freudiger, Shakti Ramkissoon, Xiaohui Liu, Darryl Lau, Alexandra J. Golby, Isaiah Norton, Marika Hayashi, Nathalie Y. R. Agar, Geoffrey S. Young, Cathie Spino, Sandro Santagata, Sandra Camelo-Piragua, Keith L. Ligon, Oren Sagher, and X. Sunney Xie.Rapid, Label-Free Detection of Brain Tumors with Stimulated Raman Scattering Microscopy.Science Translational Medicine. 4 September 2013: 201ra119.

b) Santagata S, Eberlin LS, Norton I, Calligaris D, Feldman DR, Ide JL, Liu X, Wiley JS, Vestal ML, Ramkissoon SH, Orringer DA, Gill KK, Dunn IF, Dias-Santagata D, Ligon KL, Jolesz FA, Golby AJ, Cooks RG, Agar NY. Intraoperative mass spectrometry mapping of an onco-metabolite to guide brain tumor surgery. Proc Natl Acad Sci U S A. 2014 Jul 29;111(30):11121-6. PMID: 24982150; PMC4121790.

c) Agar NYR, Golby AJ, Ligon KL, Norton I, Mohan V, Wiseman JM, Tannenbaum A, Jolesz FA. Development of stereotactic mass spectrometry for brain tumor surgery. Neurosurgery. 2011 Feb;68(2):280-89; discussion 290. PMID:21135749; PMC3678259.

d) Eberlin LS, Norton I, Dill AL, Golby AJ, Ligon KL, Santagata S, Cooks RG, Agar NY. Classifying human brain tumors by lipid imaging with mass spectrometry. Cancer Res. 2012 Feb 1;72(3):645-54. PMID: 22139378; PMC3271168.

3) **Developing Diffusion imaging as a tool for pre-surgical mapping of white matter**

The translation of this technology to clinical decision-making has required numerous fundamentally novel approaches. We have developed segmentation approaches for defining tracts based on high dimensional clustering as well as statistical atlases which allow labeling of individual patient tracts even in the setting of mass effect and peritumoral edema.

a) O'Donnell LJ, Westin CF, Golby AJ. Tract-based morphometry. Med Image Comput Assist Interv. 2007;10(Pt 2):161-8. PMID: 18044565

b) O'Donnell LJ, Westin CF, Golby AJ. Tract-based morphometry for white matter group analysis. Neuroimage. 2009 Apr 15;45(3):832-44. PMID: 19154790; PMC2768362.

c) Peled S, Whalen S, Jolesz FA, Golby AJ. High b-value Apparent Diffusion-Weighted Images from CURVE-ball DTI. J Magn Reson Imaging. 2009 Jul;30(1):243-8. PMID: 19557743; PMC2728298.

d) Qazi AA, Radmanesh A, O'Donnell L, Kindlmann G, Peled S, Whalen S, Westin CF, Golby AJ. Resolving crossings in the corticospinal tract by two-tensor streamline tractography: Method and clinical assessment using fMRI. Neuroimage. 2009 Aug;47 Suppl 2:T98-106. PMID:18657622; PMC2746909.

4) **Translation of fMRI from neuroscience applications towards a tool for pre-surgical brain mapping in patients**

The clinical adoption of advanced non-invasive brain mapping methods has the potential to greatly improve outcomes in patients undergoing brain surgery. I have led a translational research effort to adapt fMRI which was developed as a neuroscience technique in groups of subjects to make statistical inferences, to the vastly different task of mapping individual patients, many of who have neurologic deficits due to their disease which makes task performance challenging.

a) Langs G, Sweet A, Lashkari D, Tie Y, Rigolo L, Golby AJ, Golland P. Decoupling Function and Anatomy in Atlases of Functional Connectivity Patterns: Language Mapping in Tumor Patients. Neuroimage. 2014 Dec;103:462-75. PubMed PMID: 25172207; PMC4401430.

b) Petrovich Brennan NM, Whalen S, Branco DdM, O'Shea JP, Norton IH, Golby AJ. Object naming is a more sensitive measure of speech localization than number counting: Converging evidence from direct cortical stimulation and fMRI. Neuroimage. 2007;37 Suppl 1:S100-8. PMID: 17572109

c) Larsen S, Kikinis R, Talos IF, Weinstein D, Wells W, Golby A. Quantitative comparison of functional MRI and direct electrocortical stimulation for functional mapping. Int J Med Robot. 2007;3(3):262-70. PMID: 17763497; PMC3733359.

d) Tie Y, Whalen S, Suarez RO, Golby AJ. Group independent component analysis of language fMRI from word generation tasks. NeuroImage. 2008 Sep 1;42(3):1214-25. PMID: 18621548; PMC2598840.

D. Additional Information: Research Support and/or Scholastic Performance

---

Ongoing Research Support

P41EB015898 (PI: Tempany) 08/15/2015 - 06/30/2020
NIH-NIBIB
Image Guided Therapy Center
The primary goal of our proposed P41 program is to use imaging to improve target definition, localization and targeting of diseased tissue and using image guidance to optimize treatments, improving outcomes and decreasing invasiveness. In the next cycle, we propose to address open challenges in image-guided therapy (IGT) related to ill-defined target definition, inaccurate localization and targeting.
Role: Neurosurgery Core Leader

R01NS049251 (PI: Miga) 04/01/2014 - 03/31/2019
Vanderbilt University/NINDS
Multimodal Registration of the Brain's Cortical Surface
Our goal is to collect intra-operative MRI and cortical surface clinical data in order to quantitatively evaluate a low-cost deformation correction approach for image-guided brain tumor resection.
Role: Co-PI

U01CA199459 (PI: O'Donnell) 09/22/2015 - 07/31/2019 (NCE)
NIH-NCI National Cancer Institute
Open source diffusion MRI technology for brain cancer research
The major goals of this project are developing a state-of-the-art suite of diffusion MRI software tools, incorporating advanced data and modeling beyond the diffusion tensor, into the 3D Slicer community-based open-source software package.
Role: Co-investigator

Canon, USA (PI: Frisken) 08/01/2018 - 07/31/2021
Planning and Guidance System for Robotics-Assisted Deep Brain Surgery
The major goals of this project are: to design, implement and test software for planning curved insertion trajectories for Canon's medical robotic technologies.
Role: Co-PI

R01EB027134 (PI: Frisken) 12/01/2018 – 08/31/2023
NIH-NIBIB
Continuous Compensation of Brain Shift during Neurosurgery
The major goals of this project are: to investigate methods that compensate for brain shift continuously during neurosurgery using intraoperative ultrasound so that surgeons can resect as much tumor as possible while minimizing the risk of neurologic deficits
Role: Co-investigator

Partners Innovation Discovery Grant (PI: Golby) 05/01/2018 – 04/30/2019
Machine Learning Optimized Intraoperative Multiplexed Quantitative Optical Image Guidance for Brain Tumor Surgery
This effort aims to develop machine learning approaches to online rapid analysis of optical signals from tumor and tumor resection bed with the aim of tissue differentiation.

BWH Health and Technology Innovation Award (PIs: Golby and Valdes) 07/01/2018 – 06/30/2019
Internal BWH
Quantitative optical multiplexing for neurosurgical guidance of brain tumors
This effort will develop hardware to allow quantitative optical signals to be recorded over a wide field at video rate
Role: Co-PI

Completed Research Support

P01CA174645 (PI: McDannold) 06/05/2013 - 05/31/2018
NIH-NCI
MRI-guided focused ultrasound for drug delivery and ablation of brain tumors

The major goal of this project is to develop non-thermal applications of MRgFUS for the non-invasive treatment of brain tumors using image guided drug delivery or non-thermal tissue ablations. The main objective is to bring these potentially high-impact FUS technologies from the laboratory to pre-clinical stage.
Role: Co-Investigator

UL1RR025758 (PI: Golby) 08/01/2012 - 01/31/2016
Harvard Catalyst
Transforming Brain Tumor Surgery through Coherent Raman Microscopy
The goal of this project is to show that SRS imaging is a reliable method for evaluating surgical specimens for the presence of tumor and to yield a workflow in which SRS imaging data could be rapidly analyzed to generate a probability for the presence of tumor in a region of interest.
Role: PI

No Award Number 01/24/2014 - 03/23/2017
Koh Young Technology
CTA: Surgical Object Optical Tracking System
Our goal is to develop and clinically validate a novel neuro-navigation system applying Koh Yong's newly developed optical tracking sensor with improved image to patient registration and less line-of-sight issues than the currently available products in the market.
Role: Co-PI

R21CA198740 (PI: Golby and Tie) 07/01/2015 - 06/30/2017
NIH-NCI
Resting-state fMRI for Language Mapping in Brain Tumor Patients
The major goals of this project are to develop an improved method using fMRI to map critical language areas in brain tumor patients to help neurosurgeons perform more effective and safer brain surgeries. This project will evaluate the reliability and validity of a resting-state condition in which the patient only needs to rest while in the MRI scanner.
Role: Co-PI