BIOGRAPHICAL SKETCH

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NAME	POSITION TITLE
Simon Keith Warfield	Associate Professor of Radiology Harvard Medical School
eRA COMMONS USER NAME WARFIELD	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
The University of New South Wales, Australia	BS	1991	Computer Science
The University of New South Wales, Australia	BE	1993	Electrical Engineering
The University of New South Wales, Australia	Ph.D.	1997	Computer Science and Engineering
Harvard Medical School, Boston, USA	Postdoctoral training	1997-1998	Medical Imaging

Please refer to the application instructions in order to complete sections A, B, and C of the Biographical Sketch.

A. Positions and Honors. List in chronological order previous positions, concluding with your present position. List any honors. Include present membership on any Federal Government public advisory committee.

1996-1998 Research Fellow, Dept. of Radiology, Brigham and Women's Hospital (BWH), Harvard Medical School
1998-2001 Instructor in Radiology, Harvard Medical School
2001- Assistant Professor of Radiology, Harvard Medical School
2001- Director, Computational Radiology Laboratory, Brigham and Women's Hospital
2002-2007 Research Affiliate, CSAI Laboratory, Massachusetts Institute of Technology
2004- Associate Professor of Radiology, Harvard Medical School
2004- Director, Computational Radiology Laboratory, Children's Hospital and BWH
2004/02 Service on NIH NIDA review panel on ``Design Evaluation, and Integration of Image Analysis Methods to Facilitate Clinical Neuromaging in Substance Abuse.''
2004/10 NIH ZRG1 SBIB-Q 50 Study Section., 2005-2006 NIH BDCN K-10 Study Section
2006 NIH ZRG1 SBIB-L (40) MR P41 Study Section, 2007 NIH BDCN E-10 Study Section
2006-2008 Research and Investment Advisory Committee, Member, e-Health Research Centre, CSIRO, Australia
2008 NIH ZRG1 BDCNF 10 Study Section 2008 ZRG1 NT-K 01 Study Section
2008- Director of Research, Department of Radiology, Children's Hospital Boston

Selected Honors and Awards:

1993 BE Honors Class 1, 1997-1998 NMSS Postdoctoral Fellowship Award
2005 Ferrant et al. Med Imag Anal 2002 - Top 1% Most Cited Paper in the Field, Thompson/ISI
2006 CIMIT Edward M. Kennedy Award for Healthcare Innovation
2006 Fast Breaking Paper - Warfield et al. IEEE TMI 2004 -Top 1% Most Cited Paper in the Field., Thomson/Essential Science Indicators 2007 IEEE Senior Member.
2008 Australia-Harvard Fellowship.

B. Selected from 85 peer-reviewed publications (in chronological order). Do not include publications submitted or in preparation.

1. **Warfield S**, Dengler J, Zaers J, Guttmann CRG, Wells WM, Ettinger GJ, Hiller J, Kikinis R. Automatic Identification of Grey Matter Structures from MRI to Improve the Segmentation of White Matter Lesions. J Image Guid Surg 1995; 1(6): 326-338.
2. **Warfield S.** Fast k-NN Classification for Multichannel Image Data.. Pattern Recog Let 1996; 17(7):713-721.
3. Huppi P, **Warfield S**, Kikinis R, Barnes P, Zientara G, Jolesz FA, Tsuji M, Volpe J. Quantitative Magnetic Resonance Imaging of Brain Development in Premature and Mature Newborns. Ann Neurol;1998;43(2):224-235.
4. **Warfield SK**, Jolesz FA, Kikinis R. A High Performance Computing Approach to the Registration of Medical Imaging Data. Parallel Computing 1998; 24(9-10): 1345-1368.

5. Inder TE, Huppi PS, **Warfield SK**, Kikinis R, Zientara GP, Barnes P, Jolesz FA, Volpe JJ. Periventricular White Matter Injury in the Premature Infant Is Followed by Reduced Cerebral Cortical Gray Matter Volume at Term. Ann Neurol 1999; 46(5): 755-760.
6. **Warfield SK**, Kaus M, Jolesz FA, and Kikinis R. Adaptive, Template Moderated, Spatially Varying Statistical Classification. Medical Image Analysis 2000; 4(1): 43-55.
7. **Warfield SK**, Mulkern RV, Winalski CS, Jolesz FA, Kikinis R. Image Processing Strategy for Quantification and Visualization of Exercise Induced Muscle MRI Signal Enhancement. JMRI 2000;11:525-531.
8. Ferrant M, Nabavi A, Macq B, Jolesz FA, Kikinis R, **Warfield SK**. Registration of 3D Intraoperative MR Images of the Brain using a Finite Element Biomechanical Model. IEEE TMI 2001;20:1384-1397.
9. Ruiz-Alzola J, Westin CF, **Warfield SK**, Maier SE, Alberola C, Kikinis R. Nonrigid Registration of 3D Tensor Medical Data. Med Imag Anal 2002; 6:143-161.
10. **Warfield SK**, Talos F, Tei A, Bharatha A, Nabavi A, Ferrant M, Black PM, Jolesz FA, Kikinis R. Real-Time Registration of volumetric brain MRI by Biomechanical Simulation of Deformation during Image Guided Neurosurgery. Comput Visualization Science 2002; 5:3-11.
11. Ferrant M, Nabavi A, Macq B, Black PM, Jolesz FA, Kikinis R, **Warfield SK**. Serial Registration of Intraoperative MR Images of the Brain. Med Image Anal 2002; 6(4): 337-359.
12. Jaume S, Ferrant M, Macq B, Hoyte L, Fielding J, Schreyer A, Kikinis R, **Warfield SK**. Tumor detection in the bladder wall with a measurement of abnormal thickness in CT scans. IEEE TBME 2003;50(3):383-90.
13. Zou, KH, Wells WM, Kikinis R, **Warfield SK**. Three Validation Metrics For Automated Probabilistic Image Segmentation of Brain Tumors. Stat Med, 2004; 23(8):1259-82.
14. Grau V, Mewes AUJ, Alcaniz M, Kikinis R, **Warfield SK**. Improved watershed transform for medical image segmentation using prior information. IEEE Trans Med Imag 2004; 23 (4): 447-458.
15. Als H, Duffy FH, McAnulty G, Rivkin MJ, Vajapeyam S, Mulkern RV, **Warfield SK**, Huppi PS, Butler SC, Conneman N, Eichenwald E. Early experience alters brain function and structure. Pediatrics 2004;113(4):846-857.
16. Tolsa CB, Zimine S, **Warfield SK**, Freschi M, Sancho Rossignol A, Lazeyras F, Hanquinet S, Pfizenmaier M, Huppi P. Early alteration of structural and functional brain development in premature infants born with intrauterine growth restriction. Pediatr Res. 2004 Jul;56(1):132-8.
17. **Warfield SK**, Zou KH, Wells WM. Simultaneous Truth and Performance Level Estimation (STAPLE): An Algorithm for the Validation of Image Segmentation. IEEE Trans Med Imag 2004; 23(7):903-921.
18. Silverman, SG, Sun MR, Tuncali K, Morrison PR, vanSonnenberg E, Shankar S, Zou KH, **Warfield SK**. Three-dimensional assessment of MRI-guided percutaneous cryotherapy of liver metastases. AJR Am J Roentgenol 2004; 183(3):707-12.
19. Inder TE, **Warfield SK**, Wang H, Huppi PS, Volpe JJ. Abnormal cerebral structure is present at term in premature infants. Pediatrics. 2005 Feb;115(2):286-94.
20. Limperopoulos C, Soul JS, Gauvreau K, Huppi PS, **Warfield SK**, Bassan H, Robertson RL, Volpe JJ, du Plessis AJ. Late gestation cerebellar growth is rapid and impeded by premature birth. Pediatrics. 2005 Mar; 115(3):688-95.
21. Tsai A, Wells WM, **Warfield SK**, Willsky AS. An EM algorithm for shape classification based on level sets. Med Image Anal. 2005; 9(5):491-502.
22. Goldberg-Zimring D, Mewes AUJ, Maddah M, **Warfield SK**. Diffusion tensor magnetic resonance imaging in multiple sclerosis. J Neuroimaging 2005; 15:68s-81s.
23. du Bois d'Aische A, Craene MD, Geets X, Gregoire V, Macq B, **Warfield SK**. Efficient multi-modal dense field non-rigid registration: alignment of histological and section images. Med Image Anal. 2005 Dec;9(6):538-46.
24. Mewes AU, Huppis PS, Als H, Rybicki FJ, Inder TE, McAnulty GB, Mulkern RV, Robertson RL, Rivkin MJ, **Warfield SK**. Regional brain development in serial magnetic resonance imaging of low-risk preterm infants. Pediatrics. 2006 Jul;118(1):23-33.
25. Wittek A, Miller K, Kikinis R, **Warfield SK**. Patient-specific model of brain deformation: Application to medical image registration. J Biomech. 2006.
26. Shah DK, Anderson PJ, Carlin JB, Pavlovic M, Howard K, Thompson DK, **Warfield SK**, Inder TE. Reduction in cerebellar volumes in preterm infants: relationship to white matter injury and neurodevelopment at two years of age. Pediatr Res. 2006;60(1):97-102.

27. Shah DK, Guinane C, August P, Austin NC, Woodward LJ, Thompson DK, **Warfield SK**, Clemett R, Inder TE. Reduced Occipital Regional Volumes at Term Predict Impaired Visual Function in Early Childhood in Very Low Birth Weight Infants. Invest Ophthalmol Vis Sci. 2006;47(8):3366-3373.
28. Thompson DK, **Warfield SK**, Carlin JB, Pavlovic M, Wang HX, Bear M, Kean MJ, Doyle LW, Egan GF, Inder TE. Perinatal risk factors altering regional brain structure in the preterm infant. Brain. 2006.
29. Goldberg-Zimring D, **Warfield SK**. Novel image processing techniques to better understand white matter disruption in multiple sclerosis. Autoimmun Rev. 2006;5(8):544-8.
30. Archip N, Clatz O, Whalen S, Kacher D, Fedorov A, Kot A, Chrisochoides N, Jolesz F, Golby A, Black PM, **Warfield SK.** Non-rigid alignment of pre-operative MRI, fMRI, and DT-MRI with intra-operative MRI for enhanced visualization and navigation in image-guided neurosurgery. 2007;35(2):609-624.
31. Archip N, Jolesz FA, **Warfield SK**. A validation framework for brain tumor segmentation. Acad Radiol. 2007 14(10):1242-51.
32. Wittek A, Miller K, Kikinis R, and **Warfield SK**. Patient-specific model of brain deformation: Application to medical image registration. J Biomech, 2007;40(4):919-29.
33. D K Thompson, **S K Warfield**, J B Carlin, M Pavlovic, H X Wang, M Bear, M J Kean, L W Doyle, G F Egan, and T E Inder. Perinatal risk factors altering regional brain structure in the preterm infant. Brain, 2007;130(Pt 3): 667-77.
34. Alayon S, Robertson R, **Warfield SK** and Ruiz-Alzola J. A fuzzy system for helping medical diagnosis of malformations of cortical development. Biomed Inform, 2007;40(3):221-35.
35. Mewes AU, Zollei L, Huppi PS, Als H, McAnulty GB, Inder TE, Wells WM, and **Warfield SK**. Displacement of brain regions in preterm infants with non-synostotic dolichocephaly investigated by MRI. Neuroimage, 2007;36(4):1074-85.
36. Dauguet J, Peled S, Berezovskii V, Delzescaux T, **Warfield SK**, Born R and Westin CF. Comparison of fiber tracts derived from in-vivo DTI tractography with 3D histological neural tract tracer reconstruction on a macaque brain. Neuroimage, 2007;37(2):530-8.
37. **Warfield SK**, Zou KH, and Wells WM. Validation of image segmentation by estimating rater bias and variance. Phil. Trans. R. Soc. A. 2008;366(1874):2361-75.
38. Thompson DK, Wood SJ, Doyle LW, **Warfield SK**, Lodygensky GA, Anderson PJ, Egan GF, and Inder TE. Neonate Hippocampal Volumes: Prematurity, Perinatal Predictors, and 2-Year Outcome. Annals of Neurology. 2008;63(5):642-51.
39. Lodygensky GA, Seghier ML, **Warfield SK**, Tolsa CB, Sizonenko S, Lazeyras F, and Huppi PS. Intrauterine Growth Restriction Affects the Preterm Infant's Hippocampus. Pediatr Res,2008;63(4):438-43
40. Rivkin MJ, Davis PE, Lemaster JL, Cabral HJ, **Warfield SK**, Mulkern RV, Robson CD, Rose-Jacobs R, and Frank DA. Volumetric MRI study of brain in children with intrauterine exposure to cocaine, alcohol, tobacco, and marijuana. Pediatrics. 2008;121(4): 741-50.
41. Maddah M, Grimson WE, **Warfield SK** and Wells WM. A unified framework for clustering and quantitative analysis of white matter fiber tracts. Med Image Anal, 2008;12(2):191-202.
42. Archip N, Clatz O, Whalen S, Dimaio SP, Black PM, Jolesz FA, Golby A, **Warfield SK**. Compensation of geometric distortion effects on intraoperative magnetic resonance imaging for enhanced visualization in image-guided neurosurgery. Neurosurgery. 2008;62(3 Suppl 1):209-15; discussion 215-6.
43. Commowick O, Fillard P, Clatz O, **Warfield SK**. Detection of DTI white matter abnormalities in multiple sclerosis patients. Med Image Comput Comput Assist Interv Int Conf Med Image Comput Comput Assist Interv. 2008;11(Pt 1):975-82.
44. De Craene MS, Macq B, Marquesc F, Salembierc P, and **Warfield SK**. Unbiased Group-wise Alignment by Iterative Central Tendency Estimation. Math. Model. Nat. Phenom., 3(6):2-32 2008.
45. Dubois J, Benders M, Borradori-Tolsa C, Cachia A, Lazeyras F, Ha-Vinh Leuchter R, Sizonenko SV, **Warfield SK**, Mangin JF, Hüppi PS. Primary cortical folding in the human newborn: an early marker of later functional development. Brain. 2008 Aug;131(Pt 8):2028-41.
46. Rullmann M, Anwander A, Dannhauer M, **Warfield SK**, Duffy FH, Wolters CH. EEG source analysis of epileptiform activity using a 1 mm anisotropic hexahedra finite element head model. Neuroimage. 2009; 44(2):399-410.
47. Thompson DK, Wood SJ, Doyle LW, **Warfield SK**, Egan GF, Inder TE. MR-determined hippocampal asymmetry in full-term and preterm neonates. Hippocampus. 2009;19(2):118-23.
48. Commowick O and **Warfield SK**. A Continuous STAPLE for Scalar, Vector and Tensor Images: An Application to DTI Analysis. IEEE TMI, 2009, in press

C. Research Support. List selected ongoing or completed (during the last three years) research projects (federal and non-federal support).

Selected Ongoing Research Support

Bioinformatics Software for MRI of Brain Development
Principal Investigator: **Warfield, Simon K.** 8/1/06-7/31/10
Agency: NIH R01 RR021885
Purpose: The research proposed here involves the enhancement of an existing software package for quantitative analysis of MRI of the developing brain by the implementation, as open-source software, of existing validated and proven algorithms, and the creation of a user-friendly graphical user interface to enable end users to easily apply these methods. The objective is to enhance the existing software to create a platform for scientific discovery and for clinical research.
Role: Principal Investigator with overall intellectual responsibility for the entire project.

Bioinformatics Tools for Multi-Center Diagnostic Trials
Principal Investigator: **Warfield, Simon K.** 2/7/06-1/31/10
Agency: NIH R01 GM074068
Purpose: We propose to develop a novel and general statistical validation strategy for evaluating multi-center diagnostic imaging trial data, illustrated on two completed prospective studies previously conducted by the Radiological Diagnostic Oncology Group and the Biomedical Informatics Research Network, respectively. Receiver operating characteristic analysis, mutual information, overlap index, and the expectation-maximization algorithm will be employed to evaluate diagnostic classification accuracy. These methods may be generalized to many problems related to the analysis of prospective diagnostic trials.
Role: Principal Investigator with overall intellectual responsibility for the entire project.

Assessment of Improved Navigation for Pediatric Brain Tumor Surgery
Principal Investigator: **Warfield, Simon K.** 9/15/07-5/31/11
Agency: NIH R01 EB008015
Purpose: This research proposal is to apply and evaluate novel surgical navigation technology to improve outcomes in pediatric brain tumor surgery. The capacity to visualize the tumor and tumor margin throughout the surgery, together with functionally significant cortical gray matter regions and white matter fiber tracts, will better enable the neurosurgeon to achieve more complete tumor resection without creating neurological deficits.
Role: Principal Investigator with overall intellectual responsibility for the entire project.

Disruption of White Matter Circuits and Cognitive Deficits in Multiple Sclerosis
Principal Investigator: **Warfield, Simon K.** 10/01/04-03/31/09
Agency: National Multiple Sclerosis Society RG3478A2/2
Purpose: This study will construct statistical atlases of conventional MRI and Line Scan Diffusion Tensor utilizing 3.0T MRI of healthy controls and early diagnosis multiple sclerosis patients. Patterns of white matter alteration associated with multiple sclerosis will be determined.
Role: Principal Investigator with intellectual responsibility for all aspects of the study.

Bayesian Source Imaging of Pediatric Epilepsy
Principal Investigator: Warfield, Simon K. 08/19/08-07/31/09
Agency: CIMIT No. 08-293
Purpose: The goal of this project is to create a new device capable of locating epileptogenic foci and thereby make curative surgery available to a larger population of epilepsy patients at an earlier age.
Role: Principal Investigator with intellectual responsibility for all aspects of the study.

Harvard Clinical and Translational Science Center
Principal Investigator: **Nadler , Lee** 5/19/08-04/30/13
Agency: NIH/NCRR UL1 RR025758-01
Purpose: The Harvard CTSC is a new collaborative and trans-disciplinary environment to foster clinical translational research and training for Harvard and its affiliated Academic Healthcare Centers.
Role: Site Director of Translational Imaging Consortium.