BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.
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NAME	POSITION TITLE
Anand Gopinath	Professor of Electrical and Computer Engineering
eRA COMMONS USER NAME (credential, e.g., agency login) AGopinath	

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
University of Sheffield, Sheffield, England	Ph.D.	June 1965	Electrical Engineering
University of Sheffield, Sheffield, England	D.Eng (higher doctorate)	September 1978	Electrical Engineering

Personal Statement

The goal of the project is to facilitate the use of high field MRI systems with their high signal to noise ratios. These high field systems require the use of multi-channel RF B_1 coils to mitigate the effects of the small wavelength in the human body/head including inhomogeneity of the RF excitation, constructive and destructive interference effects leading to anomalous contrasts in the images. The innovative multi-channel transmission line (TEM) coil has high Q elements that produce outstanding images but requires retuning when the loading varies. An automatic electronic tuning system is being investigated and will be implemented with a custom designed control IC which is likely to find wide usage. The RF shimming technique in these high field systems using convex optimization and the least squares methods determine the magnitude and phase of the exciting currents in the TEM coil elements to obtain uniform B_1^+ fields in a region of interest. This technique needs further modifications to obtain these parameters rapidly, it requires the extraction of B_1^+ field with all currents equal and the subsequent computations to determine the effect of excitation of the coil elements, which needs to be done extremely fast. We have been using the integral equation approach to improve the computational speed but need to perform further refinements to implement these calculations rapidly. Current work is also to extend this region of interest to the entire field of view of the system and currently experiments are in progress to obtain this goal.. The widely used microstrip elements of the TEM coil are to be replaced by metamaterial transmission line elements operating as zeroth-mode resonators, which are very efficient radiators, in turn will reduce the RF power requirements at these high field systems. Also suggested is the implementation of distributed receive elements which will enable the use of radar type beam forming in the MRI context.

The expertise in my group includes the calculation of RF/microwave electromagnetic fields for guided wave structures, antennas, scattering from dielectric objects and other cases, using a variety of methodologies including finite difference, finite element methods and integral equations using CAD packages and also in-house written codes. Collaborating with members of Dr. Vaughan's group have resulted in excellent results and hopefully this project will allow this to continue.

A. Positions and Honors.

Positions and Employment

1965- 1966 University of Sheffield, Sheffield, England, Postdoctoral Assistant
1966- 1979 Univ. College of North Wales Bangor, Wales, Lecturer, Sr. Lecturer, Reader(1978)
1981- 1982 Chelsea College (now part of King's College), University of London, England

Chair of Electronics

1978- 1981 MIT Lincoln Lab. Lexington, MA, Research Staff Member
1982- 1986
1986- University of Minnesota Minneapolis, MN Professor of ECE

Other Experience and Professional Membership

1990 Fellow, Institute of Electrical and Electronic Engineers, New York
1998 Fellow, Optical Society of America
1982 Fellow, Institution of Engineering Technology, London, England
1988(?) Member American Physical Society
1999-2003 Associate Editor of Journal of Lightwave Technology
2003-2004 Associate Editor of IEEE Phtonic Technology Letters
2002 (Nov-Dec): Guest Editor for Journal of Selected Topics In Quantum Electronics: Integrated Optics
2007 (September): Guest Editor Special section of Journal of Lightwave Technology on Modeling of Guided Wave Photonic Devices.
Conferences:
2003-2011 IEEE International Microwave Symposium technical program committee on Biological and Medical Effects
2000, 2009 Conference Co-Chair of OSA Integrated Photonics Research Meeting.

B Selected peer-reviewed publications

Most Relevant

1. J. T. Vaughan, L. DelaBarre, C. Snyder, J. Tian, C. Akgun, D. Shrivastava, W. Liu, C. Olson, G. Adriany, J. Strupp, P. Andersen, A. Gopinath, P.-F. van de Moortele, M. Garwood, K. Ugurbil, "9.4T Human MRI: Preliminary Results" Magn. Reson. Med., Vol. 56, pp.1274-1282, 2006.
2. Hyoungsuk Yoo, A. Gopinath, J. T. Vaughan Convex optimization for RF B1 field localization, 2009 ISMRM Meeting, Hawaii April 2009.
3. Can Akgun, Lance DelaBarre, Carl Snyder, Gregor Adriany, Kamil Ugurbil, Anand Gopinath, John Thomas Vaughan, Alternating Impedance Element for 7T Multi-Channel Transceiver Coil, 2009 ISMRM Meeting, Hawaii April 2009.
4. Can Akgun, Lance DelaBarre, Sung-Min Sohn, Carl Snyder, Gregor Adriany, Kamil Ugurbil, John Thomas Vaughan, Anand Gopinath, Novel multi-channel transmission coil, for high field magnetic resonance imaging, IEEE 2009 International Microwave Symposium, June 2009, Boston, MA.
5. Can Eyup Akgun, Lance DelaBarre, Carl Jason Snyder, Sung-Min Sohn, Gregor Adriany, Kamil Ugurbil, Anand Gopinath, John Thomas Vaughan, Alternating Impedance Multi-Channel Transmission Line Resonators for High Field Magnetic Resonance Imaging, IEEE 2010 International Microwave Symposium, Annaheim, CA, May 2010.
6. Hyoungsuk Yoo, Anand Gopinath, J. Thomas Vaughan, A Method to Control Non-uniformity RF B1 Field for High Field Magnetic Resonance Imaging, IEEE 2010 International Microwave Symposium, Annaheim, CA, May 2010.
7. H. Yoo, A. Gopinath, and T. Vaughan, Rapid B1 field calculation using integral equations for RF shimming, 2010 ISMRM Meeting, Stockholm, May 2010.
8. Can Akgun, Lance DelaBarre, Carl Snyder, Gregor Adriany, Kamil Ugurbil, Anand Gopinath, John Thomas Vaughan, Alternating Impedance Element for 7T Multi-Channel Transceive Coil, 2010 ISMRM Meeting, Stockholm, May 2010.
9. Can Akgun, Lance Delabarre, Hyoungsuk Yoo, Carl Snyder, Sung-Min Sohn, Gregor Adriany, P-F Van De Moortele, Anand Gopinath, Kamil Ugurbil,and J. Thomas Vaughan, Stepped impedance resonators

for high field MRI, International Society for Magnetic Resonance in Medicine (ISMRM), Montreal, Canada, May 7~13, 2011.
10. Can Akgun, Hyoungsuk Yoo Lance Delabarre, Carl Snyder, Gregor Adriany, P-F Van De Moortele, Anand Gopinath, Kamil Ugurbil,and J. Thomas Vaughan, Novel 24 element volume head coil for high field MRI, International Society for Magnetic Resonance in Medicine (ISMRM), Montreal, Canada, May 7~13, 2011.
11. S-M. Sohn, A. Gopinath, J. Thomas Vaughan, Electrically auto-tuned RF coil design, International Society for Magnetic Resonance in Medicine (ISMRM), Montreal, Canada, May 7~13, 2011.
12. S-M. Sohn, A. Gopinath, J. Thomas Vaughan, Auto-tuning of The RF Transmission Line Coil for High-Fields Magnetic Resonance Imaging (MRI) Systems, IEEE 2011 International Microwave Symposium, Baltimore, MD, June 5-11, 201.

Related Papers

1. P. R. Hayes, P. R. Woodward, M. O'Keefe, A. Gopinath, Time domain solutions of optical waveguide problems with higher order schemes, Quantum Electronics and Optics, Vol. 31, no. 10, pp. 813 - 826, 1999
2. R. Scaramozzino, A. Gopinath, R. Pregla, S. Helfert, Numerical techniques for modeling guided wave photonic devices, IEEE J. STQE, Vol. 6, no 1, pp. 150-162, 2000. (Invited Paper).
3. Y. E. Nesmelov, A. Gopinath, D. D. Thomas., Aqueous sample in an EPR cavity: sensitivity considerations, J Magn Reson, 167: 138-146, 2004.
4. J. Kim, A. Gopinath, Simulation of Metamaterial Using Cubic High Dielectric Resonators in a Low Dielectric Background, Phys. Rev. B, Vol. 76, pp. 115126, 2007.
5. Hyoungsuk Yoo, Yassine Beaubendir, A. Gopinath, Analysis of Open waveguides using finite element and boundary element method, IEEE J. Quantum Electronics, Vol. 44, 7, pp.676-679, 2008.
6. Hyoungsuk Yoo, A. Gopinath, Analysis of open dielectric waveguides using the finite-element penalty method, Optics Letters, v 33, n 18, pp. 2068-70, 15 Sept. 2008.
7. Hyoungsuk Yoo, Anand Gopinath, Pseudoinverse method for modal solutions of open dielectric waveguides, Optics Letters, vol. 34, no. 8, 1282-1284, 2009.
8. Jaesang Oh, A. Gopinath, A coplanar strip slow wave structure for the optical directional coupler modulators, IEEE Microwave and Wireless Components Letters, v 20, n 1, p 7-9, Jan. 2010.
9. Heather Orser, Anand Gopinath, A 20Gs/s 1.2V 0.13μm CMOS switched cascode track and hold amplifier, IEEE Trans. Circuits and Systems- Express Briefs, vol. 57, no. 7, pp.512-515, 2010.
10. Jaewan Kim, Hyoung-Suk Yoo, Anand Gopinath, Simulations and experiments on higher resonant modes of cubic high dielectric resonator metamaterial, Electronics Letters, v 46, n 24, p 1590-1, 25 Nov. 2010
11. Sung-Min Sohn, J. T. Vaughan, A. Gopinath, An interdigitated split-ring resonator for metamaterials, Microwave and Optical Technology Letters, v 53, n 1, p 174-7, Jan. 2011.

B. Research Support. List selected ongoing or completed (during the last three years) research projects (federal and non-federal support). Begin with the projects that are most relevant to the research proposed in this application. Briefly indicate the overall goals of the projects and your role (e.g. PI, Co-Investigator, Consultant) in the research project. Do not list award amounts or percent effort in projects.

Ongoing Projects

NIH-EB006835	Vaughan (PI)	08/15/07-05/31/2011

Goal of this study is to develop the technology applicable for human MRI in systems with B_0 fields of 9.4T and above. Role of my group is to develop methods for rapidly calculating the RF B_1^+ fields using a combination of integral equations and finite element methods in the human head/body; to develop RF shimming so that inhomogeneities in the images are mitigated using convex optimization and pseudo-inverse method; to develop a technique for automatic tuning for the multi-channel elements of TEM coils; to develop efficient antenna elements for multi-channel RF coils for 9.4T systems.

Completed Projects

NIH-EB000985-04 Vaughan (PI) 09/01/2004-08/31/2009

Goal of this study is to minimizes losses in high field MRI systems. Role of my group was to develop methods of rapid calculation of RF B_1^+ fields using finite elements which then lead to the use of integral equations in the current project; to develop RF shimming so that inhomogeneities in the images are mitigated using convex optimization which has lead to the continuation in the current project.

Medical Devices Center, Univ. of MN Gopinath(PI) 09/01/2008-03/31/2010

Goal of project was to use the composite right hand and left hand metamaterial transmission line for innovative RF coils for high field MRI systems, this is continuing in the current project.