

## *Curriculum Vitae*



*Ronald D. Watkins*

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**Current Focus:** My current focus is the design and development of hardware and systems for Medical Imaging and Image Guided Therapeutics within the Radiological Sciences Lab in the Department of Radiology at Stanford. A lot of my work involves RF coils and associated hardware for multi-nuclear and Very High Field MRI. I am also involved in the development of Ultrasound Systems for imaging and therapeutic use including many variations of hybrid systems that involve both MRI and Ultrasound combined.

### **Significant Accomplishments:**

Co inventor of MR guided Focused Ultrasound (MRgFUS) led to formation of InsightTec Therapeutics

Awarded Magna Cum Laude Citation, RSNA 1994 for MR Guided Focused Ultrasound

Developed first commercial whole body 3 Tesla MRI system 1999

Demonstrated the use of cMUTS for MR guided HIFU

Developed first birdcage head coil for 7 Tesla

Designed hardware for first 32 receive channel MRI system now designing 128

Designed hardware for first 8 channel parallel transmit MRI system

Designed Fiber Optic based MRI surface coil, with no conducting RF cables

49 Patents; 39 U.S. 10 foreign

### **Education:**

AAS Electronics Technology 1981 American River College, Sacramento California

Six Sigma Certified Master Black Belt, General Electric, Croton Ville, New York,

Coursework complete for AOS Culinary Arts Schenectady County Community College

Various courses in MRI coils, MR physics, Ultrasound transducer Design and physics, 3D solid modeling, electronic circuit modeling, and FDTD EM modeling

### **Employment:**

2007 to Present: Richard M. Lucas Radiological Sciences Laboratory Department of Radiology, Stanford University School of Medicine. Edward L. Ginzton Laboratory, Stanford University Dept. of Applied Physics.

Position: Senior Scientific Staff, Research Electrical Engineer, Imaging and Therapeutic Systems

1991-2007: General Electric Research & Development 1 Research Circle Schenectady New York 12309

Senior Staff, RF and Systems Engineer, Magnetic Resonance Imaging and Image guided therapy systems.

1989-1991: Cardiovascular Imaging Systems (Boston Scientific) Sunnyvale California, Electronic Design Engineer

High Frequency Intra-vascular Ultrasound Imaging (IVUS)

1986-1989: General Electric Medical Systems, Waukesha Wi. Engineering Specialist Diagnostic Ultrasound Imaging Systems

1980-1986: General Electric Medical Systems Ranch Cordova Ca.

Engineering Technician, subsystem design for Magnetic Resonance, CT, and image processors for x-ray DSA.

1977-1980: PCE Systems, Fair Oaks Ca. Engineering technician, Microprocessor based microcomputer systems

### **Professional Skills:**

Broad in depth Knowledge of Ultrasound and Magnetic Resonance Imaging Systems, including image guided therapy and surgical systems

Design and construction of RF imaging coils for magnetic resonance of all types: birdcages, phased arrays, open planar coils, saddle coils, vertical field coils, catheter micro coils, solenoid coils, surface coils, body coils.

Analog and RF electronics, low noise preamp and receiver design, T/R switches quad hybrid RF power amplifiers, analog and digital filters, transmission lines and antennas..

Design and fabrication of ultrasound transducers for imaging and therapeutic tissue ablation, MRI guided focused ultrasound ablation system.

Experienced with virtually all parts of whole body MR scanners from .2T to 7T. RF and gradient coil, RF and gradient amplifiers magnet, DAQ

Knowledge of MR physics and familiarity with most type of imaging pulse sequences.

Experience with MR Microscopy at 7 Tesla using 77K cryogenic superconducting receive coils

Digital electronic design, sequencers, filters, signal processing circuits, microprocessor and high speed digital pipeline processing, FPGA design, control circuits.

Expert at electrical safety regulatory requirements, IEC, UL, TUV, VDE, FDA

Project Manager of various projects with budgets from \$200K/yr. to \$2.0M/yr. staffing, scheduling, review of milestones etc.

### **Publications and Presentations:**

#### **Early Detection of Osteoarthritis in Patients with ACL Injury Using Sodium MRI.**

Gold GE, Koo S, Staroswiecki E, Watkins R, Bangerter NK, Hargreaves BA. 2009 Meeting of the SCBT/MR, March 2009. Winner of the Cum Laude Award.

#### **A Microwave Engineer's View of MRI**

Abbas Omar, Robert Caverly, William Doherty, Ronald Watkins, Anand Gopinath, and J. Thomas Vaughan  
IEEE Microwave Magazine Volume 12 Issue 3 May 2011

#### **Radiofrequency Coils for Musculoskeletal Magnetic Resonance Imaging**

Kambiz A. Asher, BS, Neal K. Bangerter, PhD, Ronald D. Watkins, and Garry E. Gold, MD  
Top Magn Reson Imaging & Volume 21, Number 5, October 2010

#### **MRI-compatible Voltage-based Electro-Anatomic Mapping System for Cardiac Electrophysiological Interventions**

Zion Tsz Ho Tse, Charles L Dumoulin, Ronald Watkins, Israel Byrd, Jeffrey Schweitzer, Raymond Y Kwong, Gregory F. Michaud, William G. Stevenson, and Ehud J. Schmidt Proceedings of the 2012 ISMRM Melbourne Australia

#### **Interactive Interventional Applications for the MRI Scan Room**

Andrew B. Holbrook, Ronald Watkins, and Kim Butts Pauly Proceedings of the 2012 ISMRM Melbourne Australia

#### **Performance Comparison of a Hybrid Dual-Tuned $^{23}\text{Na}/^1\text{H}$ Birdcage to a Single-Tuned $^{23}\text{Na}$ Birdcage with Identical Geometry.**

Peterson B, Watkins R, Morrell GR, Allen SP, Park D, Kaggie J, Gold GE, Bangerter NK. 18th ISMRM Meeting, May 2010.

#### **Fast and Robust B1 Mapping at 7T by the Bloch-Siegert Method**

Mohammad Mehdi Khalighi, Laura I. Sacolick, W Thomas Dixon, Ronald D. Watkins, Sonal Josan, Brian K. Rutt  
Proceedings of the 18th ISMRM Meeting, May 2010. Stockholm Sweden

### **Dynamic Modeling of Low Magnetic Moment PIN Diodes for MR Scanner Applications**

Robert Caverly, Ronald Watkins, William Doherty  
Proceedings of the 18th ISMRM Meeting May 2010. Stockholm Sweden

### **Ultra-High-Resolution Skin Imaging at 7 T with Motion Correction and Fat/Water Separation**

Joëlle Karine Barral, Mohammad Mehdi Khalighi, Ronald D. Watkins, Michael Lustig, Bob S. Hu, Dwight G. Nishimura  
Proceedings of the 18th ISMRM Meeting May 2010. Stockholm Sweden

### **High SNR Dual Tuned Sodium/Proton Knee Coil**

Watkins RD, Staroswiecki E, Bangerter N, Hargreaves B, Gold G.. 18th ISMRM Meeting, May 2010.

### **In Vivo Sodium MRI at 3.0T of Patients with Previous ACL Injury.**

Gold GE, Koo S, Staroswiecki E, Watkins R, Hargreaves BA, Bangerter NK. 17th ISMRM Meeting, April 2009, p. 3969.

### **High Precision Tracking of Un-Tuned Micro-Coils for Real-Time Motion Correction Applications**

Melvyn B. Ooi, Murat Aksoy, Ronald D. Watkins, and Roland Bammer Proceedings of the 2012ISMRM Melbourne Australia

### **Combining Active Markers and Optical Tracking for Prospective Head Motion Correction**

Murat Aksoy, Melvyn Ooi, Ronald D Watkins, Daniel Kopeinigg, Christoph Forman, and Roland Bammer  
Proceedings of the 2012ISMRM Melbourne Australia

### **Time Domain Modeling of MR Linear Balanced Duplexers Switched with Low Magnetic Moment PIN Diodes**

Robert H. Caverly, William E.Doherty, Ronald Watkins  
Proceedings of the 2011 ISMRM Montreal Canada

### **298MHz Micro miniature Transmit Receive Switch for 7.0 Tesla T/R arrays**

Ronald D. Watkins, Robert H Caverly, William E Doherty  
Proceedings of the 2012 ISMRM Melbourne Australia

### **MRI guided electrophysiological intervention with a voltage-based electro-anatomic mapping system**

Zion Tse, Charles Dumoulin, Ronald Watkins, Israel Byrd, Jeffrey Schweitzer, Raymond Kwong,  
Gregory F Michaud, Ehud J Schmidt ;Journal of Cardiovascular Magnetic Resonance 2012, 14(Suppl 1):P206

**Repeatability of in vivo sodium MRI of cartilage in early osteoarthritis**, Gold GE, Staroswiecki E, Bangerter NK, Jordan C, [Koo S](#), Watkins R, Hargreaves BA, Workshop on Imaging-based Measures of Osteoarthritis, Boston, MA, June 2008.

### **Parallel Transmit using 3D Spokes RF Pulses for Improved B<sub>1</sub> + Homogeneity over 3D Volumes**

Mohammad Mehdi Khalighi, Manojkumar Saranathan, William Grissom, Adam B. Kerr, Ron Watkins, Brian K. Rutt Proceedings of the 2011 ISMRM Montreal Canada

### **Reduction of RF Heating of Interventional Cryoprobes using Chokes**

Sonal Josans, Kim Butts Pauly Ronald D Watkins Proceedings of the 2008 ISMRM Toronto Canada

### **MR Acoustic Radiation Imaging: Comparison of Encoding Gradients**

Jing Chen, Kim Butts Pauly, Ronald D Watkins Proceedings of the 2008 ISMRM Toronto Canada

### **Feasibility of MR-Temperature Mapping of Ultrasonic Heating from a CMUT**

S. H. Wong, R. D. Watkins, M. Kupnik, K. Butts-Pauly, and B. T. Khuri-Yakub,  
*Ultrasonics, Ferroelectrics and Frequency Control, IEEE Transactions on*, April 2007.

### **Accurate flip-angle calibration for <sup>13</sup>C MRI.**

by: I Hancu, R Watkins, SJ Kohler, RP Mallozzi *Magn Reson Med*, Vol. 58, No. 1. (July 2007), pp. 128-133.

### **PIN Diodes with Low Magnetic Moment for Surface Coils in High Field MRI**

R D Watkins, WE Doherty, RD Joos, P Voskoboynik Proceeding of 2008 ISMRM Toronto Canada

### **Dual Tuned <sup>13</sup>C/<sup>23</sup>Na Low Pass Birdcage Coil**

I Hancu, R. Watkins, S. Kohler, R. Mallozzi Proceedings of the 2007 ISMRM, Berlin Germany

### **B1 Homogeneity of Re-entrant Cavity Resonator**

S. Bulumulla, R. Watkins, J. Schenck, R. Mallozzi, B Amm Proceedings of the 2007 ISMRM, Berlin Germany

### **Transmit Coil Array for Accelerating 2D excitation on an 8 channel parallel Transmit System.**

Y. Zhu, R. Giaquinto R. Watkins, A. Kerr, M. Vogel, J. Piel, T. Foo, I. Hancu K. Park Proceedings of the ISMRM 2006 Seattle Washington

### **128-Channel Body MRI with a Flexible High-Density Receiver-Coil Array**

CJ. Hardy, R.O. Giaquinto, J.E. Piel, K.W. Rohling, L. Marinelli, E.W. Fiveland, C. J. Rossi, K.J. Park, R.D. Darrow, R.D. Watkins Proceedings of the 2007 ISMRM, Berlin Germany

**Diffusion-weighted MRI after cryosurgery of the canine prostate. Magnetic resonance imaging.** Butts K, Daniel BL, Chen L, Bouley DM, Wansapura J, Maier SE, Dumoulin C, Watkins R.D. *J Magn Reson Imaging*. 2003; 17: 1: 131-5.

**“Non Invasive MRI-Guided Focused Ultrasound Surgery”** K Hynynen, H Cline, W Freund, R Watkins, J Vetro F Jolesz Radiological Society of North America 1994 Scientific Sessions Radiographics, Vol 16, 185-195, (*Awarded Magna Cum Laude blue Ribbon*)

**Distinction between soft plaque and thrombus by intravascular ultrasound tissue characterization.** Fitzgerald PJ, Connolly AJ, Watkins RD, Hargrave VK, Yock, PG.. *J Am Coll Cardiol*, 17:111A, 1991. and Abstract American College of Cardiology, 40th Annual Scientific Session Mar 3-7 1991 Atlanta GA.

### **Superconducting Open-Configuration MR Imaging System for Image-guided Therapy’**

John F. Schenck, MD, PhD Ferenc A. Jolesz, MD Peter B. Roemer, PhD Harvey E. Cline, PhD. Ronald D. Watkins et. al. *Radiology* 1995; 195:805-814

**Mapping of the prostate in endorectal coil-based MRI/MRSI and CT: a deformable registration and validation study.** Lian J, Xing L, Hunjan S, Dumoulin C, Levin J, Lo A, Watkins R, Rohling K, Giaquinto R, Kim D, Spielman D, Daniel B. *Med Phys*. 2004; 31: 11: 3087-94.

**“ A Focused Ultrasound System for MRI Guided Tumor Ablation”** HE Cline, K Hynynen, RD Watkins, WJ Adams, JF Schenck, RH Ettinger, WR Freund, JP Vetro, FA Jolesz (*Radiology*), Vol.194 #3 p.731-737 1995

**Invited Talk: Fiber Optic Cabling for RF Coils**Ronald D. Watkins 13<sup>th</sup> ISMRM Engineering Study Group, Miami Fl May 2005

**Optical MR Receive Coil Array Interconnect** Glen P. Koste, Mathew C. Nielsen, Todd R. Tolliver, Richard L. Frey, Ronald D. Watkins Proceedings of the 13<sup>th</sup> ISMRM, Miami Fl. May 2005

### **Magnetic Resonance Imaging, A Commercial Application for Analog Photonics.**

G.P. Koste, R.L. Frey, M.C. Nielsen, T.R. Tolliver, R. Watkins Proceeding of 2005 Avionics, Fiber-Optics and Photonics Conference

### **Patient Isolation System for Invasive MRI**

Patrick Gross, Kenneth W. Rohling Paul Bishop Ronald D. Watkins, Randy O. Giaquinto Charles J. Rossi, Keith J. Park, Charles L. Dumoulin Proceedings of the 13<sup>th</sup> ISMRM, Miami Fl. May 2005

### **8 Channel Multicoil and Transmit Coil with Dynamic Disabling Switches for 7 T Head Imaging**

Akira Nabetani, Ronald D Watkins, Gerald M. Beranek, Tsutomu Nakada Proceedings of the 13<sup>th</sup> ISMRM, Miami Fl. May 2005

### **A Trans Rectal Focused Ultrasound Probe for MR Guided Ablation of the Prostate**

Joseph E. Piel, Randy O. Giaquinto, Ronald D. Watkins, Patrick Gross Renee Ghude Robert D. Darrow, Paul Bishop, Narter Ari, Xuli Zong, Terry M. Topka, Charles L. Dumoulin. Proceedings of the 13<sup>th</sup> ISMRM, Miami Fl. May 2005

### **“Parallel Excitation on an Eight Transmit Channel MRI System”**

Yudong Zhu, Ronald Watkins, Randy Giaquinto, Christopher Hardy..... Proceedings of the 13<sup>th</sup> ISMRM, Miami Fl. May 2005

### **Dynamic Disabling Switch Development for 7T Self Shielded Birdcage**

Akira Nabetani, Ronald D Watkins Proceeding of the 12<sup>th</sup> ISMRM, Kyoto, Japan May 2004

### **300MHz Quadrature Shielded Birdcage Head Coil for 7 Tesla**

Ronald D. Watkins, Kenneth W. Rohling Proceedings of the 11<sup>th</sup> ISMRM, Toronto Canada July 2003

### **A 32 Channel Coil for Phased Array Imaging at 1.5 Tesla**

Charles L. Dumoulin, Randy O. Giaquinto, Kenneth W. Rohling, Charles J. Rossi, Ronald D. Watkins, Christopher J. Hardy, Robert D. Darrow Proceedings of the 11<sup>th</sup> ISMRM, Toronto Canada July 2003

### **3 Tesla Imaging of the Prostate with a Rigid Endo Rectal Coil**

Bruce L Daniel, Charles Dumoulin, Ronald Watkins, Ken Rohling, Randy Giaquinto, Joseph Presti, Kim Butts, Roland Bammer, Michael Mosley, Proceedings of the 11<sup>th</sup> ISMRM, Toronto Canada July 2003

### **Non Uniform Current Distributions and High Field B1 of Cylindrical Coils filled with Uniform Dielectric**

Harvey E. Cline, Richard P. Mallozzi, Ronald D. Watkins, Douglas Kelley. Proceedings of the 11<sup>th</sup> ISMRM, Toronto Canada July 2003

### **Linear Balanced Duplexer T/R Switch**

Ronald D. Watkins, Douglas A.C. Kelley  
Proceedings of the 11<sup>th</sup> ISMRM, Toronto Canada July 2003

### **An Easily Removable Transmit Only Coil for Vertical Gap Magnets**

Charles Dumoulin, Kenneth Rohling, Ray F. Lee, Randy Giaquinto, Charles Rossi, William Edelstein. Proceedings of the 10<sup>th</sup> ISMRM Honolulu Hawaii May 2002

### **A Handheld Device for MR Guided Focused Ultrasound Ablation of the Prostate**

Ronald D. Watkins, Joseph Piel, Kenneth Rohling, Charles Dumoulin Proceedings of the 10<sup>th</sup> ISMRM Honolulu Hawaii May 2002

### **Magnetic resonance imaging compatible neonate incubator**

C.L. Dumoulin, K.W. Rohling, J.E. Piel, C.J. Rossi, R.O. Giaquinto, R. D. Watkins, D. B. Vigneron, A. J. Barkovich, N. Newton Concepts in Magnetic Resonance Magnetic Resonance Engineering Volume 15, Issue 2, Pages 117 – 128 Published 28 Jun 2002

### **A Self Contained Neonate Incubator for Use in MR Scanners**

Charles Dumoulin, Kenneth Rohling, Joseph Piel, Charles Rossi, Randy Giaquinto, Ronald D. Watkins, Daniel B. Vigneron, Anthony James Barkovich, Nancy Newton Proceedings of the 10<sup>th</sup> ISMRM Honolulu Hawaii May 2002

### **In-Vivo Mapping of B1 Uniformity Produced by a Whole Body 3T RF Coil**

David Alsop, Ronald D. Watkins, Robert Greenman, John Schenck, Robert Lenkinski  
Proceedings of the 9<sup>th</sup> ISMRM Glasgow, Scotland April 2001

### **Whole Body RF Coil for 3 Tesla MRI System**

Ronald D Watkins, John F. Schenck, Kenneth W. Rohling, Joseph Piel, Daniel Rosenfeld, Douglas Kelley, Robert Lenkinski, Herbert Kressel, Avram Montag. Proceedings of the 9<sup>th</sup> ISMRM Glasgow, Scotland April 2001

### **Human Cardiac MRI at 3Tesla Using a Whole Body Radio Frequency Coil**

Robert L. Greenman, Robert E. Lenkinski, David Alsop, Ronald Watkins, John F. Schenck, Randy Giaquinto, Joseph Piel, Kenneth Rohling Proceedings of the 9<sup>th</sup> ISMRM Glasgow, Scotland April 2001

### **Diffusion Weighted MRI after Cryosurgery of the In Vivo Canine Prostate**

K. Butts, Daniel J. Wansapura, L. Chen, S Maier C. Dumoulin, R. Watkins  
Proceedings of the 9<sup>th</sup> ISMRM Glasgow, Scotland April 2001

### **Magnetic Resonance Image Guided Biopsy in Prostate**

R.D. Watkins, K.W. Rohling, E.E. Uzguris, C.L. Dumoulin, R.D. Darrow, R.O. Giaquinto. Proceeding of the 8<sup>th</sup> ISMRM Denver Colorado, April 2000

### **Shaped Focused Ultrasound Ablation Zones**

H.E. Cline, K. Hynynen, R.D. Watkins, W.J. Adams  
Proceedings of the 5<sup>th</sup> ISMRM Vancouver, B.C., Canada April 1997

### **“Nuclear Magnetic Resonance Temperature Maps In Muscle”**

HE Cline, Kullervo Hynynen, Erika Schnieder, CJ Hardy, RD Watkins, Stefan Meier, Ferenc Jolesz Magnetic Resonance in Medicine Vol. 35 p.309-315 1996

### **“MR Temperature Mapping of Focused Ultrasound Surgery”**

HE Cline, K Hynynen, CJ Hardy, RD Watkins, JF Schenck, FA Jolesz  
Magnetic Resonance in Medicine Vol. 31 p.628-636 1994

### **“One Dimensional Thermal Mapping of Focused Ultrasound Surgery”**

CJ Hardy, HE Cline, RD Watkins  
Journal of Computer Assisted Tomography Vol. 18 p. 476-483 1994

**“ Real Time Acquisition, Display and Interactive Control of NMR Cardiac Profiles and Images”**

CJ Hardy, RD Darrow, EJ Nieters, PB Roemer, RD Watkins, WJ Adams, NR Hattes, JK Maier *Magnetic Resonance in Medicine* Vol. 29 p. 667, 1993

**“Magnetic Resonance Guided Thermal Surgery”**,

HE Cline, JF Schenck, RD Watkins, K Hynynen, FA Jolesz *Magnetic Resonance in Medicine* Vol. 30 p. 98-106, 1993

**“MR Guided Focused Ultrasound Surgery”**, HE Cline, JF Schenck, RD Watkins, K Hynynen, SP Souza,

FA Jolesz *Journal of Computer Assisted Tomography* Vol. 16, p. 956-965, 1992

**“Magnetic Resonance Image Guided Focused Ultrasound Surgery”**

HE Cline, JF Schenck, K. Hynynen, RD Watkins, SP Souza, FA Jolesz SMRM 11th Annual Meeting, Berlin, Germany August 8-14, 1992 Book of Abstracts p. 1519

**MR temperature mapping of focused ultrasound surgery**

Cline HE, Hynynen K, Hardy CJ, Watkins RD, Schenck JF, Jolesz FA *Magn Resons. Med* 1994;31:628-636

**“ Real Time Acquisition, Display and Interactive Graphic Control**

**of NMR Cardiac Profiles”** CJ Hardy, RD Darrow, EJ Nieters, PB Roemer, RD Watkins, WJ Adams, NR Hattes, JK Maier SMRM 11th Annual Meeting, Berlin, Germany August 8-14, 1992 Book of Abstracts p. 107

**“A 4 Switch GTO Speed-Up Inverter for Fast Scan MRI”**

OM Mueller, PB Roemer, JN Park, SP Souza, RD Watkins SMRM 11th Annual Meeting, Berlin, Germany August 8-14, 1992 Book of Abstracts

**“One Dimensional NMR Thermal Mapping of Focused Ultrasound**

**Surgery”** CJ Hardy, HE Cline, RD Watkins SMRM 12th Annual Meeting, New York, New York August 14-20, 1993 Book of Abstracts

**“MRI Temperature Guided Focused Ultrasound Surgery”**

HE Cline, K Hynynen, RD Watkins, CJ Hardy, JF Schenck, FA Jolesz SMRM 12th Annual Meeting, New York, New York August 14-20, 1993 Book of Abstracts

**“A Clinical MR Guided Focused Ultrasound Surgery System”**

HE Cline, K Hynynen, RD Watkins, WJ Adams, JP Vetro, WR Freund, FA Jolesz SMR 2nd Annual Meeting, San Francisco, California August 6-12, 1994 Book of Abstracts

**“A Continuous Wave Doppler Ultrasound Trigger for Magnetic**

**Resonance Imaging”** RD Watkins, CL Dumoulin, RD Darrow, CG Caro SMRM 11th Annual Meeting, Berlin, Germany August 8-14, 1992 Book of Abstracts p. 2918

**“Safety of MR Tracking Catheters”**

S.E. Maier, S. Wildermuth, R.D. Darrow, R.D. Watkins, J.F. Debatin, C.L. Dumoulin SMRM 12th Annual Meeting, Nice, France August 19-25, 1995 Book of Abstracts p. 497 and the European Society for Magnetic Resonance in Medicine and Biology. Berkeley, Calif

**“Fast Magnetic Resonance Phase and Magnitude**

**Temperature Maps”**. H.E. Cline, C.J. Hardy, R.D. Watkins and K. Hynynen ISMRM 4th Annual Meeting, New York, New York

April 27-May 3, 1996 Book of Abstracts

**Methodology for *in-vivo* tissue temperature rise due to RF absorption in a 3T whole body MR system** Ronald D. Watkins

(*Workshop on Current Issues in MR Safety*)

Feb 22-24 2003 Arabella Grand, Munich Germany

**“Simultaneous Magnetic Resonance Phase and Magnitude Temperature Maps in Muscle”**

H.E. Cline, K. Hynynen, E. Schneider, C.J. Hardy, S.E. Maier, Watkins RD, Jolesz FA (*Magnetic Resonance in Medicine*) 1996 Mar; 35(3):309-15 and SMRM 12th Annual Meeting, Nice, France August 19-25, 1995 Book of Abstracts p. 1174

## **Patents:**

US Patent Application 20050020904 A1  
System and method for the detection of brain iron using magnetic resonance  
Harvey E. Cline, Ronald D. Watkins, John F. Schenck

US Patent Application 20040266362 A1 Transmit/receive switch  
Ronald D. Watkins, Douglas A.C. Kelley, Joseph E. Piel

US Patent #7,439741  
Thermal management apparatus and uses thereof  
Mehmet Arik, Kenneth Rohling, Ronald Watkins

US Patent #7,392213B2  
Three Axis Angle Invariant RF Coil Assembly, Method and System.  
Ronald Watkins, Charles Dumoulin, Randy Giaquinto

US Patent #7378844  
Magnetic resonance system, receiver and method of generating detecting and digitizing solely within the MR shielded environment  
Ronald D. Watkins, Richard L. Frey, Glen P Koste, Naveen S. Chandra

US Patent# 7309989  
Wireless RF coil Power Supply  
Eddy Boskamp, Ronald Watkins, Glen Koste

US Patent# 7167000  
Cryogenically Cooled Radiofrequency Coil Array for Magnetic Resonance Imaging  
Kathleen Amm, Ronald Watkins, William Barber, Christopher Hardy, Kenneth Rohling

US Patent#7140420  
Thermal management apparatus and uses thereof  
Mehmet Arik, Kenneth Rohling, Ronald D Watkins

US Patent # 7123015 B2  
Magnetic resonance system and method  
Glen P Koste, Ronald D. Watkins, Richard L. Frey, Matthew C. Nielsen, Joseph A. Iannotti, Todd R. Tolliver

US Patent #7046005 B2 Application 20050134265 A1  
Driver circuits for magnetic systems  
Ronald D. Watkins Douglas A.C. Kelley, Joseph E. Piel

US Patent #6933724 B2 US Patent Application 20050110492 A1  
Matrix coil for generating a variable magnetic field  
Ronald D. Watkins, Douglas A.C. Kelley, Harvey E. Cline

US Patent #6914432 B2  
Phased array coil assembly and method and system for employing the same  
Charles L. Dumoulin, Ronald D. Watkins, Randy O. Giaquinto

US Patent #6822448 B2  
RF coil for very high field magnetic resonance imaging  
Ronald D Watkins, John F. Schenck

US Patent #6791328 B1  
Method and apparatus for very high field magnetic resonance imaging systems  
Akira Nabetani, Ronald D Watkins

US Patent #6618608 B1

Thermal imaging of fat and muscle using a simultaneous phase and magnitude double echo sequence Ronald D. Watkins, Harvey E. Cline

US Patent #6611702 B2

Apparatus for use in neonatal magnetic resonance imaging.

Kenneth W. Rohling, Ronald D. Watkins, Charles L. Dumoulin, Joseph E. Piel, Charles J. Rossi, Randy O. Giaquinto

US Patent #6538441 B1

RF coil for reduced electric field exposure for use in very high field magnetic resonance imaging. Ronald D. Watkins, John F. Schenck, Randy O. Giaquinto

US Patent #6492814 B1

Self localizing receive coils for MR

Ronald D. Watkins, Charles L. Dumoulin, Robert D. Darrow

US Patent#6470204

Intercavity Probe for MR Image Guided Biopsy and delivery of Therapy

Egudijus Uzgirus, Ken Rohling, Ronald D. Watkins

US Patent #6437567 B1

Radio frequency coil for open magnetic resonance imaging system

John F. Schenck, Ronald D. Watkins, William A. Edelstein, Sayed-Amr El-Hamamsy Eddy B. Boskamp, Randy O. Giaquinto, John A. Mallick

US Patent #6393314 B1

RF driven resistive ablation system for use in MRI guided therapy

Ronald D. Watkins, Kenneth W. Rohling, Erika Schnieder

US Patent# 6252405 B1

Temperature compensated NMR magnet and method of operation therefore

Ronald D. Watkins, William D. Barber, Peter G. Frishman

US Patent #6184684 B1

Method to automatically tune MRI RF coils

Charles L. Dumoulin, Ronald D. Watkins, Timothy I.E. Iben, Sayed-Amr El-Hamamsy William A. Edelstein

US Patent #6175757 B1

Luminal mapping Ronald D. Watkins, Charles L. Dumoulin, Robert D. Darrow, Christine E. Dumoulin

US Patent #6144205 A

Optical control of radio frequency antennae in a magnetic resonance imaging system

Steven P. Souza, Ronald D. Watkins

US Patent #6129667 A

Luminal diagnostics employing spectral analysis Charles L. Dumoulin, Robert D. Darrow, Ronald D. Watkins

US Patent #6054858 A

Method to automatically tune MRI RF coils Charles L. Dumoulin, Ronald D. Watkins, Timothy I.E. Iben, Sayed-Anr El-Hamamsy, William A Edelstein

US Patent #5882305

Charles L. Dumoulin, Ronald D. Watkins, Robert D. Darrow, Steven P. Souza Optical Coupling for Invasive Devices

US Patent #5873845

Harvey E. Cline, Ronald D Watkins, George R. Russell, Kullervo H. Hynynen

Ultrasound Transducer with focused ultrasound refraction plate

US Patent # 5807253

Charles L. Dumoulin, Kenneth W. Rohling, Ronald D. Watkins, Randy O. Giaquinto "Patient Electrical Isolation System"



US Patent # 5769790  
Ronald D. Watkins, Christopher M.W. Daft “Focused Ultrasound Surgery System Guided by Ultrasound Imaging”

US Patent # 5739936  
Christopher P. Yakymyshyn, Peter B. Roemer, Ronald D Watkins “Electro-Optical Circuit for Signal Transmission”

US Patent # 5730134  
Charles L. Dumoulin Ronald D. Watkins, Robert D. Darrow, Steven P. Souza  
“System to Monitor Temperature Near and Invasive Device during Magnetic Resonance Procedures”

US Patent # 5715822  
Ronald D. Watkins, Charles L. Dumoulin “Magnetic Resonance Devices Suitable for Both Tracking and Imaging

US Patent # 5711300  
Erika Schneider, Harvey E. Cline Ronald D. Watkins Sheila Washburn, Christopher J. Hardy  
“Real Time In-Vivo Measurement of Temperature Changes with NMR Imaging “

US Patent #5545999  
Otward M. Mueller, Christopher P. Yakymyshyn, Peter B. Roemer, Ronald D. Watkins  
“Preamplifier Circuit for magnetic resonance system”

US Patent # 5368032  
HE Cline, RD Watkins  
“Manually Positioned Focused Energy System Guided by Medical Imaging ”

US Patent #5526814  
HE Cline, RD Watkins  
“Automatically positioned focused energy system guided by medical imaging”

US Patent # 5275165  
RH Ettinger, HE Cline, RD Watkins, KW Rohling  
“Magnetic Resonance Guided Ultrasound Therapy System with  
Inclined Track to Move Transducers in a Small Vertical Space”

US Patent # 5247935  
HE Cline, RH Ettinger, RD Watkins, KW Rohling  
“Magnetic Resonance Guided Focused Ultrasound Surgery”

**Affiliations:**

Member of International Society for Magnetic Resonance in Medicine  
Member of IEEE Society of Ultrasonic, Ferroelectrics and Frequency Control  
Reviewer for International Society of Magnetic Resonance in Medicine  
Journal Reviewer for IEEE Transactions on Medical Imaging  
Journal Reviewer for International Journal of Computer Assisted Radiology and Surgery  
Prior Member of American Culinary Federation.