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: Gold, Garry E.

eRA COMMONS USER NAME: GOLD.GARRY

POSITION TITLE: Stanford: Professor, Department of Radiology and (by courtesy) Bioengineering and Orthopedics

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	FIELD OF STUDY
Stanford University, Stanford, CA	BS	1986	Electrical Engineering
Stanford University, Stanford, CA	MS	1988	Electrical Engineering
Stanford University, Stanford, CA	MD	1992	Medicine
Stanford University, Stanford, CA	Residency	1998	Department of Radiology
University of San Diego, San Diego CA	Fellow	1999	Department of Radiology

A. **Personal Statement**

I am a clinical musculoskeletal radiologist and researcher in imaging of osteoarthritis and musculoskeletal disease. I have a great deal of experience designing and testing imaging protocols for studies of joint disease and lead several NIH-funded projects in this area. I am an expert in quantitative and semi-quantitative analysis of joint features using both PET and MRI. My laboratory develops new methods for assessment of musculoskeletal diseases using imaging, often correlated with clinical outcomes, biomechanics, and other markers of joint disease. The overarching goal of my research is to develop new or improved advanced imaging techniques to better understand musculoskeletal diseases and to apply these techniques to clinically relevant problems. As a clinical radiologist, I assess images of patients with osteoarthritis in my everyday practice. I am the PI of the Stanford-GE Healthcare PET-MRI collaboration, and the head of the research PET-MRI program at Stanford. I hold longstanding collaborations with Drs. Delp, Giori, and Beaupre in imaging research involving PET and biomechanics. I have longstanding collaborations with Drs. Kogan, Gambhir, Larson, and Hargreaves on developing new imaging tools.

B. **Positions and Honors**

Positions

1988-1989 Research Assistant, Department of Electrical Engineering, Stanford University
1990-1991 Research Assistant, Department of Computer Science, Stanford University
1991-1992 Research Assistant, Department of Radiology, Stanford University Medical School
1992-1993 Resident, Department of Internal Medicine, Kaiser Medical Center, Santa Clara
1994-1998 Resident, Department of Radiology, Stanford University Medical Center
1995-1997 Research Fellow, Department of Radiology, Stanford University
1998-1999 Musculoskeletal Radiology Fellow and Clinical Faculty, Department of Radiology, UCSD
1999-2006 Assistant Professor, Department of Radiology, Stanford University
2006-2012 Associate Professor, Department of Radiology and (by courtesy) Bioengineering and Orthopedics, Stanford University
2012- Professor, Department of Radiology and (by courtesy) Bioengineering and Orthopedics, Stanford University
2017- Vice Chair of Research and Organization in Radiology at Stanford University

Honors

1986 Tau Beta Pi Engineering Honor Society

1988 Hewlett Packard Award for Outstanding Engineering Design Project
1991 Stanford Medical Scholars Research Grant
1992 Stanford Medical School Dean's Award for Research
1994 NIH Research Resident's Award
1995 International Society of Magnetic Resonance in Medicine Young Investigator Award
1996 Radiological Society of North America Roentgen Resident/Fellow Research Award
Radiological Society of North America Certificate of Merit (co-author)
1997 International Society of Magnetic Resonance in Medicine Young Investigator Award (Co-author)
American Roentgen Ray Society President's Award in Radiology
1998 Veteran's Affairs Young Investigator Award
1999 Society of Body Computed Tomography and MR Cum Laude Award
Medical Device Challenge Invention Challenge Winner
2001 Society of Body Computed Tomography and MRI Lauterbur Award (Best MRI Paper)
2002 Society of Body Computed Tomography and MRI Lauterbur Award
American Roentgen Ray Society President's Award in Radiology (Senior Author)
Society of Body Computed Tomography and MRI Lauterbur Award
2003 American Roentgen Ray Society President's Award (Senior Author)
2004 Society of Body Computed Tomography and MRI Cum Laude Award
2005 Society of Body Computed Tomography and MRI Lauterbur Award (Co-author)
2006 Society of Body Computed Tomography and MRI Lauterbur and Moncada Awards
2007 International Skeletal Society President's Medal
2008 Society of Body Computed Tomography and MRI Lauterbur and Moncada Awards
2009 Society of Body Computed Tomography and MRI Lauterbur and Cum-Laude Awards
2010 Society of Body Computed Tomography and MRI Young Investigator Award
2011 Fellow of the International Society of Magnetic Resonance in Medicine
Allan V. Cox Medal for Excellence in Undergraduate Research Mentoring
Society of Body Computed Tomography and MRI Young Investigator Award
2012 Academy of Radiology Research Distinguished Investigator Award
2013 Faculty of the Year, Radiology, Stanford University
2014 ISMRM Summa Cum Laude Award – Outstanding Paper
2015 American Institute for Medical and Biological Engineering College of Fellows
2016 13TH Annual Lodwick Award Recipient
2017 Osteoarthritis Research Society International Scholarship Recipient

Societies
ISMRM, RSNA, ARRS, ISS, SCBT/MR, OARSI

C. Contributions to Science

1. My early publications explored the use of ultrashort echo time MR imaging in the musculoskeletal system as well as other organ systems. Several tissues in the body, including cortical bone, tendon, ligament, menisci, and lung have extremely short T2 relaxation times. We were able to obtain MR signal on clinical scanners from these tissues that were previously invisible on MR systems due to rapid T2 relaxation times.
    a. Kogan F, Fan AP, Monu U, Iagaru A, Hargreaves BA, **Gold GE**. Quantitative imaging of bone-cartilage interactions in ACL-injured patients with PET-MRI. 2018 Jun;26(6):790-796. PMID: 29656143.
    b. **Gold GE**, Pauly J, Glover G, Moretto J, Macovski A, Herfkens R. Characterization of Atherosclerosis with a 1.5-T Imaging System. *J Magn Reson Imaging.* 1993 Mar-Apr; 3(2): 399-407. PMID: 8448403.
    c. **Gold GE**, Pauly J, Macovski A, Herfkens R. MR Spectroscopic Imaging of Collagen: Tendons and Knee Menisci. *Magn Reson Med.* 1995 Nov; 34(5): 647-54. PMID: 8544684.
    d. Larson PE, Gurney P, Nayak K, **Gold GE**, Pauly J, Nishimura D. Designing Long-T2 Suppression Pulses for Ultra-Short Echo Time (UTE) Imaging. *Magn Res Med.* 2006 Jul;56(1):94-103. PMID: 16724304. PMCID: PMC2942755.

2. Many of my contributions have focused on developing new MR imaging approaches to evaluate cartilage in the knee joint. We have worked to make MR more efficient or more accurate for clinical detection of cartilage defects and assessment of cartilage thickness, volume and physiology.

    a. Jordan CJ, McWalter EJ, Monu UD, Watkins RD, Chen W, Bangerter NK, Hargreaves BA, **Gold GE.** Variability of CubeQuant T1rho, Quantitative DESS T2, and Cones Sodium MRI in Knee Cartilage. *Osteoarthritis and Cartilage.* 2014 Oct; 22(10):1559-67. PMID: 25278065. PMCID: PMC4185151.
    b. **Gold GE**, Hargreaves BA, Vasanawala SS, Webb JD, Shimakawa AS, Brittain JH, Beaulieu CF. Articular cartilage of the knee: evaluation with fluctuating equilibrium MR imaging—initial experience in healthy volunteers. *Radiology*. 2006; 238(2): 712-8. PMID: 16436826.
    c. **Gold GE**, Reeder S, Yu H, Kornaat P, Shimakawa A, Johnson J, Beaulieu C, Brittain J. Articular Cartilage of the Knee: Rapid 3D MR Imaging at 3.0T with IDEAL Balanced Steady-State Free Precession – Initial Experience. *Radiology*. 2006 Aug; 240(2): 546-51. PMID: 16801369.
    d. Matzat SJ, McWalter EJ, Kogan F, Chen W, **Gold GE**. T2 Relaxation time quantitation differs between pulse sequences in articular cartilage. *J Magn Reson Imaging*. 2014 Sep. MID: 25244647. PMCID: PMC4369475.

3. In addition to improving efficiency of cartilage MRI, our lab has recently focused more closely on evaluation of joint tissue during the osteoarthritis process using quantitative MRI.

    a. Kogan F, Hargreaves BA, **Gold GE**. Volumetric multislice gagCEST imaging of articular cartilage: Optimization and comparison with T1rho. *Magn Reson Med.* 2016 Feb. PMID: 26923108.
    b. Keenan KE, Besier TF, Pauly JM, Han E, Rosenberg J, Smith RL, Delp SL, Beaupre GS, **Gold GE**. Prediction of glycosaminoglycan content in human cartilage by age, T1ρ, and T2 MRI. *Osteoarthritis Cartilage*. 2011 Feb; 19(2): 171-9. PMID: 21112409. PMCID: PMC3041640.
    c. Kogan F, Levine E, Chanudhari AS, Monu U, Epperson K, Oei EHG, **Gold GE**, Hargreaves BA. Simultaneous bilateral-knee MR imaging. Magn Reson Med 2017. Dec. Epub ahead of print. PMID: 29250856.
    d. Chaudhari AS, Black MS, Eijgenramm S, Wirth W, Maschek S, Sveinsson B, Eckstein F, Oei EHG, **Gold GE**, Hargreaves BA. Five-minute knee MRI for simultaneous morphometry and T2 relaxometry of cartilage and meniscus and semi-quantitative assessment using double echo steady state MRI. J Magn Reson Imaging 2017. Epub ahead of print. PMID 29090500.

4. Another significant area of contribution to science has been in imaging of weight bearing and moving joints using MRI and using these images to assess biomechanical properties of tissue. This has led to new insights as the cause of patellofemoral pain syndrome.

    a. **Gold GE,** Besier T, Draper C, Asakawa D, Delp S, Beaupre G. Weight-bearing MRI of Patellofemoral Cartilage Contact Area. *J Magn Reson Imaging.* 2004 Sept; 20:526-30. PMID: 15332263.
    b. Draper CE, Besier TF, Fredericson M, Santos JM, Beaupre GS, Delp SL, **Gold GE**. Differences in patellofemoral kinematics between weight-bearing and non-weight-bearing conditions in patients with patellofemoral pain. *J Orthop Res.* 2011 Mar; 29(3): 312-7. PMID: 20949442.
    c. Pal S, Besier TF, Beaupre GS, Fredericson MF, Delp SL, **Gold GE**. Patellar maltracking is prevalent among patellofemoral subjects with patella alta: an upright, weight-bearing MRI study. *J Orthop Res.* 2013 Mar; 31(3): 448-57 2013 Mar; 31(3):448-57 PMCID: 3562698.
    d. Draper CE, Fredericson M, **Gold GE**, Besier TF, Delp SL, Beaupre GS, Quon A. Patients with patellofemoral pain exhibit elevated bone metabolic activity at the patellofemoral joint. *J Orthop Res.* 2012 Feb;30(2):209-13. PMID: 21812024. PMCID: PMC3219799.

5. A final area of contribution has been in the emerging field of PET-MRI and PET-CT, particularly with applications to musculoskeletal disease. The paper below by Kogan et al. was a finalist for the ISMRM Young Investigator Award in 2017.

    a. Kogan F, Fan AP, McWalter EJ, Oei EHG, Quon A, **Gold GE**. PET/MRI of metabolic activity in osteoarthritis: A feasibility study. J Magn Reson Imaging. 2017 Jun;45(6):1736-1745. doi: 10.1002/jmri.25529. Epub 2016 Oct 31. PMID: 27796082.
    b. Draper CE, Fredericson MF, Besier TF, Delp SL, Beaupre GS, Quon A, **Gold GE**. Comparison of MRI and 18F-NaF PET/CT in patients with patellofemoral pain. *J Magn Reson Imaging.* 2012. Oct; 36(4):928-32. PMID: 22549985. PMCID: PMC3411864.

c. Iagaru A, Mittra E, Minamimoto R, Jamali M, Levin C, Quon A, **Gold GE**, Herfkens R, Vasanawala S, Gambhir S, Zaharchuk G. Simultaneous Whole-Body Time-of-Flight 18F FDG PET/MRI: A pilot Study Comparing SUVmax Values with PET/CT and Assessment of MR Image Quality. *Clinical Nuclear Medicine*. 2015 Jan. PMID: 25489952.
d. Kogan F, Fan AP, **Gold GE.** Potential of PET-MRI for imaging of non-oncologic musculoskeletal disease. *Quant Imaging Med Surg*. 2016 Dec. PMID: 28090451. PMCID: PMC5219958.

Complete List of Published Work in My Bibliography:

http://www.ncbi.nlm.nih.gov/sites/myncbi/garry.gold.1/bibliography/45404179/public/?sort=date&direction=ascending

D. Research Support

ACTIVE

1 R01 AR065248-01A1(PI: Gold) 04/1/15 – 02/28/19
Title: Weight-Bearing Imaging of the Knee Using C-Arm CT
Goals: Development of a new, non-invasive, quantitative, 3-dimensional image-based test that will evaluate the health of cartilage in the knee joint while a subject is standing in a weight-bearing position.
Role: Principal Investigator

5 R01 EB002524-09 (PI: Gold) 04/01/15 – 01/31/19
Title: Osteoarthritis: Quantitative Evaluation of Whole Joint Disease with MRI
Goals: This project seeks to use MRI to understand whole joint progression of Osteoarthritis
Role: Principal Investigator

5 K24 AR062068-04 (PI: Gold) 04/01/12 – 03/31/23
Title: Advanced MRI for Early Osteoarthritis
Goals: This project seeks to build a mentoring program for young investigators in patient-oriented research program on imaging in musculoskeletal disease.
Role: Principal Investigator

Advanced MR Applications Development - GE Healthcare (PI: Hargreaves) 04/01/08 – 03/31/20
Title: Advanced Musculoskeletal MRI
Goals: The aims of this project are to improve clinical musculoskeletal MRI through improved 3D bright-fluid imaging, sodium MRI of cartilage, imaging near metallic implants, ultrashort echo-time imaging of connective tissue, and contrast-enhanced imaging of rheumatoid arthritis
Role: Principal Investigator of Musculoskeletal Team

5 R01 AR063643-03 (PI: Hargreaves) 09/09/13 – 07/31/19
Title: Quantitative 3D Diffusion and Relaxometry MRI of the Knee
Goals: This work aims to develop a novel magnetic resonance imaging approach that offers three-dimensional imaging of knee structure as well as multiple quantitative measures that can be used to assess joint health.
Role: Co-Investigator

5 R01 EB017739-02 (PI: Hargreaves) 07/01/14 - 06/30/19
Title: Comprehensive MRI near Total Joint Replacements
Goals: This project seeks to make routine MRI available for patients with total hip replacements and total knee replacements, including fast, high-resolution imaging and temperature mapping.
Role: Co-Investigator

5 R01 AR052784-10 (PI: Chu) 07/01/12 - 06/30/19
Title: Enhanced Clinical Diagnosis of Early Osteoarthritis
Goals: This project seeks to make MRI evaluation of post-ACL injury better correlated with clinical outcomes.
Role: Co-Investigator

PET-MRI – GE Healthcare (PI: Gold) 09/04/14 - 08/31/18

Title: Advanced PET-MRI Research and Development Project
Goals: This project seeks to make PET-MR a routine application in neurological, body, and musculoskeletal imaging
Role: PI; Co-Investigator on imaging of pain project

Knee and Patellofemoral Overload – GE Healthcare (PI: Gold) 9/01/17-8/31/20
Title: Knee and Patellofemoral Overload and Articular Cartilage Injuries: The Advanced Imaging Protocol Study
Goals: Acquire high-quality advanced longitudinal MRI data in basketball players and correlate the microstructural changes seen in cartilage, meniscus, subchondral bone, tendon, and other tissues with activity tracking.
Role: Principal Investigator

PENDING

K24 AR062068 (PI: Gold) 04/01/18 – 03/31/23
Title: Advanced MRI for Early Osteoarthritis
Goals: This project seeks to build a mentoring program for young investigators in patient-oriented research program on imaging in musculoskeletal disease.
Role: Principal Investigator

COMPLETED

Zeego Flexibility – Siemens Medical Solutions (PI: Gold) 11/05/13-11/04/17
Title: Combined Investigations: Zeego Flexibility and Improvement Phase II
Goals: Extend the flexibility of the Zeego imaging platform, to allow the full testing of new detector technologies as they become available, and to develop new imaging protocols that fully exploit the new capabilities of the robotic platform.
Role: Principal Investigator

NIH 5U01-AG019069-04 (PI: Gold) 09/30/01 – 06/30/12
Title: Multi-Center Osteoarthritis Study
Goals: Longitudinal study of osteoarthritis
Role: Principal investigator on safety sub-contract. Overall project PI: Michael Nevitt, Ph.D.

NIH 1R01-AR049792-01 (PI: Andriacchi) 03/16/04 – 12/31/12
Title: Cartilage Morphology Relative to In-Vivo Knee Function
Goals: Cartilage biomechanics in the knee related to gait
Role: Co-investigator, imaging cartilage at high resolution with MRI

Arthritis Foundation IRG (PI: Gold) 10/01/10 – 09/30/13
Title: Sodium MRI of Post-Traumatic Arthritis
Goals: Improved MR Imaging after ACL Injury
Role: Principal Investigator

Evaluation of Fitness Algorithm – Samsung (PI: Gold) 04/21/14-04/20/15
Title: Evaluation of Fitness Algorithm
Goals: Evaluation of a new fitness-tracking algorithm in healthy volunteers
Role: Principal Investigator

5 PO1 CA159992-05 (PI: Butts-Pauly) 09/22/11 – 08/31/16
Title: MR-Guided HIFU of Soft Tissue Tumors
Goals: This project aims to develop and test controlled minimally invasive thermal ablation techniques for the treatment of cancers that are attributed to a quarter of cancer deaths. We aim to provide precise imaging, feedback, and control of the shape and size of thermal lesions.
Role: Project Co-Principal Investigator