

# Daehyun Yoon

*Research Associate, Radiology, Stanford University*

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## Education

2012 – **Ph.D. in Electrical Engineering, University of Michigan, Ann Arbor, Michigan.**

Joint design of RF and gradient waveforms for MRI parallel excitation. Advisors: Douglas C. Noll, Jeffrey A. Fessler.

2007 – **M.S. in Electrical Engineering, University of Michigan, Ann Arbor, Michigan.**

2004 – **B.S. in Computer Science & Engineering, Seoul National University, Seoul, South Korea.**

## Work Experience

2016 – Present

**Research Associate, Department of Radiology, Stanford University, Stanford, California.**

MRI Research on PET/MRI for chronic pain, peripheral nerve MRI, and metal artifact correction.

2012 – 2016

**Postdoctoral Fellow, Department of Radiology, Stanford University, Stanford, California.**

MRI Research on metal artifact correction, PET/MRI for pain, and peripheral nerve MRI.

2001- 2004

**Software engineer, MOCOCO Mobile solution department, Seoul, South Korea.**

Development of a GUI platform for handheld devices.

## Awards / Honors

- |      |   |
|------|---|
| 2016 | ISMRM merit award, magna cum laude for [18F] FDG PET/MRI of patients with chronic pain alters management: early experience.                 |
| 2014 | ISMRM merit award, summa cum laude for Fast SEMAC by separation of on-resonance and off-resonance signals                                   |
| 2009 | 1st place in Signal Processing in ECE poster presentations, Engineering Graduate Symposium, University of Michigan                          |
| 2005 | Doctoral Study Abroad Scholarship, the Korea Foundation for Advanced Studies  |
| 2004 | Summa cum laude for the B.S. degree   |
| 2004 | Jang Young Shil Award, 15th week in 2004, the Minister of Science and Technology, South Korea for developing an embedded GUI platform, REXY |
| 1999 | College student scholarship, the Korea Foundation for Advanced Studies  |

## Peer-Reviewed Journal Articles

1. Cipriano P, **Yoon D**, Holley D, Hargreaves B, Carroll I, Curtin C, Biswal S. Diagnosis and Successful Management of an Unusual Presentation of Chronic Foot Pain using PET/MRI and a Simple Surgical Procedure. Clin J Sport Med., 2019. Online available.
2. Sveinsson B, Gold G, Hargreaves B, **Yoon D**. SNR-Weighted Regularization of ADC Estimates from Double-Echo

- in Steady-State (DESS). *Mag. Res. Med.*, 2019; 81(1):711-718
3. Cipriano P, Lee S, **Yoon D**, Shen B, Tawfik V, Curtin C, Dragoo J, James M, McCurdy C, Chin F, Biswal S. Successful treatment of chronic knee pain following localization by a sigma-1 receptor radioligand and PET/MRI: a case report. *J. Pain Res.*, 2018;11:2353-2357.
  4. Kogan F, Broski S, **Yoon D**, Gold G. Applications of PET-MRI in Musculoskeletal Disease. *J. Magn. Reson. Imaging.*, 2018;48(1):27-47.
  5. Cipriano P, **Yoon D**\*, Gandhi H, Holley D, Thakur D, Ith M, Hargreaves B, Kennedy D, Smuck M, Cheng I, Biswal S. <sup>18</sup>F-FDG PET/MRI in Chronic Sciatica: Early Results Revealing Spinal and Non-spinal Abnormalities. *J. Nucl. Med.*, 2018; 59(6):967-972.
  6. **Yoon D**\*, Biswal S, Rutt B, Lutz A, Hargreaves B. Feasibility of 7T MRI for imaging fascicular structures of peripheral nerves. *Muscle Nerve*. 2018; 57(3):494-498.
  7. Hargreaves BA, Taviani V, Litwiller DV, **Yoon D**. 2D multi-spectral imaging for fast MRI near metal. *Mag. Res. Med.*, 2018; 79(2):968-973.
  8. Hjørnevik T, Cipriano PW, Shen B, Park JH, Gulaka P, Holley D, Gandhi H, **Yoon D**, Mitra ES, Zaharchuk G, Gambhir SS, McCurdy CR, Chin FT, Biswal S. Biodistribution and Radiation Dosimetry of <sup>18</sup>F-FTC-146 in Humans. *J. Nucl. Med.*, 2017; 58(12):2004-2009.
  9. Shen B, Park JH, Hjørnevik T, Cipriano PW, **Yoon D**, Gulaka PK, Holly D, Behera D, Avery BA, Gambhir SS, McCurdy CR, Biswal S, Chin FT. Radiosynthesis and First-In-Human PET/MRI Evaluation with Clinical-Grade [<sup>18</sup>F]FTC-146. *Mol. Imaging Biol.*, 2017; 19(5):779-786.
  10. Shi X, **Yoon D**, Koch KM, Hargreaves BA. Metallic Implant Geometry and Susceptibility Estimation Using Multi-spectral B0 Field Maps. *Mag. Res. Med.*, 2017; 77(6):2402-2413.
  11. Weber H, Taviani V, **Yoon D**, Ghanouni P, Pauly KB, Hargreaves BA. MR thermometry near metallic devices using multispectral imaging. *Mag. Res. Med.*, 2017; 77(3):1162-1169.
  12. Chun J, Peltier S, **Yoon D**, Manschreck TC, Deldin PJ. Prolongation of ERP latency and reaction time (RT) in simultaneous EEG/fMRI data acquisition. *Journal of Neuroscience Methods*, 2016; 268:78-86.
  13. Nielsen J, **Yoon D**, Noll DC. Small-tip fast recovery imaging using non-slice-selective tailored tip-up pulses and radiofrequency-spoiling. *Mag. Res. Med.*, 2013; 69(3):657-66.
  14. **Yoon D**, Fessler JA, Gilbert AC, Noll DC. Fast joint design method for parallel excitation radiofrequency pulse and gradient waveforms considering off-resonance. *Mag. Res. Med.*, 2012; 68(1):278-285.
  15. Yip C, **Yoon D**, Olafsson V, Lee S, Grissom WA, Fessler JA, Noll DC. Spectral-spatial pulse design for through-plane phase precompensatory slice selection in T2\*-weighted functional MRI. *Mag. Res. Med.*, 2009; 61(5):1137-47.

\*: featured on the cover of *Muscle & Nerve*, March 2018.

\*\* : co-first author.

## Journal Articles in Preparation

1. **Yoon D**, Bartret A, Cipriano P, Hargreaves B, Biswal S, Lutz A. Comparison of 3D DESS and 2D T2-weighted fast-spin-echo with fat saturation for imaging the lumbosacral plexus.
2. **Yoon D**, Xu Y, Cipriano P, Tawfik V, Curtin C, Carroll I, Biswal S. Musculoskeletal changes by complex regional pain syndrome on [<sup>18</sup>F]FDG PET/MRI
3. Choi S, **Yoon D**, Biswal S. Persistent metabolic activities near total hip replacements on [<sup>18</sup>F]FDG PET/CT
4. Doyle Z, **Yoon D**, Lee P, Hargreaves B, Beaulieu C, Stevens K. Comparison of Accelerated MAVRIC-SL with Robust-PCA and conventional MAVRIC-SL in Evaluation of Symptomatic Total Hip Arthroplasties
5. Sveinsson B, Gold G, Hargreaves B, **Yoon D**. Image denoising using shard information between gradient-spoiled and RF-spoiled steady-state signals

## Abstracts

1. Black M, **Yoon D**, Young K, Chaudhari A, Kogan F, Gold G, Levenston M, Hargreaves B. Detecting early changes in ACL-reconstructed knee cartilage: cluster analysis of t2 relaxation times in superficial and deep cartilage and ADC analysis. *Proc. Intl. Soc. Mag. Res. Med.*, p. 1322, 2019
2. Doyle Z, **Yoon D**, Lee P, Hargreaves B, Beaulieu C, Stevens K. Comparison of accelerated MAVRIC-SL with Robust-PCA and conventional MAVRIC-SL in evaluation of symptomatic total hip arthroplasties. *Proc. Intl. Soc. Mag. Res. Med.*, p. 4603, 2019
3. **Yoon D**, Xu Y, Cipriano P, Tawfik V, Curtin C, Carroll I, Biswal S. Neurovascular, muscle, and skin changes on

- [18F]FDG PET/MRI in foot complex regional pain syndrome (CRPS). Proc. Intl. Soc. Mag. Res. Med., p. 4345, 2019.
4. **Yoon D**, Choi S, Sveinsson B, Hargreaves B. The b-value dependence of apparent diffusion coefficient (ADC) values in knee cartilage. Proc. Intl. Soc. Mag. Res. Med., p. 1387, 2019
  5. **Yoon D**, Hargreaves B, Beaulieu Christopher, Lutz A. A 1x1x1 mm isotropic resolution CUBE-FLEX for imaging piriformis syndrome. Proc. Intl. Soc. Mag. Res. Med., p. 1352, 2019
  6. **Yoon D**, Cipriano P, Hjoernevik T, Holley D, Gandhi H, Tawfik V, Curtin C, Carroll I, McCurdy C, Hargreaves B, Chin F, Biswal S. Management of complex regional pain syndrome (CRPS) with [18F]FTC-146 PET/MRI. World Molecular Imaging Congress, 2018
  7. **Yoon D**, Xu Y, Cipriano P, Tawfik V, Curtin C, Carroll I, Biswal S. [18F]FDG PET/MRI shows higher sensitivity to neuromuscular changes due to complex regional pain syndrome (CRPS) than MRI. World Molecular Imaging Congress, 2018.
  8. Cipriano P, **Yoon D**, Carroll I, Curtin C, Tawfik V, Xu Y, Thakur D, Biswal S. [18F]FDG PET/MRI of patients with chronic pain alters management. World Molecular Imaging Congress, 2018.
  9. **Yoon D**, Bartret A, Cipriano P, Hargreaves B, Biswal S, Lutz A. Comparison of DESS and conventional clinical sequences for imaging the lumbosacral plexus. Proc. Intl. Soc. Mag. Res. Med., p. 5150, 2018.
  10. **Yoon D**, Khalighi M, Shi X, Gandhi H, Holley D, Biswal S, Hargreaves B. Robust MR-based attenuation correction for PET near metal implants. Proc. Intl. Soc. Mag. Res. Med., p. 3690, 2018.
  11. Lee P, **Yoon D**, Shi X, Hu Y, Levine E, Hargreaves B. Reformattable MAVRIC-SL using robust principal component analysis and variable density complementary Poisson disc sampling. Proc. Intl. Soc. Mag. Res. Med., p. 2686, 2018.
  12. Lee P, Shi X, **Yoon D**, Levine E, Hargreaves B. bin-SENSE: accelerated MRI with no additional hardware. Proc. Intl. Soc. Mag. Res. Med., p. 4220, 2018.
  13. **Yoon D**, Hargreaves B. Bi-exponential T2\* mapping of peripheral nerve from in-vivo human scans with a 3D UTE cones sequence. Proc. Intl. Soc. Mag. Res. Med., p. 5014, 2017.
  14. Taviani V, Mitsuharu M, Wang K, King K, Banerjee S, Biswal S, Vasanaawala S, **Yoon D**, Peter R. A flexible technique for flow-sensitive fat-suppressed high-resolution peripheral nerve imaging. Proc. Intl. Soc. Mag. Res. Med., p. 0096, 2017.
  15. **Yoon D**, Cipriano P, Hjoernevik T, Shen B, Holley D, Gandhi H, Tawfik V, Curtin C, Carroll I, McCurdy C, Hargreaves B, Chin F, Biswal S. Management of complex regional pain syndrome (CRPS) with p18[F]FTC-146 PET/MRI. Proc. Intl. Soc. Mag. Res. Med., p. 1164, 2017.
  16. Sveinsson B, Gold G, Hargreaves B, **Yoon D**. SNR-weighted regularization of ADC estimates using double-echo in steady-state. Proc. Intl. Soc. Mag. Res. Med., p. 1436, 2017.
  17. **Yoon D**, Stevens K, Hargreaves BA. T<sub>2</sub>-weighted Multispectral Imaging for Postoperative Imaging of Patients with Lumbar Spinal Fusion. Proc. Intl. Soc. Mag. Res. Med., p. 2260, 2016.
  18. **Yoon D**, Biswal S, Rutt BK, Lutz A, Hargreaves BA. High Resolution 3D Steady-State Imaging for Peripheral Nerves at 7T. Proc. Intl. Soc. Mag. Res. Med., p. 2290, 2016.
  19. Gold G, Sveinsson B, Epperson K, Chaudhari A, Alley M, **Yoon D**, Hargreaves B, Koga F. Comparison of DESS T<sub>2</sub> Relaxation Times and Apparent Diffusion Coefficient in Articular Cartilage at 3T and 7T. Proc. Intl. Soc. Mag. Res. Med., p. 0536, 2016.
  20. **Yoon D**, Behera D, Holley D, Gallant P, Ith MAM, Carroll I, Smuck M, Hargreaves BA, Biswal S. [18F]FDG PET/MRI of Patients With Chronic Pain Alters Management: Early Experience. Proc. Intl. Soc. Mag. Res. Med., p. 0883, 2016.
  21. Weber H, **Yoon D**, Taviani V, Pauly KB, Hargreaves BA. T1-Based MR Thermometry Close to Metal. Proc. Intl. Soc. Mag. Res. Med., p. 4056, 2015.
  22. Shi X, **Yoon D**, Koch KM, Hargreaves BA. Regularized Inversion of Metallic Implant Susceptibility from B0 Field Maps. Proc. Intl. Soc. Mag. Res. Med., p. 3734, 2015.
  23. **Yoon D**, Hargreaves BA. An improved complex image combination algorithm for SEMAC. Proc. Intl. Soc. Mag. Res. Med., p. 2513, 2015.
  24. Sveinsson B, Moran C, **Yoon D**, Gold G, Hargreaves BA. Quantitative ADC Mapping using DESS with Decreased T1 and Noise Sensitivity. Proc. Intl. Soc. Mag. Res. Med., p. 579, 2015.
  25. **Yoon D**, Taviani V, Worters P, Hargreaves BA. Fast SEMAC by Separation of On-Resonance and O<sub>-</sub>-Resonance Signals. Proc. Intl. Soc. Mag. Res. Med., p. 91, 2014.
  26. Hargreaves BA, Taviani V, **Yoon D**. Fast 2D Imaging for Distortion Correction Near Metal Implants. Proc. Intl. Soc. Mag. Res. Med., p. 615, 2014.
  27. Nielsen J, **Yoon D**, Noll DC. Rapid steady-state imaging with T1 and T2 weighting using non-slice-selective tip-up pulses. Proc. Intl. Soc. Mag. Res. Med., p. 2308, 2012.
  28. Zhao F, Fessler JA, Nielsen J, **Yoon D**, Noll DC. Regularized Estimation of Magnitude and Phase of Multiple-Coil

- B1 Field via Bloch-Siegert B1 Mapping. Proc. Intl. Soc. Mag. Res. Med., p. 2512, 2012
29. **Yoon D**, Jahanian H, Noll DC, Hernandez-Garcia L. Spatially Selective PCASL with Parallel Excitation. Proc. Intl. Soc. Mag. Res. Med., p. 2087, 2011.
  30. Nielsen J, **Yoon D**, Hollingsworth NA, Moody KL, McDougall MP, Wright SM, Noll DC. Joint Optimization of Tip-Down and Tip-Up RF Pulses in Small-Tip (Non-Spin-Echo) Fast Recovery Imaging. Proc. Intl. Soc. Mag. Res. Med., p. 209, 2011.
  31. **Yoon D**, Fessler JA, Gilbert AC, Noll DC. A fast parallel excitation pulse design for efficient selection and ordering of PE locations with B0 field inhomogeneity. Proc. Intl. Soc. Mag. Res. Med., p. 2902, 2011
  32. Peltier S, Chun J, Jonides B, **Yoon D**, Deldin PJ. Prolonged P300 latency and reaction time in different experimental conditions in simultaneous EEG/fMRI data acquisition. 16th Annual Meeting of the Organization for Human Brain Mapping. p. 1585, 2010
  33. Nielsen J, **Yoon D**, Noll DC. Suppression of banding and transient signal oscillations in balanced SSFP using a spoiled RF pre-phasing approach. Proc. Intl. Soc. Mag. Res. Med., p. 77, 2010.
  34. **Yoon D**, Fessler JA, Nielsen J, Gilbert AC, Noll DC. Non-convex greedy compressed sensing for phase contrast MRI. Proc. Intl. Soc. Mag. Res. Med., p. 4852, 2010.
  35. Nielsen J, **Yoon D**, Noll DC. Toward robust banding suppression in balanced SSFP using a two-pulse RF pre-phasing approach. ISMRM Workshop on Parallel MRI, 2009.
  36. **Yoon D**, Fessler JA, Gilbert AC, Noll DC. Simultaneous signal loss correction from B1 and B0 field inhomogeneity in BOLD fMRI with parallel excitation. ISMRM Workshop on Parallel MRI, 2009.
  37. Maleh R, **Yoon D**, Gilbert AC. Fast algorithm for sparse signal approximation using multiple additive dictionaries. SPARS Proceedings, 2009.
  38. **Yoon D**, Maleh R, Gilbert AC, Fessler JA, Noll DC. Fast selection of phase encoding locations in parallel excitation. Proc. Intl. Soc. Mag. Res. Med., p. 2595, 2009.
  39. Yip C, **Yoon D**, Olafsson V, Lee S, Grissom WA, Fessler JA, Noll DC. Spectral-spatial pulse design for through-plane phase precompensatory slice selection in T2\*-weighted functional MRI. Proc. Intl. Soc. Mag. Res. Med., p. 177, 2009.
  40. **Yoon D**, Grissom WA, Fessler JA, Noll DC. Toeplitz-based acceleration of RF pulse design for parallel excitation. Proc. Intl. Soc. Mag. Res. Med., p. 1312, 2008.

## Current Research Support

### Sponsored Project (PIs: Brian Hargreaves, Ph.D.)

5/1/2016 – 4/30/2020

General Electric Healthcare

*Advanced Body, Neuro, High-Field, Musculoskeletal and Pediatric MRI*

These projects are aimed at advancing neuro MRI, high-field MRI, vascular MRI, body MRI, and musculoskeletal MRI including a focus on cancer, MRI of osteoarthritis and connective tissue, MRI near orthopedic implants, and MRI of peripheral nerves through collaboration between GE researchers, MRI scientists and clinical radiologists.

Role: Co-Investigator on peripheral nerve and musculoskeletal projects.

### Sponsored Project (PIs: Sandip Biswal, M.D.)

9/1/2016 – 8/31/2020

General Electric Healthcare

*Validation of [18F]FDG PET/MR Neurography in the Identification of Chronic Pain Generators and Pain Treatment Success.*

The goal of this project is to use [18F]FDG and [18F]FTC-146 to identify foci of neural and other soft tissue inflammation in patients with a variety of pain syndromes including low back pain, osteoarthritis, cancer pain, fibromyalgia, etc., and correlate these findings of PET and MR neurography and pain behavior measurements. These findings will be acted upon, and repeat scanning will be performed to correlate therapeutic success.

Role: Co-Investigator

**R01 EB017739-01 (PI: Brian Hargreaves, Ph.D.)**

**7/1/14-6/30/19**

NIH / NIBIB

*Comprehensive MRI near Total Joint Replacements*

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

**R01 AR0063643-01 (PI: Brian Hargreaves, Ph.D.)**

**9/9/13-7/31/19**

NIH / NIAMS

*Quantitative 3D Diffusion and Relaxometry of the Knee*

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

**P41 EB015891-18 (PI: Gary Glover Ph.D.)**

**1/1/95 – 5/31/20**

NIH/NIBIB

*Center for advanced MR Technology at Stanford*

This Center will develop, maintain and make available innovative technologies in six core MRI research areas:

(1) image reconstruction, and RF pulse design methods, (2) high-field MRI, (3) body and vascular imaging (4) neurologic imaging and (5) metabolic MR imaging methods.

Role: Co-Investigator, Body (musculoskeletal) projects.

## **Pending Research Support**

**R01 RAR074626A (PI: Sandip Biswal, M.D)**

NIH/NIAMS

\$493,000

*PET/MRI for Persistent Postsurgical Pain Following Total Hip Replacement*

*Submitted Nov 2018, Review Feb 2019, Scored 8%.*

Role: Co-Investigator (50% of preparation)

## **Completed Research Support**

**R21 EB019723-01 (PIs: Brian Hargreaves, Ph.D., Pejman Ghanouni, M.D., Ph.D.) 9/26/14 – 6/30/17**

NIH / NIBIB

*MR Guided Focused Ultrasound Surgery near Metal Implants*

This research will develop new MRI techniques that work in the presence of metal so that focused ultrasound surgery procedures can be used in subjects with metallic implants.

Role: Co-Investigator.

**RSL innovation challenge grant (PI : Daehyun Yoon, Ph.D.)**

**5/1/15 – 4/30/16**

Department of Radiology, Stanford university.

*Development of MR neurography near metallic implants*

This research develops an MRI protocol to enable non-invasive monitoring of peripheral nervous system near metallic implants by tailoring the previously designed metal imaging sequences for optimal nerve contrast and devising a new image reconstruction algorithm for improved off-resonance correction.

Role: Principal Investigator.

## **Patent**

1. **US Patent 9791530B2.** Jon-Fredrik Nielsen, **Daehyun Yoon**, and Douglas C. Noll. Method of MRI imaging using

- non-slice-selective, spatially tailored tip-up pulse. October 17, 2017.
2. **(PENDING)** Hans Weber, **Daehyun Yoon**, Valentina Taviani, Brian A. Hargreaves. Quantitative MRI Measurements Near Metal Objects. (S15-046, Filed Apr 14, 2015)

## Invited Presentations

1. *Imaging of Chronic Pain in the Musculoskeletal System*. Hospital for Special Surgery. August 2018.
2. *PET/MRI for the management of chronic pain*. International Workshop Molecular and Cellular Imaging, Erasmus MC, Rotterdam, June 2018.
3. *Management of Chronic Pain Based on PET/MRI Findings*. GE Users' Meeting, Hawaii, April 2017.
4. *[18F] FDG PET/MRI for Chronic Pain*. GE Users' Meeting, Singapore, May 2016.

## Sessions Chaired

1. Diffusion Tensor Imaging Outside the Brain, ISMRM-ESMRMB Joint Annual Meeting, 2018.

## Publication Reviewer

1. Magnetic Resonance in Medicine (2015 – present)
2. Journal of Magnetic Resonance Imaging (2017 – present)
3. IEEE Transactions on Computational Imaging (2015 – present)

## Mentorship

PhD Students:

1. Bragi Sveinsson. EE. MR ADC mapping on knee cartilage. 2016 – 2017.
2. Xinwei Shi. EE. Metal Artifact Correction in MRI. 2015 – 2018.
3. Philip Lee. EE. Metal Artifact Correction in MRI. 2017 – present.

## Teaching Experience

1. Fall 2006 Discrete Signal Processing, Graduate Student Instructor
1. Winter 2007\* Discrete Signal Processing, Graduate Student Instructor
2. Fall 2007\* Signal and Systems, Graduate Student Instructor
3. Winter 2008\* Discrete Signal Processing, Graduate Student Instructor
4. Autumn 2015 MRI signals and Sequences (Rad229), Guest lecture on MR artifacts
5. Autumn 2018 MRI signal and Sequences (Rad229), Guest lecture on EPI

\*excellent performance recognized from the ECE department of University of Michigan