John M. Drago

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Education:

Harvard Medical School (HMS), Boston, MA — *July 2017 – Current*

Harvard/MIT MD-PhD Program

Candidate for MD degree, Expected May 2026

Massachusetts Institute of Technology (MIT), Cambridge, MA — *Sept 2020 – May 2025*

Ph.D. Electrical Engineering and Computer Science, 2025

Minor in Numerical Methods for PDEs

Thesis: Mitigating Inhomogeneity in High-Field MRI Excitations: Arbitrary Waveform Optimization and Multiphoton Parallel Transmission (MP-pTx)

S.M. Electrical Engineering and Computer Science, 2022

Thesis: Multiphoton Parallel Transmit MRI for Flip Angle Mitigation Without SAR Concerns

Massachusetts Institute of Technology, Cambridge, MA — *Sept 2013 – June 2017*

S.B. Mechanical Engineering, Minor in Biomedical Engineering

Research Experience:

Magnetic Resonance Physics & Instrumentation Group, Boston, MA — *Sept 2020 – Current*

Group at MGH Martinos Center focusing on the development and improvement of various imaging modalities

- Designed and implemented a GPU-accelerated numerical optimization framework for rapid, patient-specific slice-selective RF pulse design. Utilized advanced constrained nonlinear optimization techniques.
- Developed the multiphoton parallel transmission (MP-pTx) method to reduce high-field MRI system complexity and SAR concerns while improving flip angle homogeneity. Method takes advantage of MR multiphoton phenomenon to combine off-resonant RF excitations from a birdcage coil with fields from low-frequency parallel channels. Performed physics-informed optimization of both patient-specific and database-based pulses.
- Designed cost-effective, low-complexity hardware implementation for MP-pTx through the optimization of a universal, low-frequency, single-channel multiphoton coil. Utilized boundary element methods to compute optimal current patterns.
- Conducted functional neuroimaging time-series analysis with magnetic particle imaging (MPI) to assess cerebral blood volume changes during hypercapnia paradigms in non-human primates and rodents. Optimized transmit filter design to achieve a homogeneous 25 kHz magnetic drive field for high-sensitivity functional MPI.

MGH Bioengineering Laboratory, Boston, MA — *Nov 2017 – May 2020*

Research group focusing on in vivo mechanics and clinical outcomes of knee replacements

- Evaluated *in vivo* kinematics of novel knee replacement designs in patients undergoing a variety of functional tests to assess similarity to native knee biomechanics.
- Utilized machine learning/deep learning techniques for efficient 3D to 2D image registration of knee/hip replacements onto fluoroscopic image projections obtained during functional tests.

Grodzinsky Continuum Biomechanics Lab, Cambridge, MA — *June 2014 – Aug 2017*

Research lab at MIT focusing on problems of musculoskeletal system and connective tissue

- Evaluated biological pathways that contribute to onset of osteoarthritis through various lab techniques that track cell processes. Focused on potential therapeutics that reduce chondrocyte apoptosis and cartilage degradation.
- Designed experiments to culture murine supraspinatus tendons *in vitro* under constant tensile load. Designed and built a mechanical apparatus to hold tendons at precise strain levels for biomechanical compression testing.

Compiled: Sept 2025

Manuscripts:

1. **JM Drago**, G Guryev, N Arango, E Adalsteinsson, B Guerin, LL Wald. "The Ritz Adjoint Method for MRI Pulse Design." **(under review)**

2. **JM Drago**, B Guerin, JP Stockmann, LL Wald. "Multiphoton Parallel Transmission (MP-pTx): Pulse design methods and numerical validation." *Magn Reson Med.* 2024. PMID: 38899391. DOI: 10.1002/MRM.30116.

3. EE Mason, E Mattingly, K Herb, SF Cauley, M Sliwiak, **JM Drago**, M Graeser, ET Mandeville, JB Mandeville, LL Wald. "Functional magnetic particle imaging (fMPI) of cerebrovascular changes in the rat brain during hypercapnia." *Phys Med Biol.* 2023. PMID: 37531961. DOI: 10.1088/1361-6560/acecd1.

4. E Mattingly, EE Mason, K Herb, M Sliwiak, **JM Drago**, M Graeser, LL Wald. "A sensitive, stable, continuously rotating FFL MPI system for functional imaging of the rat brain." *Int J Mag Part Imag.* 2022. PMID: 39726832. DOI: 10.18416/IJMPI.2022.2212001.

5. C Klemt, **JM Drago**, V Tirumala, YM Kwon. "Asymmetrical Tibial Polyethylene Geometry-cruciate retaining total knee arthroplasty does not fully restore in-vivo articular contact kinematics during strenuous activities." *Knee Surg Sports Traumatol Arthrosc.* 2021. PMID: 33388940. DOI: 10.1007/s00167-020-06384-9.

6. C Klemt, **JM Drago**, R Oganesyan, I Yeo, YM Kwon. "Gait and Knee Flexion In-Vivo Kinematics of Asymmetric Tibial Polyethylene Geometry Cruciate Retaining Total Knee Arthroplasty." *J Knee Surg.* 2020. PMID: 33111271. DOI: 10.1055/s-0040-1718681.

Conference Papers and Abstracts:

1. E Kazemivalipour, **JM Drago**, B Guerin, LL Wald. "Control of radiated emissions during MRI using parallel transmit: a path to eliminating the Faraday shielded room for 0.5T imaging." IEEE Engineering in Medicine and Biology Society Annual Meeting. Copenhagen, Denmark. July 14-17, 2025.

2. **JM Drago**, G Guryev, N Arango, B Guerin, LL Wald. "The Ritz adjoint method for optimization of arbitrary waveform excitation pulses: Demonstration in slice-selective parallel transmission." International Society for Magnetic Resonance in Medicine Annual Meeting. Honolulu, Hawaii, USA. May 10-15, 2025. **Awarded *magna cum laude* merit award (top 15%).**

3. B Guerin, **JM Drago**, J Herrler, LL Wald, JP Stockmann. "Slice-selective universal pulses for brain imaging at 7 Tesla using a birdcage coil." International Society for Magnetic Resonance in Medicine Annual Meeting. Honolulu, Hawaii, USA. May 10-15, 2025.

4. B Guerin, **JM Drago**, J Herrler, LL Wald, JP Stockmann. "Slice-selective, large flip-angle parallel transmission pulses for brain imaging at 7 Tesla." International Society for Magnetic Resonance in Medicine Annual Meeting. Honolulu, Hawaii, USA. May 10-15, 2025.

5. E Kazemivalipour, **JM Drago**, LL Wald. "Analysis of patch, dipole, microstrip, and loop Tx arrays as a bore-tube integrated 7T body coil." International Society for Magnetic Resonance in Medicine Annual Meeting. Honolulu, Hawaii, USA. May 10-15, 2025.

6. AC Barksdale, FH Niebel, J Chacon-Caldera, M Śliwiak, **JM Drago**, E Mattingly, M Graeser, HP Deng, JB Mandeville, LL Wald. "Measurement of cerebral blood volume modulation in non-human primates." International Workshop on Magnetic Particle Imaging. Lübeck, Germany. March 17-19, 2025.

7. **JM Drago**, M Davids, JP Stockmann, B Guerin, LL Wald. "A Universal B_z Coil for Uniform Multiphoton Excitation in High-Field MRI". International Society for Magnetic Resonance in Medicine Annual Meeting. Singapore. May 4-9, 2024. **Awarded *summa cum laude* merit award (top 5%).**

8. **JM Drago**, B Guerin, LL Wald. "Universal Design of Multiphoton Parallel Transmission (MP-pTx) Pulses for Uniform, High-Flip Angle Excitations". International Society for Magnetic Resonance in Medicine Annual Meeting. Singapore. May 4-9, 2024. **Awarded *magna cum laude* merit award (top 15%).**

9. E Mattingly, EE Mason, M Sliwiak, K Herb, A Barksdale, **JM Drago,** J Chacon-Caldera, ET Mandeville, JB Mandeville, LL Wald. "Functional magnetic particle imaging (MPI) in the rat brain and first images from a human-scale MPI." Annual Meeting of the Organization for Human Brain Mapping. Montreal, Canada. July 22-26, 2023.

10. **JM Drago**, B Guerin, SF Cauley, LL Wald. "Multiphoton Parallel Transmission (MP-pTx)." International Society for Magnetic Resonance in Medicine Annual Meeting. Toronto, Canada. June 3-8, 2023.

11. E Mattingly, EE Mason, K Herb, M Sliwiak, **JM Drago**, ET Mandeville, JB Mandeville, LL Wald. "Magnetic particle imaging of cerebrovascular functional changes in rats." World Molecular Imaging Congress. Miami, FL. September 28 - October 1, 2022.

12. **JM Drago**, EE Mason, E Mattingly, M Śliwiak, LL Wald. "Image Time-Series Stability for MPI-Based Functional Neuroimaging." International Workshop on Magnetic Particle Imaging. Digital Conference from Würzburg, Germany. March 21-23, 2022.

13. E Mattingly, M Śliwiak, **JM Drago**, EE Mason, M Graeser, LL Wald. "A drive filter design for MPI with harmonic notching and selective damping." International Workshop on Magnetic Particle Imaging. Digital Conference from Würzburg, Germany. March 21-23, 2022.

14. AC Barksdale, EE Mason, E Mattingly, M Śliwiak, **JM Drago**, LL Wald. "Shift coil assembly for a rotating permanent magnet FFL human-scale fMPI Imager." International Workshop on Magnetic Particle Imaging. Digital Conference from Würzburg, Germany. March 21-23, 2022.

15. C Klemt, V Tirumala, **J Drago**, W Boonyanuwat, W Chen, K Xiong, YM Kwon. "Two-Stage Reimplantation in Patients Requiring an Interim Spacer Exchange for Periprosthetic Joint Infection is Associated with Poorer Functional Outcomes." AAOS Annual Meeting. Orlando, FL. March 24-28, 2020.

16. BK Connizzo, **JM Drago**, EH Frank, AJ Grodzinsky. "Static Tensile Strain Does Not Alter Tendon Response To Joint Inflammation In A Murine Explant Model." BMES Annual Meeting. Philadelphia, PA. October 16-19, 2019.

17. C Klemt, P Arauz, S An, **J Drago**, A Wang, A Veith, S Limmahakhun, YM Kwon. "In-Vivo Kinematics Of Asymmetrical Bearing Geometry Cruciate Retaining Total Knee Arthroplasty During High Knee Flexion Activities." EFORT Congress. Lisbon, Portugal. June 5-7, 2019.

18. **J Drago**, P Arauz, C Klemt, S An, A Wang, A Veith, S Limmahakhun, YM Kwon. "*In Vivo* Contact Kinematic Comparison of Asymmetrical Bearing Geometry Cruciate Retaining Total Knee Arthroplasty and the Native Knee During Gait." ORS Annual Meeting. Austin, TX. February 2-5, 2019.

19. **J Drago**, P Arauz, C Klemt, S An, A Wang, A Veith, S Limmahakhun, YM Kwon. "*In Vivo* 6-DOF Assessment of Knee Kinematics During a High Flexion Lunge: A Comparison Between Asymmetrical Bearing Geometry Cruciate Retaining Total Knee Arthroplasty and Contralateral Native Knee." ORS Annual Meeting. Austin, TX. February 2-5, 2019.

20. P Arauz, C Klemt, S An, **J Drago**, A Wang, A Veith, S Limmahakhun, YM Kwon. "In-vivo Articular Contact Analysis during Step-Ups in Patients with Asymmetrical Bearing Geometry Cruciate Retaining Total Knee Arthroplasty." ORS Annual Meeting. Austin, TX. February 2-5, 2019.

21. P Arauz, C Klemt, S An, **J Drago**, A Wang, A Veith, S Limmahakhun, YM Kwon. "In-vivo Kinematics during Gait in Asymmetrical Bearing Geometry Cruciate Retaining Total Knee Arthroplasty." ORS Annual Meeting. Austin, TX. February 2-5, 2019.

22. C Klemt, P Arauz, S An, **J Drago**, A Wang, A Veith, S Limmahakhun, YM Kwon. "In-vivo Kinematics of Asymmetrical Bearing Geometry Cruciate Retaining Total Knee Arthroplasty during High Knee Flexion Activities." ORS Annual Meeting. Austin, TX. February 2-5, 2019.

23. P Arauz, C Klemt, S An, **J Drago**, A Wang, A Veith, S Limmahakhun, YM Kwon. "In-vivo Articular Contact Analysis during Functionally Strenuous Activities in Patients with Asymmetrical Bearing Geometry Cruciate Retaining Total Knee Arthroplasty." ORS Annual Meeting. Austin, TX. February 2-5, 2019.

24. A Veith, S Limmahakhun, P Arauz, C Klemt, S An, **J Drago**, A Wang, YM Kwon. "Does Posterior Tibial Slope Impact Anterior Cruciate Ligament Bundle Stress in Bi-Cruciate Retaining Total Knee Arthroplasty?" ORS Annual Meeting. Austin, TX. February 2-5, 2019.

25. BK Connizzo, HM Zlotnick, **JM Drago**, AJ Grodzinsky. "Development of an *In Vitro* Bone-Tendon-Muscle Explant Culture Model." BMES Annual Meeting. Phoenix, AZ. October 11-14, 2017.

26. Y Wang, S Wan, **J Drago**, FM White, AJ Grodzinsky. "Phosphoproteomics analysis of signaling changes in human chondrocytes following treatment with IL-1, IGF-1 and dexamethasone." OARSI World Congress on Osteoarthritis. Las Vegas, NV. April 27-30, 2017.

Talks:

1. "Mitigating Inhomogeneity in High-Field MRI Excitations: the Ritz Adjoint Method for Patient-Specific Optimization." MGB Hampton-Abrams Symposium. Boston, MA. March 28, 2025.

2. "The Adjoint Method for MRI Pulse Design: Demonstration in Ritz methods." MIT Computational Science and Engineering Seminar Series. Cambridge, MA. February 14, 2025.

3. "The Ritz Adjoint Method for pTx Pulse Design". Siemens Healthineers pTx Pulse Design Group. Virtual (Erlangen, Germany). January 28, 2025.

4. "A Universal B_z Coil for Uniform Multiphoton Excitation in High-Field MRI." International Society for Magnetic Resonance in Medicine Annual Meeting. Singapore. May 7, 2024.

5. "Universal Design of Multiphoton Parallel Transmission (MP-pTx) Pulses for Uniform, High-Flip Angle Excitations." International Society for Magnetic Resonance in Medicine Annual Meeting. Singapore. May 7, 2024.

Patents:

1. LL Wald, **JM Drago**, BG Guerin. "An optimized multiphoton excitation coil for MRI." Internal Case No. MGH 2024-119. 2024.

2. LL Wald, **JM Drago**, BG Guerin. "Multi-photon parallel transmit for MRI excitation." Internal Case No. MGH 2022-528. 2022.

Teaching:

HST.164: Principles of Biomedical Imaging, Teaching Assistant *IAP 2021, 2022, 2023, 2024*
Reviewed and updated course content. Led students in labs focused on physics of MRI acquisition. Developed course website. Course focused on mathematical understanding of various imaging modalities.

6.7300: Introduction to Modeling and Simulation, Teaching Assistant *Fall 2022*
Reviewed and updated course content. Held weekly office hours for students. Graded course material. Course focused on computational techniques for modeling and simulation of dynamical, linear/nonlinear systems.

6.022: Quantitative Systems Physiology, Teaching Assistant *Spring 2017*
Assistant teaching instructor for MIT class, modeling fluid, electricity, and mass flow through various organ systems.

Service:

Harvard Medical School Admissions Committee, Member *Aug 2023 – Current*
Evaluate candidates for admission to Pathways MD track at Harvard Medical School. Served on the HMS Main Admissions Committee during the 2024–2025 and 2025–2026 academic years.

MIT Health Consumers' Advisory Council, Member *Sept 2022 – May 2025*
Graduate student representative on committee that advised MIT Health on provided services and outreach to MIT community.

MIT DAPER Advisory Board, Member *Sept 2022 – May 2025*
Graduate student representative on committee that advised Department of Athletics, Physical Education and Recreation on serving the MIT community.

MIT EECS Visiting Committee Graduate Student Group, Member *Feb 2024 – April 2024*
Identified improvement areas for graduate student experience within EECS Department. Along with other group members, wrote report and presented in front of EECS Visiting Committee, which reports on departmental improvements to MIT Corporation and senior administration.

Harvard Medical Student Review, Associate Editor *Apr 2019 – May 2023*
Reviewed technical content and scientific rigor of submitted articles for publication.

MGH Principal Clinical Experience, Education Rep *Oct 2018 – Sept 2019*
Served as representative to clerkship administration and faculty regarding educational curriculum at MGH.

HMS Financial Aid Committee, Member *Sept 2017 – Sept 2018*
Served as student representative on committee to advocate for financial well-being of students to members of HMS administration.

HMS Student Council, Member *Sept 2017 – Sept 2018*
Helped organize and run events and initiatives for student body.

MIT IFC Sexual Misconduct Committee, Inaugural Chair *Feb 2016 – June 2017*
Led development of educational programming and incentives with MIT administrators and IFC to promote fraternity participation in sexual assault prevention and consent awareness training.

MIT Student and Affiliates Health Insurance Advisory Committee, Student Rep *Sept 2014 – June 2017*
Undergraduate member of committee advising on insurance costs and plan offerings for the MIT community. Analyzed historical data to propose competitive rates, gathered student feedback, and coordinated with campus leadership to communicate proposed changes.

MIT Committee on the Hobby Shop, Student Rep *Sept 2016 – Aug 2017*
Undergraduate representative on committee designed to improve a maker space at MIT.

MIT Women's Technology Program in Mechanical Engineering, Mentor *July 2016, July 2017*
Mentored two program participants in creation of poster to be presented for Mechanical Engineering Department viewing.

MIT Athletic Trainer Search Committee, Member *June 2016 – Aug 2016*
Helped identify and select candidates to fulfill position opening. Collaborated with Institute administration, coaches, staff, and students to select best candidates for MIT community.

Boston Marathon, Volunteer *Apr 2016, Apr 2017*

Other Activities:

MIT Varsity Baseball *Aug 2013 – June 2017*
2014 & 2015 NEWMAC Champions. ECAC Champions 2016. NCAA Northeast Regional Tournament 2014 & 2015. CoSIDA Academic All-American, 2016 & 2017. NEWMAC All-Conference 2014 & 2016, and NEWMAC Rookie of the Year, 2014.

Honors and Awards:

- Tau Beta Pi Engineering Honor Society
- Pi Tau Sigma Mechanical Engineering Honor Society
- 2025 ISMRM Annual Meeting *Magna Cum Laude* Recognition Recipient
- 2024 ISMRM Annual Meeting *Summa Cum Laude* and *Magna Cum Laude* Recognition Recipient
- 2022 NIH F30 Award Recipient
- 2020 Thomas (1959) and Sarah Kailath Fellowship recipient, awarded by MIT EECS Department
- 2017 MIT Change Maker Award Recipient
- 2016, 2017 CoSIDA Academic All-American
- 2015, 2016, 2017 CoSIDA Academic All-District Baseball Team
- 2015, 2016, 2017 Academic All-NEWMAC Baseball Team
- 2017 Chi Phi Spaur Scholarship Recipient
- 2016 2nd Team All-NEWMAC
- 2015 Chi Phi Sparks Medal Recipient
- 2014 NEWMAC Rookie of the Year
- 2014 1st Team All-NEWMAC
- 2014 D3Baseball.com All-Region Team
- 2013 United States Marine Corps Distinguished Athlete Award
- 2013 National Football Federation, Arizona Scholar Athlete
- 2006 Fiesta Bowl Aerospace Challenge Winner