Matthew B. Applegate

Curriculum Vitae

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NCBI Bibliography

Current Work

- I am currently working as an Experiential AI Fellow at Northeastern University with Jennifer Dy. My work sits at the intersection of biomedical imaging and machine learning. I seek to use new machine learning algorithms to reduce the size, increase the speed, and lower the cost of reflectance confocal microscopy (RCM) imaging devices. RCM is currently used to diagnose skin cancer and monitor suspicious lesions in specialized cancer centers. Low-cost RCM powered by AI has the potential to expand access to cutting-edge skin cancer imaging tools to clinics around the world.

Education

2016 **PhD, Biomedical Engineering**, *Tufts University*.
Thesis title: Sculpting with light: light/matter interaction in biocompatible polymers

2009 **BS, Electrical Engineering**, *Cornell University*.
Concentration in Signal Processing

Publications in preparation

- "Frequency Domain Diffuse Optical Spectroscopy (FD-DOS) for evaluation of the sternocleidomastoid muscle during isometric flexation" with Raeef Istfan

Peer-reviewed Publications (J numbers are links)

2021

J29 **Applegate MB**, Robert Amelard, Gómez CA, Roblyer D. "Real-time handheld probe tracking and image formation using digital frequency-domain diffuse optical spectroscopy" with Robert Amelard. IEEE Transactions on Biomedical Engineering. 68(11): 3399, 2021

J28 **Applegate MB**, Gómez CA, Roblyer D. "Modulation frequency selection and efficient look-up table inversion for Frequency Domain Diffuse Optical Spectroscopy." *Journal of Biomedical Optics* 26(3) 036007, 2021

J27 **Applegate MB**, Spink SS, Roblyer D, "Dual-DMD hyperspectral spatial frequency domain imaging (SFDI) using dispersed broadband illumination with a demonstration of blood stain spectral monitoring," *Biomedical Optics Express* 12(1): 676, 2021

2020

J26 **Applegate MB**, Istfan RE, Spink S, Tank A, Roblyer D, "Recent advances in high speed diffuse optical imaging in biomedicine," *APL Photonics* 5(4): 040802, 2020

J25 **Applegate MB**, Karrobi K, Angelo JP, Austin W, Tabassum SM, Aguénounon E, Tilbury K, Saager RB, Gioux S, Roblyer D, "OpenSFDI: an open-source guide for constructing a spatial frequency domain imaging system," *J. Biomed. Opt.* 25(1): 016002, 2020

2019

J24 Hariri LP, Adams DC, **Applegate MB**, Miller AJ, Roop BW, Villiger M, Bouma BE, Suter MJ, "Distinguishing Tumor from Associated Fibrosis to Increase Diagnostic Biopsy Yield with Polarization-Sensitive Optical Coherence Tomography" *Clinical Cancer Research* 25(17): 5242, 2019

J23 Adams DC, Miller AJ, **Applegate MB**, Cho JL, Hamilos DL, Chee A, Holz JA, Szabari MV, Hariri LP, Harris RS, Griffith JW, Luster AD, Medoff BD, Suter MJ, "Quantitative assessment of airway remodelling and response to allergen in asthma," *Respirology* 24: 1073, 2019

2018

J22 **Applegate MB**, Zhao Y, Istfan R, Roblyer D, "Quantitative real-time pulse oximetry with ultrafast frequency-domain diffuse optics and deep neural network processing" *Biomedical Optics Express*. 9(12): 5997, 2018

J21 **Applegate MB**,Roblyer D, "Multi-distance diffuse optical spectroscopy with a single optode via hypotrochoidal scanning" *Optics Letters*. 43(4): 747-50, 2018

2017

J20 **Applegate MB**, Roblyer D. "High-speed spatial frequency domain imaging with temporally modulated light" *Journal of Biomedical Optics*. 22(7): 076019, 2017

J19 Franklin AM, **Applegate MB**, Lewis SM, Omenetto FG. "Stomatopods detect and assess achromatic cues in contests" *Behavioral Ecology*. 28(5): 1329-36, 2017

J18 Tseng P, Napier B, Zhao S, Mitropoulos AN, **Applegate MB**, Marelli B, Kaplan DL, Omenetto FG. "Directed assembly of bio-inspired hierarchical materials with controlled nanofibrillar architectures" *Nature Nanotechnology*. 12(5): 474-80, 2017

J17 Tseng P, Zhao S, Golding AS, **Applegate MB**, Mitropoulos AN, Kaplan DL, Omenetto FG. "Evaluation of Silk Inverse Opals for 'Smart' Tissue Culture" *ACS Omega*. 2(2): 470-7, 2017

J16 Landry MJ, **Applegate MB**, Bushuyev OS, Omenetto FG, Kaplan DL, Cronin-Golomb M, Barrett CJ. "Photo-induced structural modification of silk gels containing azobenzene side groups" *Soft Matter*. 13(16): 2903-6, 2017

2016

J15 Partlow BP, **Applegate MB**, Omenetto FG, Kaplan DL. "Dityrosine Cross-Linking in Designing Biomaterials" *ACS Biomaterials Science & Engineering*. 2(12): 2108-21, 2016

J14 **Applegate MB**, Alonzo C, Georgakoudi I, Kaplan DL, Omenetto FG. "A simple computational model of multiphoton micromachining in silk hydrogels" *Applied Physics Letters*. 108(24): 241903, 2016

J13 **Applegate MB**, Partlow BP, Coburn J, Marelli B, Pirie C, Pineda R, Kaplan DL, Omenetto FG. "Photocrosslinking of silk fibroin using riboflavin for ocular prostheses." *Advanced Materials*. 28(12): 2417-20, 2016

J12 Zhao S, Chen Y, Partlow BP, Golding AS, Tseng P, Coburn J, **Applegate MB**, Moreau JE, Omenetto FG, Kaplan DF. "Bio-functionalized silk hydrogel microfluidic systems." *Biomaterials*. 93: 60-70, 2016

J11 Brenckle MA, Partlow BP, Tao H, **Applegate MB**, Reeves A, Paquette M, Marelli B, Kaplan DL, Omenetto FG. "Methods and applications of multilayer silk fibroin laminates based on spatially controlled welding in protein films." *Advanced Functional Materials*. 26(1): 44-50, 2016

2015

J10 **Applegate MB**, Coburn J, Partlow BP, Moreau JE, Mondia J, Marelli B, Kaplan DL, Omenetto FG. "Laser-based 3-dimensional multiscale micropatterning of biocompatible hydrogels for customized tissue engineering scaffolds." *Proceedings of the National Academy of Sciences*. 112(39): 12052-7, 2015

J9 **Applegate MB**, Perotto G., Kaplan DL, Omenetto FG. "Biocompatible silk step-index optical waveguides." *Biomedical Optics Express*. 6(11): 4221-7, 2015

J8 Mitropoulos A, Marelli B, Ghezzi CE, **Applegate MB**, Partlow BP, Kaplan DL, Omenetto FG. "Transparent, nanostructured silk fibroin hydrogels with tunable mechanical properties." *ACS Biomaterials Science & Engineering*. 1(10): 964-70, 2015

2014

J7 Partlow BP, Hannah CW, Rnjak-Kovacina J, Moreau JE, **Applegate MB**, Burke KA, Marelli B, Mitropoulos AN, Omenetto FG, Kaplan DL. "Highly tunable elastomeric silk biomaterials." *Advanced Functional Materials*. 24(29): 4615-24, 2014

2013

J6 **Applegate MB**, Marelli B, Kaplan DL, Omenetto FG. "Determination of multi-photon absorption of silk fibroin using the Z-scan technique." *Optics Express*, 21, 29637–42, 2013

J5 Hariri LP, **Applegate MB**, Mino-Kenudson M, Mark EJ, Medoff BD, Luster AD, Bouma BE, Tearney GJ, Suter MJ, "Volumetric optical frequency domain imaging of pulmonary pathology with precise correlation to histopathology." *Chest Journal*, 143(1): 64-74, 2013.

J4 Hariri LP, Mino-Kenudson M, **Applegate MB**, Eugene MJ, Tearney GJ, Lanuti M, Channick CL, Chee A, Suter MJ. "Towards the guidance of transbronchial biopsy: Identifying pulmonary nodules with optical coherence tomography." *Chest Journal*, 144(4): 1261-8, 2013.

J3 Hariri LP, Villager M, **Applegate MB**, Mino-Kenudson M, Mark EJ, Bouma BE, Suter MJ. "Seeing beyond the Bronchoscope to Increase the Diagnostic Yield of Bronchoscopic Biopsy." *American Journal of Respiratory and Critical Care Medicine*, 187(2): 125-9, 2013.

2012

J2 Hariri LP, **Applegate MB**, Mino-Kenudson M, Mark EJ, Bouma BE, Tearney GJ, Suter MJ. "Optical Frequency Domain Imaging of Ex vivo Pulmonary Resection Specimens: Obtaining One to One Image to Histopathology Correlation." *Journal of Visualized Experiments: JoVE*, 71, 2012.

J1 Tan KM, Shishkov M, Chee A, **Applegate MB**, Bouma BE, Suter MJ. "Flexible transbronchial optical frequency domain imaging smart needle for biopsy guidance." *Biomedical Optics Express*, 3(8): 1947-54, 2012.

Other Publications

O2 **Applegate MB**, Brenckle MA, Marelli BM, Tao H, Kaplan DL, Omenetto FG. "Silk: A different kind of 'fiber optics'," *Optics and Photonics News*. June 2014. (cover)

O1 **Applegate MB**, Hariri LP, Beagle J, Tan KM, Chee C, Hales CA, Suter MJ. "Assessment of smoke inhalation injury using volumetric optical frequency domain imaging in sheep models," *Proc. of the SPIE* 8207, 2012.

Honors & Awards

2019 **Awardee**, *NIH F32 Ruth L. Kirschstein National Research Service Award (NRSA) Individual Postdoctoral Fellowship*.
National 2-year fellowship

2017 **3rd place**, *Poster competition*.
ECI Advances in Optics for Biotechnology XV Conference

2015 **Recipient**, *Incubic Milton Chang Student Travel Grant*.
International

2014 **Awardee**, *National Defense Science and Engineering Graduate Fellowship*.
National 3-year fellowship

2014 **Winner**, *Tufts University Graduate Student Research Competition*.
University-wide

2013 **Honorable Mention**, *National Science Foundation Graduate Research Fellowship*.
National

2012 **Recipient**, *Stern Fellowship, Tufts University*.
College of Engineering 2-year fellowship

Invited Talks

2016 **"Photostructuring silk biomaterials"**, *Institute for Theoretical Atomic, Molecular, and Optical Physics (ITAMP) seminar*.
Harvard University

2016 **"'Subtractive' 3D printing via multiphoton absorption in silk hydrogels"**, *SelectBio Conference*.
Boston, MA

Presentations

2021 **Frequency-Domain Diffuse Optical Spectroscopy with Real-time Data Visualization for Monitoring of Breast Neoplasms**, *Photonics West*, Held virtually due to COVID.
Oral presentation

2021 **Frequency Selection in Frequency Domain Diffuse Optical Spectroscopy**, *Photonics West*, Held virtually due to COVID.
Oral presentation

2020 **High-speed Frequency Domain Diffuse Optical Spectroscopy for Rapid Assessment of Breast Neoplasms**, *OSA Biophotonics Congress: Biomedical Optics*, Held virtually due to COVID.
Oral presentation

2018 **Hyperspectral spatial frequency domain imaging (HS-SFDI) for monitoring rapid changes in tumor oxygenation**, *SPIE Photonics West*, San Francisco, CA.
Podium Presentation

2018 **Real-time diffuse optical B-mode Imaging (DOBI) for cancer monitoring**, *SPIE Photonics West*, San Francisco, CA.
Podium Presentation

2017 **High-speed spatial frequency domain imaging with temporally modulated light**, *ECI Advances in Optics for Biotechnology XV*, Snowmass, CO.
Poster Presentation

2015 **Biocompatible silk fibroin optical waveguides**, *Advanced Photonics Congress*, Boston,MA.
Podium Presentation

2015 **3D laser ablation of silk fibroin hydrogels for biomedical applications**, *Conference on Lasers and Electro-Optics (CLEO)*, San Jose, CA.
Podium Presentation

2013 **Direct Laser Writing of Three Dimensional Microscale Features in Silk Fibroin Hydrogels**, *Biomedical Engineering Society (BMES) Annual Meeting*, Seattle, WA.
Podium Presentation

2009 **A novel method of electrothermal weed control**, *Cornell University Undergraduate Research Symposium*, Ithaca, NY.
Poster Presentation

Teaching Experience

2014 **Teaching Assistant**, *Tufts University*.
Design of Medical Instrumentation

2013 **Teaching Assistant**, *Tufts University*.
Systems Biology

2011 **Volunteer Math Tutor**.

2009 **Volunteer Math Tutor**, *Tompkins Learning Partners*.

Service

2018–2020 **Instructor**, *Artemis Project Summer Program*, Boston University.

2017 **Reviewer**, *Journal of Biomedical Optics*.

2016 **Reviewer**, *Applied Physics Letters: Photonics*.

2014–2015 **Reviewer**, *Graduate Student Research Competition*, Tufts University.

2015 **Vice President**, *Optical Society of America Student Chapter*, Tufts University.

2015 **Optics Outreach**, *O-mazing Optics*, Discovery Museum, Acton, MA.

2014 **Optics Outreach**, *Community Day*, Tufts University.

Research Experience

2017–present **Diffuse optical spectroscopic imaging (DOSI), spatial frequency domain imaging (SFDI)**.
Boston University

2012–2016 **Nonlinear Optics, Microscopy, Multiphoton Micromachining, Biopolymers, Photopolymerization, Tissue Engineering Scaffolds**.
Tufts University

2010–2012 **Optical Coherence Tomography (OCT), Lung Biology**, *Suter Lab*.
Massachusetts General Hospital

2009 **Organic Cropping Systems**.
Cornell University

Relevant skills

Electronics

- Firmware design
- DSP in FPGA
- PCB Design
- PCB Layout

Optics

- FD diffuse optics
- Spatial frequency domain imaging
- Beam alignment
- Optical coherence tomography
- Supercontinuum generation
- Microscopy
- Micromachining
- Interferometry

Programming

- C++
- VHDL
- Python
- Matlab
- LabView
- R
- ImageJ
- LaTeX

Biomaterials

- Mechanical testing
- SEM
- 3D printing
- Biopolymer processing