BIOGRAPHICAL SKETCH

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NAME: Fang, Qianqian

eRA COMMONS USER NAME (credential, e.g., agency login): qfang1

POSITION TITLE: Associate Professor, Northeastern University

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 MM/YYYY	FIELD OF STUDY
Univ. of Elec. Sci.&Tech. of China, Sichuan, China	B. Eng.	07/1999	Electrical Engineering
Dartmouth College, Hanover, NH	Ph.D.	06/2005	Biomedical Engineering
Massachusetts General Hospital, Charlestown, MA	Postdoctoral	06/2009	Biomedical Engineering

A. Personal Statement

I am a researcher working in the field of biomedical optics with specific interests in multi-modality imaging, computational imaging methods, functional optical brain imaging and neuroimaging data informatics. Over the past years, I have received highly competitive research grants from the NIH, Massachusetts Life Sciences Center, Gates Foundation and US Agency for International Development, and have published over 50 journal papers with an h-index of 30. Specifically, I have led the development of a multi-modal breast imaging system for early detection of breast cancer. With my collaborations with Philips Healthcare and strong preliminary data including over 470 patients [a], I have received an NIH R01 grant to further develop this technique, making us well position towards the clinical translation of this technology. Furthermore, I have published one of the first papers on GPU-accelerated Monte Carlo (MC) simulation algorithm for 3D photon transport simulations [b]. My paper has received over 600 citations; the associated software (http://mcx.space) was widely disseminated among the biophotonics community across the world, driving the development of novel optical imaging systems and enabling exploration of complex biological systems. My paper on a new MC algorithm – mesh-based MC [c,d] – had also topped the most-downloaded papers in a premier journal for 5 consecutive months in 2013. In addition, my works on 3-D mesh generation from medical images [e,f] and the associated software, Iso2Mesh, has also been widely cited among a broad research community. In 2015, my USAID-funded project on developing non-contact mobile-phone based pulse oximeter was named as one of the 30 leading innovations in the Innovation Countdown 2030 (http://ic2030.org/) Initiative's inaugural report.

a. **Fang Q**, Selb J, Carp SA, Kopans DB, Moore RH, Brooks DH, Miller EL, Boas DA (2011). "Combined optical and tomosynthesis breast imaging," Radiology, (**front-cover**), 258(1), 89-97. PMCID: PMC3009384
b. **Fang Q** and Boas D, (2009) "Monte Carlo simulation of photon migration in 3D turbid media accelerated by graphics processing units," Optics Express (**featured**), 17(22), 20178-20190. PMCID: PMC2863034
c. **Fang Q**, (2010) "Mesh-based Monte Carlo method using fast ray-tracing in Plücker coordinates," Biomed. Optics Exp., 1(1), 165-175. PMCID: PMC3003331, URL: http://mcx.space/#mmc
d. **Fang Q*** and Yan S, (2019) "Graphics processing unit-accelerated mesh-based Monte Carlo photon transport simulations," J. of Biomedical Optics, 24(11), 115002, PMCID: PMC6863969.
e. **Fang Q** and Boas D, (2009) "Tetrahedral mesh generation from volumetric binary and gray-scale images," Proc. of IEEE Int. Symp. on Biomed. Img. (ISBI), pp. 1142-1145, http://iso2mesh.sf.net
f. Tran AP†, Yan S†, **Fang Q***, (2020) "Improving model-based fNIRS analysis using mesh-based anatomical and light-transport models," Neurophotonics, 7(1), 015008, PMCID: PMC7035879.

B. Positions and Honors

Positions and Employment

2000-2005	Research Assistant, Thayer School of Engineering, Dartmouth College, NH
2005-2009	Research Fellow, Martinos Center for Biomedical Imaging, Mass. General Hospital (MGH), MA
2009-2012	Instructor of Radiology, Harvard Medical School, MGH Martinos Center, MA
2012-2015	Assistant Professor of Radiology, Harvard Medical School, MA
2015-2020	Assistant Professor, Dept. of Bioengineering, Northeastern University, MA
2015-	Affiliated faculty, Dept. of ECE, Northeastern University, MA
2020-	Associate Professor, Dept. of Bioengineering, Northeastern University, MA

Other Experience and Professional Memberships

2004-2007	Member, IEEE, Engineering in Medicine and Biology Society (IEEE-EMBS)
2007-	Member, SPIE, International Society for Optical Engineering
2007	Guest Associate Editor, Medical Physics
2008-	Member, OSA, Optical Society of America
2009	Grant Reviewer, NIH
2009	Session co-chair, SPIE Photonics West, Multimodal Biomedical Imaging IV
2010	Reviewer, Natural Sciences and Engineering Research Council of Canada
2010-	Associate Editor, International Journal of Microwave Science and Technology
2011	Session co-chair, SPIE Photonics West, Multimodal Biomedical Imaging VI
2011-2012	Reviewer, Romanian National Council for Scientific Research
2012	Organizing committee, session co-chair, IEEE Int. Conf. on Comp. Photography 2013
2013-2018	Conference organizing committee, SPIE Photonics West, Multimodal Biomedical Imaging
2014	Conference organizing committee, 40th Annual Northeast Bioengineering Conference (NEBEC)
2014	Conference organizing committee, OSA Signal Recovery & Synthesis (SRS) meeting
2015	Grant Reviewer, ZRG1 SBIB-Z* Study Section, National Institutes of Health (NIH)
2017	Grant Reviewer, ZRG1 SBIB-Q* Study Section, National Institutes of Health (NIH)
2018-	Full Conference Chair, SPIE Photonics West, Multimodal Biomedical Imaging Conference
2019-2020	Conference organizing committee, OSA Biophotonics Congress 2020
2019-2020	Conference organizing committee, fNIRS 2020
2019-	Associate Editor, Journal of Biomedical Optics
2020	Grant Reviewer, ZNS1 SRB-S*, National Institutes of Health (NIH)
2020	Grant Reviewer, ZEB1 OSR-E*, National Institutes of Health (NIH)

C. Contribution to Science

Complete List of Published Work (h-index: 30, i10-index: 46 - according to Google Scholar):
https://www.ncbi.nlm.nih.gov/myncbi/qianqian.fang.1/bibliography/public/

1. **Multi-modal breast imaging combining diffuse optical tomography with x-ray mammography** - Early diagnosis of breast cancer is critically important. However, the current clinical standard, x-ray mammography, is poor in specificity. Over the past decade, my colleagues and I have been working on a new method to find breast cancers by combining safe, non-invasive near-infrared diffuse optical imaging with the high-resolution x-ray mammography [a]. Since 2005, I have been leading this research and conducted a 450-patient clinical study in collaboration with Dr. Daniel Kopans from MGH Avon Center. With my innovative image reconstruction algorithms [b,c], we have demonstrated the potential to differentiate malignant from benign lesions using the functional and structural information together. Our findings were highlighted as a front-cover article in *Radiology* [d]. In 2011, I received an award from Mass. Life Science Center (MLSC) to accelerate the clinical translation of this technique in collaboration with Philips Healthcare (Andover, MA). My project was highlighted by MA then-Governor Deval Patrick in his speech during the "Friends of Cancer Research" forum in Washington D.C. in 2014. In 2016, I was awarded an R01 by the NIH to develop the next-generation breast tomography system using compressive imaging approach.

    a. **Fang Q**, Carp SA, Selb J, Boverman G, Zhang Q, Kopans DB, Moore RH, Brooks DH, Miller EL, Boas DA, (2009). "Combined optical Imaging and mammography of the healthy breast: optical

contrast derives from breast structure and compression," IEEE Trans. on Medical Imaging, 28(1), 30-42. PMCID: PMC2642986

b. Deng B, Brooks DH, Boas DA, Lundqvist M, and **Fang Q**, (2015) "Characterization of structural-prior guided optical tomography using realistic breast models derived from dual-energy x-ray mammography," Biomed. Opt. Express 6(7), 2366-2379, PMCID: PMC4505695

c. **Fang Q**, Moore RH, Kopans DB, Boas DA (2010), "Compositional-prior-guided image reconstruction algorithm for multi-modality imaging," Biomedical Optics Express, 1(1), 223-235. PMCID: PMC3005170

d. **Fang Q**, Selb J, Carp SA, Kopans DB, Moore RH, Brooks DH, Miller EL, Boas DA (2011). "Combined optical and tomosynthesis breast imaging," Radiology, (front-cover article), 258(1), 89-97. PMCID: PMC3009384

2. **GPU-based Monte Carlo light transport and applications to neuroscience** - The rapid advance in General Purpose Graphics Processing Units (GP-GPU) has unleashed revolutionary power of massively parallel computing and is impacting every aspect of medical imaging at present. In 2009, I reported one of the first works using GPUs to accelerate 3D photon transport simulations [a]. My code reported a 300- to 1000-fold acceleration and was considered "game-changing" by Dr. Simon Arridge (UCL) – a pioneer in optical tomography. In 2010, I published a novel mesh-based Monte Carlo algorithm [b]. This paper became the most downloaded paper for Biomed. Optics Express in 5 consecutive months in 2013. So far, these works have attracted over 1,150 citations, over 2,400 registered users and 30,000 downloads worldwide. My MC algorithm is considered one of the most accurate tools for modeling light propagation inside human brains [b] and was widely used by the fNIRS research community for developing new imaging platforms [c] and neuroimaging studies [d].

   a. **Fang Q** and Boas D, (2009) "Monte Carlo simulation of photon migration in 3D turbid media accelerated by graphics processing units," Optics Express (featured), 17(22), 20178-20190. PMCID: PMC2863034, URL: http://mcx.space

   b. **Fang Q**, (2010) "Mesh-based Monte Carlo method using fast ray-tracing in Plücker coordinates," Biomed. Optics Exp., 1(1), 165-175. PMCID: PMC3003331, URL: http://mcx.space/#mmc

   c. Chen J, **Fang Q**, Intes X (2012), "Mesh-based Monte Carlo method in time-domain widefield fluorescence molecular tomography," J. of Biomed. Optics, 17(10), 106009, PMCID: PMC3569407

   d. Cassano P, Tran AP, Katnani H, Bleier BS, Hamblin MR, Yuan Y, **Fang Q**, (2019) "Selective photobiomodulation for emotion regulation: model-based dosimetry study," Neurophotonics 6(1) 015004 PMCID: PMC6366475

3. **3-D mesh generation from medical images and mesh-based brain modeling** – In 2007, I created Iso2Mesh [a] – one of the widely adopted open-source mesh generators that can create high-quality surface and volumetric mesh models from medical images. As of today, this work has received over 510 citations; the number of registered users of Iso2Mesh exceeded 4,500 originated from over 165 regions/countries. Iso2Mesh is currently included/embedded in many of the most popular neuroimaging data analysis platforms, such as FieldTrip and Lead-DBS [b], and play crucial roles in these data processing pipelines. In addition, our group has developed extensive workflows in generating high-quality multi-layered brain mesh models [c,d]. This work is shared as an open-source toolbox, Brain2Mesh, and is widely adopted for quantitative neuroimaging analysis.

   a. **Fang Q** and Boas D, (2009) "Tetrahedral mesh generation from volumetric binary and gray-scale images," Proc. of IEEE Int. Symp. on Biomed. Img. (ISBI), pp. 1142-1145, http://iso2mesh.sf.net

   b. A. Horn, M. Reich, J. Vorwerk, N. Li, G. Wenzel, **Q. Fang**, T. Schmitz-Hübsch, R. Nickl, A. Kupsch, J. Volkmann, A.A. Kühn, M.D. Fox, (2017), "Connectivity predicts deep brain stimulation outcome in Parkinson's disease," Ann. Neurol. 10.1002/ana.24974, PMCID: PMC5880678

   c. Tran A and **Fang Q**, (2017) "Fast and high-quality tetrahedral mesh generation from neuroanatomical scans," arXiv:1708.08954v1 [physics.med-ph], URL: https://arxiv.org/abs/1708.08954

   d. Tran AP, Yan S, **Fang Q**, (2019) "Improving model-based fNIRS analysis using mesh-based anatomical and light-transport models," Neurophotonics 7(1), 015008, PMCID: PMC7035879

4. **Three-dimensional microwave tomography** - Between 2000 and 2005, I was part of the research team that has pioneered 3D microwave tomography for *in-vivo* human imaging [a]. I dedicated my early research career, as a PhD candidate, to the development of viable 3D microwave tomography imaging algorithms. I studied numerical methods and proposed several novel approaches such as multi-spectral reconstructions [b], hybrid 2D/3D algorithm and adjoint method [c], singular spectra analysis, and an analytical framework for phase-unwrapping. These advances have made 2D microwave imaging hundreds times faster and 3D microwave imaging clinically viable [d]. These methods are now widely used in microwave imaging research.

    a. Meaney PM, Fanning MW, Raynolds T, Fox CJ, **Fang Q**, Kogel CA, Poplack SP, Paulsen KD (2007), "Initial Clinical Experience with Microwave Breast Imaging in Women with Normal Mammography," Acad Radiol., 14(2), 207-218, PMCID: PMC1832118.
    b. **Fang Q**, Meaney PM, Paulsen KD, (2004) “Microwave image reconstruction of tissue property dispersion characteristics utilizing multiple frequency information”, IEEE Trans. on Microwave Theory and Techniques, 52(8), 1866-1875.
    c. **Fang Q**, Meaney PM, Geimer SD, Streltsov AV, Paulsen KD, (2004) “Microwave image reconstruction from 3D fields coupled to 2D parameter estimation”, IEEE Trans. on Medical Imaging, 23(4), 475-484.
    d. **Fang Q**, Meaney PM, Paulsen KD, (2010) “Viable three-dimensional microwave imaging, theory and experiments,” IEEE Trans. on Antennas and Propagation, 58(2), 449– 458. PMCID: PMC2844097

D. Research Support

<u>Ongoing Research Support</u>

R01-EB026998 Fang(PI) 09/21/18 – 07/31/21
NIH/NINDS/NIBIB 2 academic months 1.0 summer month/year $301,018
<u>Next-generation optical brain functional imaging platform</u>
The proposed study aims to develop the next generation advanced optical brain imaging platform (AOBI), featuring a wireless, modular, fiberless and wearable functional near-infrared spectroscopy (fNIRS) head-gear design, highly-scalable 3D-aware flexible optical modules, GPU-accelerated tomographic image reconstructions.
Role: PI

2R01-GM114365 (renewal) Fang (PI) 08/01/20 – 07/31/24
NIH/NIGMS 2 academic months and 1.2 summer month/year $380,800
<u>GPU-Accelerated Monte Carlo photon transport simulation platform</u>
By further extending, solidifying and disseminating our widely distributed GPU-accelerated Monte Carlo light transport modeling platform, we aim to make a broad impact and set a new standard in our community for developing innovative biophotonics techniques, exploring complex biological systems, facilitating reproducible research and promoting efficient collaboration among the research community.
Role: PI

R01- CA204443 Fang (PI) 05/01/16 – 04/30/21
NIH/NCI 1.0 summer month/year $257,715
<u>A versatile high-performance optical mammography co-imager</u>
The proposed study aims to develop a versatile high-performance optical mammography co-imager (OMCI) that can bring functional breast tumor diagnosis to any existing (and future) 2D or 3D x-ray digital mammography system worldwide.
Role: PI

<u>Completed Research Support</u>

R01-GM114365 Fang (PI) 05/01/15 – 04/30/20

NIH/NIGMS 2 academic months and 1.0 summer month/year $380,800
GPU-Accelerated Monte Carlo photon transport simulation platform
By further extending, solidifying and disseminating our widely distributed GPU-accelerated Monte Carlo light transport modeling platform, we aim to make a broad impact and set a new standard in our community for developing innovative biophotonics techniques, exploring complex biological systems, facilitating reproducible research and promoting efficient collaboration among the research community.
Role: PI

AMD Kaeli/Fang (PI) 06/01/19 – 05/31/20
Advanced Micro Devices, Inc. (AMD) 0.2 summer month/year $90,000
Optimized Photon Transport Modeling for ROCm platform
One of the largest CPU/GPU makers, AMD, funds us to specifically optimize our widely disseated Monte Carlo eXtreme (MCX) photon transport simulation platform to run efficiently on their ROCm platform.
Role: Co-PI

R01-CA187595 Carp (PI) 04/01/15 – 03/31/20
NIH/NCI
Dynamic optical imaging biomarkers of tumor response to therapy
The goal of this study is to validate that the variation in tissue total hemoglobin concentration (HbT) and hemoglobin oxygen saturation (SO_2) following a change in breast compression are prognostic and are predictive biomarkers for breast cancer neoadjuvant chemotherapy monitoring.
Role: Co-Investigator

AID-OAA-F-15-00009 Fang (PI) 04/01/15 – 03/31/17
USAID (US Agency for International Development) – Saving Lives at Birth Award
Non-contact Mobile Oximeter for Rapid Birth Asphyxia and Childhood Pneumonia Assessment
We aim to develop a non-invasive infrared-based oximeter attachment for a mobile phone to enable non-contact and rapid assessment of a newborn and mother's blood oxygen level and respiratory rate (RR) during or after the childbirth.
Role: PI

AID-OAA-F-15-00018 Hibberd (PI) 02/01/15 – 01/31/17
USAID (US Agency for International Development) – Saving Lives at Birth Award
Thermal Images on Smartphones to Diagnose Bacterial Neonatal Pneumonia in Pakistan
We will clinically validate a mobile phone thermal imaging attachment prototype for detecting childhood pneumonia in Pakistan.
Role: Co-Investigator