



Imaging Science Interdisciplinary Research Theme
2018 Year End Report



2018 Imaging Science IRT Annual Report

IRT Scope and Mission

The Imaging Science IRT will provide the following services to the community:

The Imaging Science IRT seed grant program supported ten collaborative projects. Results from these projects have led directly to one funded NIH proposal and seven pending or planned proposal submissions.

The Imaging Science IRT faculty led four (> \$1.0M) funded proposals (\$8.8M total), two pending proposals (\$5.0M total), and two proposals that were not funded and will be resubmitted (\$5.5M total).

The Imaging Science IRT faculty have enhanced the reputation of CU in the community through high-impact publications, keynote addresses at international conferences, conference organization, and numerous invited lectures.

Seed Grant Summary

Development of a Photoacoustic Imaging System

PI: Mark Borden (several collaborators)

The seed grant provided funding for a research collaboration between two postdoctoral

target through a turbulent atmosphere, but this equipment has not yet arrived, but is expected shortly.

3D Super-Resolution via Multiple-Scattering Waves

PI: Rafael Piestun

We have submitted a NIH R21 proposal with a new international collaborator and developed a novel approach for imaging through scattering with excellent resolution.

Next Steps and Anticipated Milestones

Seed grant program: the next round of seed funding will support new collaborative efforts that have the potential to lead to large scale funding opportunities. Proposals will be due at the end

Carol Cogswell has an ongoing collaboration with a microscope R&D company in Denver called "Intelligent Imaging Innovations (3i)." This work is funded in part by a Colorado Advanced Industries Accelerator award (2017-2018).

Mark Borden: 3-Party agreement put in place between CU Boulder, University of Florence and X-Phase for research using an open-platform ultrasound system (ULA-OP)

Mark Borden started a research collaboration with Acertara, Longmont, CO.

Mark Borden started a research collaboration with Medtronic, Boulder, CO.

Bob McLeod: AlignTech, world's largest user of 3D printing, is part of an NSF GOALI proposal and has started licensing discussions.

Bob McLeod is working with Oculus Research on materials for augmented reality.

Todd Murray established a new collaboration with LLNL, was a partner on an internal proposal (LDRD), and received funding to develop new inspection techniques for advanced manufacturing

Technology transfer, IP generation, and start-ups

Patents

Carol Cogswell: provisional patent filed: European National Phase Application Based on PCT Patent Application No. PCT/US2017/022600 Entitled "Super-Resolution Imaging of Extended Object" (2018)

Won Park: patent awarded: W. Park, T. Flaig, X. Yang, L.-J. Su and K. Emoto, "Multifunctional nanomaterials for treatment of cancer", United States Patent 10,052,393 (Aug. 21, 2018)

Svenja Knapp filed provisional patent application on "High-resolution magnetographic camera based 1 0 0 1 1083 Tm0 g0 GU0(o)-5(rd)4(en)12(st).04 Tf12 00 1 1ETQ G(b)31Q/F1 11.04 Tf1 0 0 1 181.1 665.02

National/International Recognition

Ted Randolph's work on machine learning strategies for analysis of flow microscopy images of aggregated protein within therapeutic protein formulations and the relationships of these aggregates with clinical safety profiles won the Ebert Prize. The Ebert Prize, established in 1873, is the oldest pharmacy award in existence in the United States. They have been asked not to announce this award until the American Pharmacist Association makes the official announcement early next year, but there will be some press coverage at that point.

Mahmoud Hussein is the Founding Vice President of the International Phononics Society (IPS)

Mahmoud Hussein was Elected Fellow of ASME

Rafael Piestun delivered Keynote talk at LANE conference in Germany.

Rafael Piestun co-chaired the

Svenja Knapp gave an invited lecture at the Kolloquium des Institutes für Microsystemtechnik der Universität Freiburg/Germany, 2018, "Magnetic Imaging with Microfabricated Optically Pumped Magnetometers"

Svenja Knapp gave an invited lecture at the International Workshop on Advanced Magnetometry for Defense Applications, 2018, Adelaide/Australia, "Microfabricated optically-pumped magnetometers for imaging applications"

Bob McLeod: Invited talk at LLNL on "Transport effects in photo responsive polymer gels"

Bob McLeod: Invited talk at Oculus Research on "Holographic Photopolymers"

Rafael Piestun gave an invited talk at the Latin America Optics & Photonics Conference (Lima)

Rafael Piestun gave an invited talk at the European Optical Society Biennial Meeting (Delft)

Kelvin Wagner: Editorial Board for 3-D research

Kelvin Wagner: Conference Program Committee for Information Photonics 2019

Carol Cogswell was voted as the first "Conference Chair Emeritus" by the SPIE society

Carol Cogswell is an ongoing member of the International Advisory Committee of Focus on Microscopy (one of the leading international conferences on optical microscopy).

Stephen Becker was invited to give a short-course at Cambridge this June on optimization

Mark Borden was funded by GIAN to give a 1-week short course on "Microbubbles for Biomedical Applications" at the India Institute of Technology in Gandhinagar

Mark Borden was appointed to Scientific Committee for the European Contrast Ultrasound Symposium

Mark Borden was Elected to the Technical Program Committee for the International Ultrasound Symposium

Mark Borden was invited to give a master class on ultrasound contrast agents at the International Ultrasound Symposium in Kobe, Japan (October 21-25, 2018)

Mark Borden: Agreement for Scientific and Cultural Exchange put in place between CU Boulder and the University of Florence

Mark Borden: Session Chair, Ultrasound Mediated Agent Delivery, 2018 IEEE IUS, Kobe, Japan

Mark Borden: Session Chair, Emulsions Bubbles & Foams, 2018 American Chemical Society, Colloids and Surface Science Symposium, Penn State

Mark Boden: Invited Talk, 2018 American Institute of Ultrasound in Medicine, New York, NY

Mark Borden: Two Invited Talks, 2018 Acoustical Society of America, Victoria, Canada.

- x Mark Borden: Graduate student Alec Thomas completed his PhD on acoustic droplet vaporization for ultrasound imaging, and accepted a postdoctoral to the Technical Progra(T)9(echn)49:xf4 Tf1 0d64 27878

Fatemeh Pourahmadian gave an invited lecture to the bureau of Reclamation in April on emerging imaging technologies for sensitive infrastructures. This work will be published in their State of the Art report to come out this December.

Multi-department proposals/projects (> \$1M)

Mahmoud Hussein was awarded as PI (Multi-department) a grant from ARPA-E to develop a new type of thermoelectric device (nanophononic thermoelectric device). Project is for 3 years and is in collaboration with NIST and Colorado School of Mines 2.5M (funded)

Svenja Knapp- DARPA N3: "Multifocal Integrated Non-Invasive Device for Sensing and Stimulation (MINDSS)" subcontract to Teledyne Scientific; with Prof. Daniel Barth (Dept. Neuroscience and Psychology) CU portion: Phase 1: \$1.1M (funded), Phase 2: \$780K, Phase 3: \$670K

Mark Borden, PI: Air Force, Supporting Study to Transform En Route Care Phase 3, 10/2018-9/2024, \$3.7M. (funded)

Bob McLeod (PI) was funded by Oculus, "High Performance Holographic Photopolymers for Augmented Reality," \$1.5M (funded)

Corey Ne (PI) NIH 2 R01 AR063712-07 / Probing Osteoarthritis Pathogenesis by Noninvasive Imaging of Cartilage Strain, 4/2019-3/2024 (This renewal application received a percentile score of 1.0) Goal: To utilize novel noninvasive imaging methods of measuring articular cartilage biomechanics to predict osteoarthritis pathogenesis in vivo following anterior cruciate ligament transection. Total funds requested: \$3.1M (pending,)

IRT Members Todd Murray (PI), Mark Borden, Daria Kotys-Schwartz, Stephen Becker, Rafael Piestun, Fatemeh Pourahmadian, Andrew Goodwin, and Mahmoud Hussein; NSF NRT: Focusing Waves on Information, Safety, and Health, nBT/F20(rd(n)3(n)4(g)7(,)JTJET)7(0912 0 612 792 reW* nBTn(w)-16(4

APPENDIX
IRT Members

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