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TITLE: Trimodal Mammography with Perfect Coregistration

PRINCIPAL INVESTIGATOR: Ke Li

RECIPIENT: University of Wisconsin System
Madison, WI 53715-1218

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Fort Detrick, Maryland 21702-5012

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6. AUTHOR(S)
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5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

University of Wisconsin System
Madison, WI 53715-1218

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U.S. Army Medical Research and Materiel Command
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13. SUPPLEMENTARY NOTES

14. ABSTRACT
This project aims at developing a trimodel x-ray mammography imaging system to improve both sensitivity and specificity in breast cancer screening and diagnosis, particularly for radiologically dense breasts. In the proposed system, three complementary image datasets will be generated from a single data acquisition: the first is the conventional absorption contrast mammography image, the second is a novel phase contrast mammography image with enhanced edges and reduced anatomical background, the major confounding factor in reading mammography; the imaging characteristics suggest that this contrast mechanism would be preferable for cancer mass detection. The third image is the dark-field mammogram, which is sensitive to the local distribution of microcalcifications, calcified vessels, and other small objects in the breast. The proposed system will be constructed, optimized, and evaluated using mastectomy specimens.

15. SUBJECT TERMS
None provided

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			USAMRMC
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1. INTRODUCTION: Narrative that briefly (one paragraph) describes the subject, purpose and scope of the research.

This project aims at developing a trimodel x-ray mammography imaging system to improve both sensitivity and specificity in breast cancer screening and diagnosis, particularly for radiologically dense breasts. In the proposed system, three complementary image datasets will be generated from a single data acquisition: the first is the conventional absorption contrast mammography image, the second is a novel phase contrast mammography image with enhanced edges and reduced anatomical background, the major confounding factor in reading mammography; the imaging characteristics suggest that this contrast mechanism would be preferable for cancer mass detection. The third image is the dark-field mammogram, which is sensitive to the local distribution of microcalcifications, calcified vessels, and other small objects in the breast. The proposed system will be constructed, optimized, and evaluated using mastectomy specimens.

2. KEYWORDS: Provide a brief list of keywords (limit to 20 words).

Early breast cancer detection, dense breast, mammography, x-ray phase contrast imaging, x-ray dark field imaging, Talbot-Lau interferometer, prototype imaging system

3. ACCOMPLISHMENTS: The PI is reminded that the recipient organization is required to obtain prior written approval from the awarding agency Grants Officer whenever there are significant changes in the project or its direction.

What were the major goals of the project?
List the major goals of the project as stated in the approved SOW. If the application listed milestones/target dates for important activities or phases of the project, identify these dates and show actual completion dates or the percentage of completion.

As stated in the approved SOW, the major goals of the project include:

1. Develop a grating interferometer for a trimodal mammography system
2. Integrate the grating interferometer into existing digital mammography system
3. Objective and quantitative performance evaluation of the proposed system
4. Subjective performance evaluation of the proposed system using mastectomy specimens

Specific tasks for this reporting period (01/15/2017-01/14-2018) include:

1. Calibrate the interferometer and detector responses (completed in 04/2017)
2. Physical performance assessments of the prototype trimodal system (completed in 10/2017)
3. Task-driven optimization of the prototype system and image acquisition protocol (completed in 07/2017)
4. Collection of mastectomy specimens and perform multi-contrast image acquisitions (0%)

What was accomplished under these goals?

For this reporting period describe: 1) major activities; 2) specific objectives; 3) significant results or key outcomes, including major findings, developments, or conclusions (both positive and negative); and/or 4) other achievements. Include a discussion of stated goals not met. Description shall include pertinent data and graphs in sufficient detail to explain any significant results achieved. A succinct description of the methodology used shall be provided. As the project progresses to completion, the emphasis in reporting in this section should shift from reporting activities to reporting accomplishments.

A. Major activities

During this reporting period (01/15/2017-01/14-2018), the following major activities were performed:

1. Calibrate the grating interferometer system
2. Characterize the wave optical performance of the interferometer system
3. Characterize the radiation safety of the constructed prototype system
4. Phantom-based testing of the constructed prototype system
5. Streamlining the workflow for imaging the mastectomy specimen

B. Specific objectives

The major objective of Year 2 is to calibrate and characterize the constructed trimodal mammographic imaging system.

C. Key outcomes

C.1 Fringe visibility of the constructed prototype trimodal breast imaging system

- Major finding: The measured fringe visibility of the prototype system is 28±4%. The two moiré patterns shown in Figure 1 were measured with a time interval of 60 minute. Compared with the first moiré image, the relative root mean square error of the second image is 3.2%, indicating good system reproducibility and no significant drift of grating response.

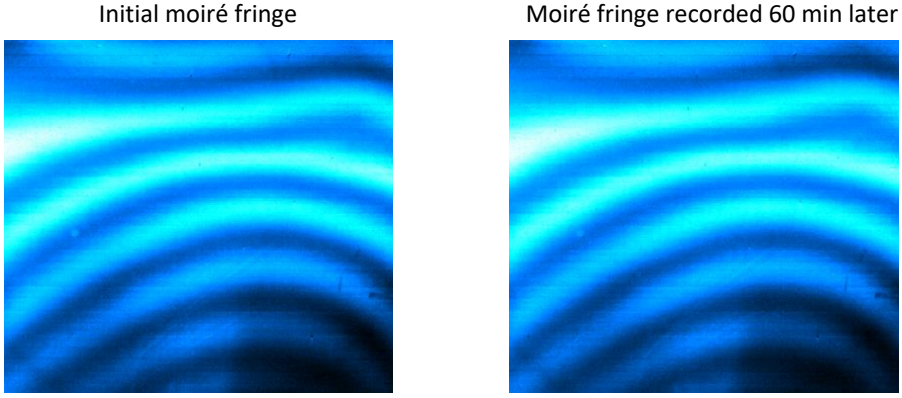

Figure 1: Two consecutive Moiré patterns acquired by the constructed system.

C.2 Radiation safety of the constructed prototype trimodal breast imaging system

- Major finding: To eliminate the possible scatter radiation introduced by the grating assembly, a lead shielding was introduced to a side wall of the breast support that faces the patient chest wall (Figure 2). Exposure measurements were performed to both the original digital mammography system and the constructed trimodal system. At positions that correspond to the patient chest wall, scattered radiation was reduced due to the use of lead shielding. In other words, the prototype system does not introduce additional scattered radiation to patients.

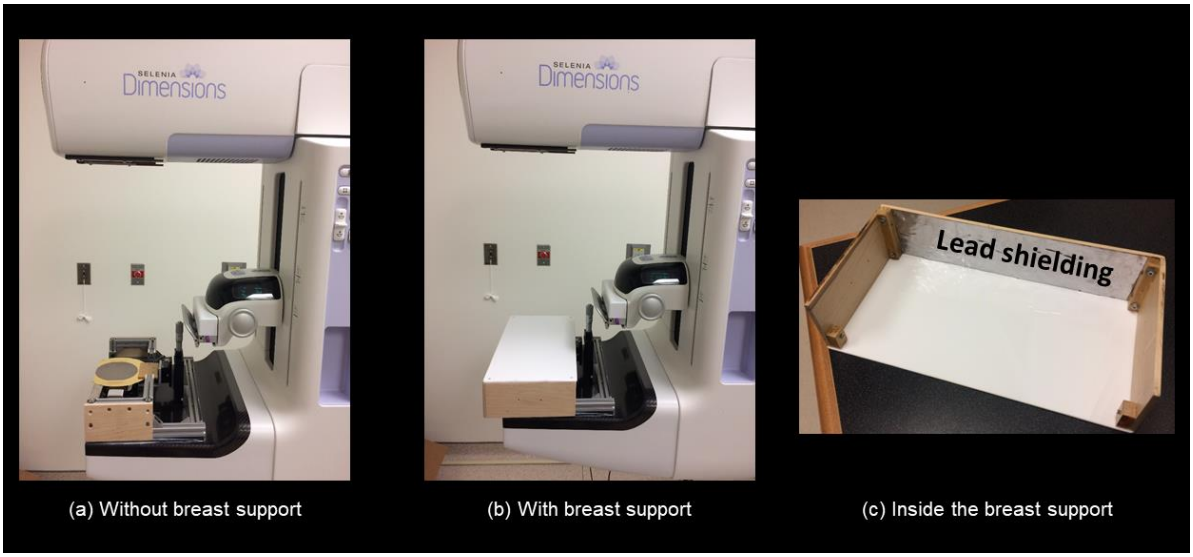

Figure 2. Customized breast support for the prototype system.

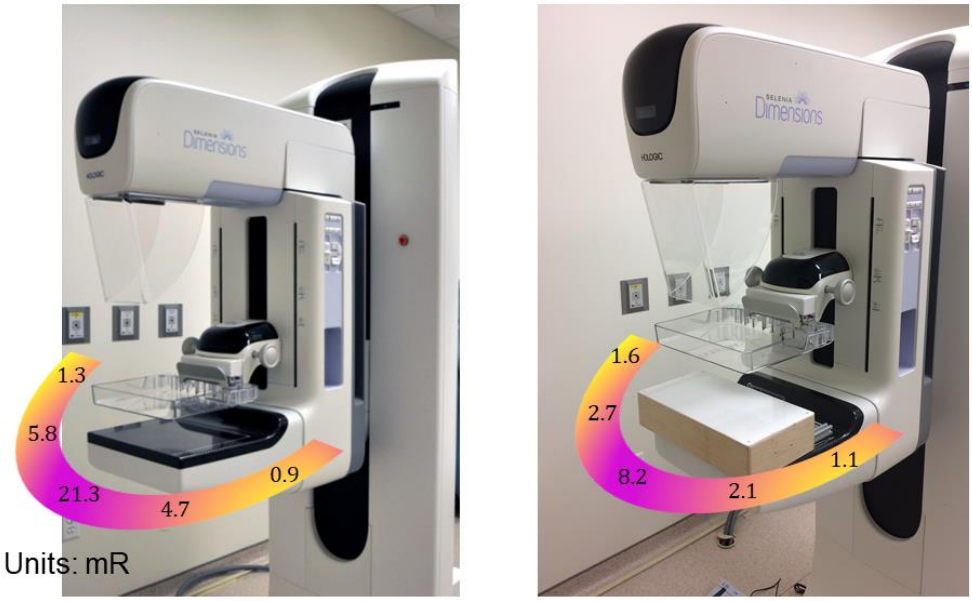

Figure 3: Measured scattered radiation for the conventional digital breast imaging system (left) and the prototype trimodal x-ray breast imaging system (right). Both systems were operated at 36 kV and 140 mAs. The prototype system led to reduced exposure levels at locations corresponding to the patient chest wall.

C.3 Phantom images generated by the prototype system

- Major finding: As shown in Figure 4, the constructed trimodal x-ray imaging system successfully generated multi-contrast images of a physical phantom. The two novel contrast mechanisms (dark field and differential phase contrast) provided additional information of the internal structure of the phanhtom that was missing in the conventional x-ray absorption contrast image.

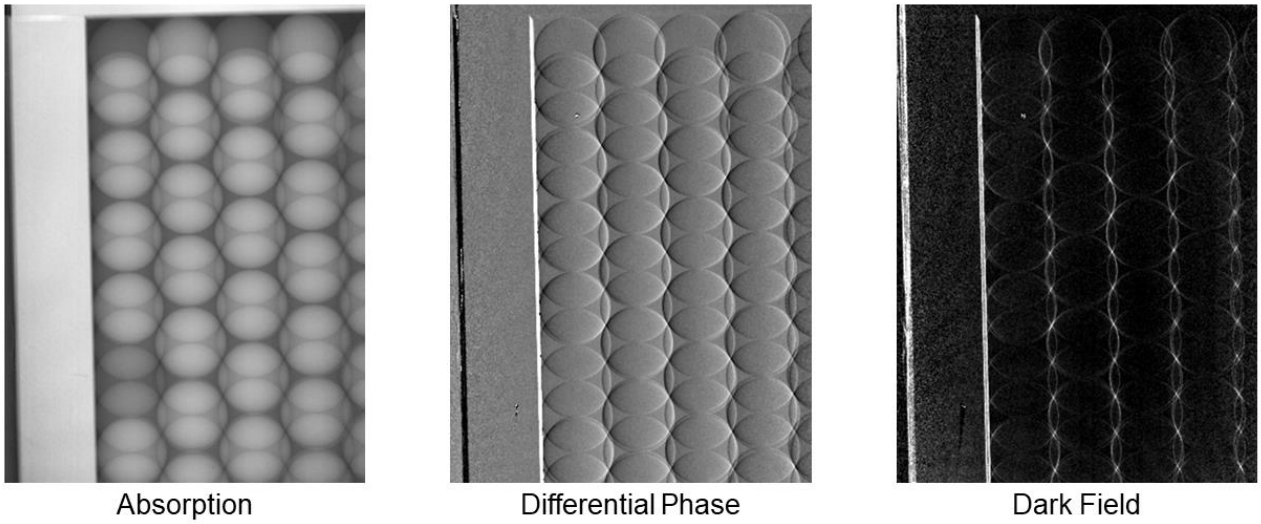

Figure 4: Multi-contrast x-ray images of a physical phantom produced by the constructed prototype system.

C.4 Multi-contrast images of a fresh bovine specimen

- Major finding: To study the potential of using multi-contrast agents for trimodal imaging, a fresh bovine specimen was imaged (Figure 5). This specimen contains three contrast agents, including iodine that can be highlighted by the absorption contrast, microbubbles that can be highlighted by the dark field contrast, and PMMA spheres that can be highlighted by the phase contrast mechanism. As shown in Figure 6, the three contrast agents can be clearly differentiated by the three contrast mechanisms, which do not seem to be achievable by the conventional x-ray absorption contrast alone.

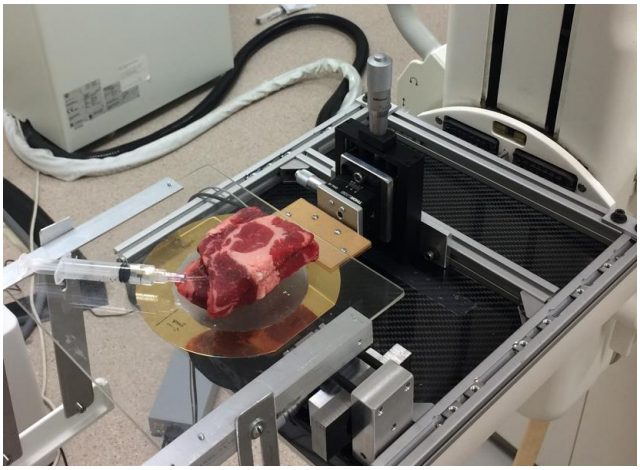

Figure 5: A fresh bovine specimen containing three different contrast agents was imaged by the prototype system.

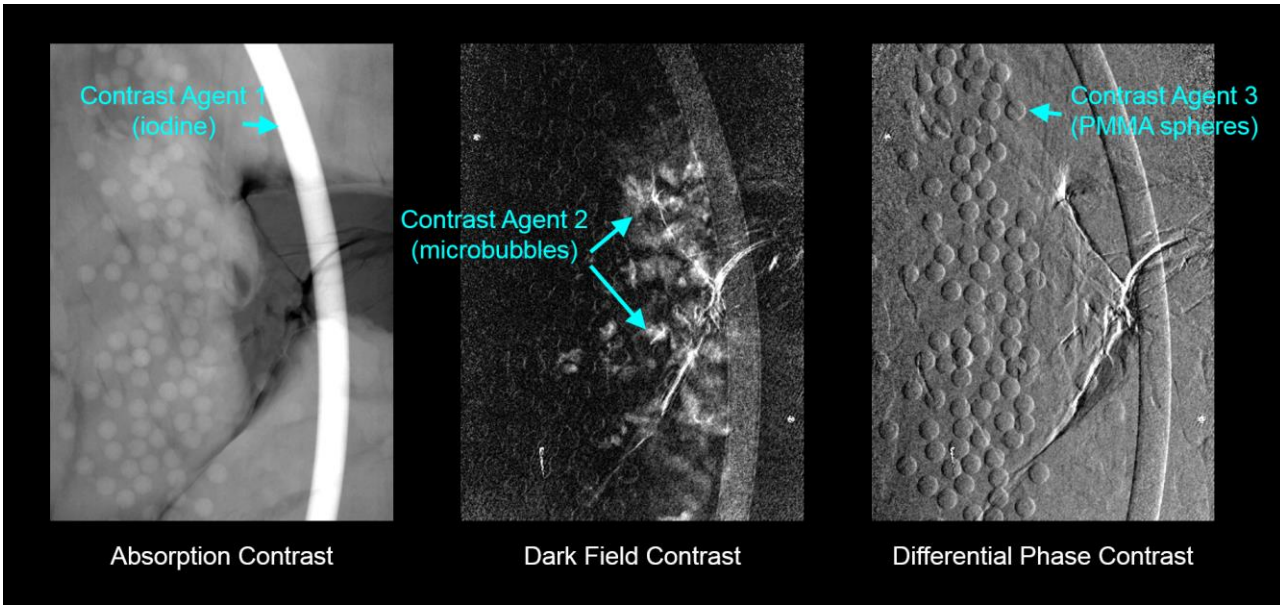

Figure 6: Each of the three contrast mechanisms highlights a unique contrast agent embedded in the bovine specimen.

C.5 Validation of the mastectomy specimen imaging workflow

The study team performed a "dry run" of the mastectomy imaging workflow on 7/31/2017. The specimen container was taken from the breast surgery room to the trimodal imaging lab at a designated time, then the container was transported to the pathology lab within 45 minutes that's required by the human subject protocol. The team members validated they have the needed door/building access to the trimodel imaging suite, surgery room, and pathology department.

What opportunities for training and professional development has the project provided?
If the project was not intended to provide training and professional development opportunities or there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe opportunities for training and professional development provided to anyone who worked on the project or anyone who was involved in the activities supported by the project. "Training" activities are those in which individuals with advanced professional skills and experience assist others in attaining greater proficiency. Training activities may include, for example, courses or one-on-one work with a mentor. "Professional development" activities result in increased knowledge or skill in one's area of expertise and may include workshops, conferences, seminars, study groups, and individual study. Include participation in conferences, workshops, and seminars not listed under major activities.

The University of Wisconsin-Madison requires that all graduate students and postdoctoral researchers supported by federal funding utilize Individual Development Plans to set academic and career goals and facilitate conversations with their mentors. The university offers a collection of resources and tools to support mentees, mentors, and PIs in implementing IDPs. These include a UW-Madison IDP template, workshops for mentees (both face-to-face and online videos), peer learning groups for mentees, as well as guidelines for mentors.

How were the results disseminated to communities of interest?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe how the results were disseminated to communities of interest. Include any outreach activities that were undertaken to reach members of communities who are not usually aware of these project activities, for the purpose of enhancing public understanding and increasing interest in learning and careers in science, technology, and the humanities.

We published results in peer reviewed journals such as Medical Physics and conference proceedings such as Proceeding of SPIE. The results were also disseminated to the breast imaging research community via our presentations at medical imaging conferences such as RSNA. In addition, the PI (Dr. Li) was invited to give a SAM talk entitled "Phase-Contrast Imaging of the Breast with Photon-Counting Detectors" at the Imaging Scientific Symposium of the 2017 AAPM Annual Meeting. The video of this presentation has become available to the medical physics community (http://www.aapm.org/education/vl/vl.asp?id=12253)

What do you plan to do during the next reporting period to accomplish the goals?
If this is the final report, state "Nothing to Report."

Describe briefly what you plan to do during the next reporting period to accomplish the goals and objectives.

(1) Collection of mastectomy specimens and acquire trimodal mammographic images: Under a human subject research protocol proved by both the UW-Madison Health Science IRB and HRPO, fresh mastectomy specimens will be transferred directly from the surgical room to the trimodal mammography suite, where multi-contrast images will be acquired using the constructed prototype system. Immediately after trimodal image acquisition, the specimens will be transferred to pathology department for histology studies.

(2) Reading and scoring of trimodal mammographic images: Two breast radiologists will read the acquired trimodal mammographic images. A training session will be provided to each radiologist, during which example dark field and absorption contrast images of fresh mastectomy specimens will be presented together with the prior mammography images and clinical diagnosis results. After the training session, each radiologist will undergo the formal image reading session, in which the radiologist will assign a BI-RADS score to each contrast mechanism, annotate any significant findings/cancer type, and also record the total number of suspicious foci, along with subjective feedback.

(3) Statistical analysis of the reading results: We will compare the BI-RADS scores assigned to each contrast mechanism, and to compare the number of foci found by pathology with the number found by radiologists during the image reading. We will then estimate a generalized estimating equation (GEE) model to compare the sensitivity for each cancer type and thus determine whether the sensitivity of the constructed multi-modal x-ray breast imaging system depends on cancer type.

4. IMPACT: Describe distinctive contributions, major accomplishments, innovations, successes, or any change in practice or behavior that has come about as a result of the project relative to:

What was the impact on the development of the principal discipline(s) of the project?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe how findings, results, techniques that were developed or extended, or other products from the project made an impact or are likely to make an impact on the base of knowledge, theory, and research in the principal disciplinary field(s) of the project. Summarize using language that an intelligent lay audience can understand (Scientific American style).

The research development in Year 2 made direct impact to the field of multi-contrast x-ray breast imaging. The successful construction of the prototype trimodal mammographic imaging system provides the first experimental demonstration of the compatibility of the trimodal x-ray imaging method with the geometry and hardware of clinical full field digital mammography system. The constructed system would significantly advance the field, since previous studies on multi-contrast x-ray breast imaging were performed using synchrotron- or benchtop-based systems that are usually not directly compatible with the clinical dose constraint, system compactness, and limited x-ray beam quality as seen in clinical mammography systems. During this reporting period, additional knowledge has been gained on how to integrate the gratings with a digital mammography system together with the needed mechanical support for a compressed breast, while not introducing any additional radiation to the patient. Knowledge is also gained on how to calibrate the three gratings to maximize the trimodal imaging performance.

What was the impact on other disciplines?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe how the findings, results, or techniques that were developed or improved, or other products from the project made an impact or are likely to make an impact on other disciplines.

Nothing to Report.

What was the impact on technology transfer?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe ways in which the project made an impact, or is likely to make an impact, on commercial technology or public use, including:

- *transfer of results to entities in government or industry;*
- *instances where the research has led to the initiation of a start-up company; or*
- *adoption of new practices.*

Nothing to Report.

What was the impact on society beyond science and technology?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe how results from the project made an impact, or are likely to make an impact, beyond the bounds of science, engineering, and the academic world on areas such as:

- *improving public knowledge, attitudes, skills, and abilities;*
- *changing behavior, practices, decision making, policies (including regulatory policies), or social actions; or*
- *improving social, economic, civic, or environmental conditions.*

Nothing to Report.

5. CHANGES/PROBLEMS: The Project Director/Principal Investigator (PD/PI) is reminded that the recipient organization is required to obtain prior written approval from the awarding agency Grants Officer whenever there are significant changes in the project or its direction. If not previously reported in writing, provide the following additional information or state, "Nothing to Report," if applicable:

Changes in approach and reasons for change
Describe any changes in approach during the reporting period and reasons for these changes. Remember that significant changes in objectives and scope require prior approval of the agency.

Nothing to Report.

Actual or anticipated problems or delays and actions or plans to resolve them
Describe problems or delays encountered during the reporting period and actions or plans to resolve them.

Nothing to Report.

Changes that had a significant impact on expenditures
Describe changes during the reporting period that may have had a significant impact on expenditures, for example, delays in hiring staff or favorable developments that enable meeting objectives at less cost than anticipated.

Nothing to Report.

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents
Describe significant deviations, unexpected outcomes, or changes in approved protocols for the use or care of human subjects, vertebrate animals, biohazards, and/or select agents during the reporting period. If required, were these changes approved by the applicable institution committee (or equivalent) and reported to the agency? Also specify the applicable Institutional Review Board/Institutional Animal Care and Use Committee approval dates.

Significant changes in use or care of human subjects

Nothing to Report.

Significant changes in use or care of vertebrate animals.

Nothing to Report.

Significant changes in use of biohazards and/or select agents

Nothing to Report.

6. PRODUCTS: List any products resulting from the project during the reporting period. If there is nothing to report under a particular item, state "Nothing to Report."

- **Publications, conference papers, and presentations**
  Report only the major publication(s) resulting from the work under this award.

  Journal publications. *List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Identify for each publication: Author(s); title; journal; volume: year; page numbers; status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).*

  1. X. Ji, Y. Ge, R. Zhang, K. Li, G.-H. Chen, "Studies of signal estimation bias in grating-based x-ray multi-contrast imaging." Medical Physics, 44(6), 2453 (2017) http://dx.doi.org/10.1002/mp.12235
  2. Y.Ge, X. Ji, R. Zhang, K. Li, G.-H. Chen, "K-edge energy-based calibration method for photon counting detectors." Physics in Medicine and Biology, 63(1), 015022 (2017) https://doi.org/10.1088/1361-6560/aa9637

Books or other non-periodical, one-time publications. *Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like. Identify for each one-time publication: Author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (e.g., book, thesis or dissertation); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).*

Ke Li and Guang-Hong Chen, "*Chapter 52 X-ray Phase Contrast Tomosynthesis Imaging*" in "*Handbook of X-ray Imaging: Physics and Technology*", edited by P. Russo, CRC Press, Boca Raton, FL (2018)

Other publications, conference papers, and presentations. *Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication as noted above. List presentations made during the last year (international, national, local societies, military meetings, etc.). Use an asterisk (*) if presentation produced a manuscript.*

Conference papers

1. X. Ji, Y. Ge, R. Zhang, K. Li, G.-H. Chen, "Potential bias in signal estimation for grating-based x-ray multi-contrast imaging." Proc. SPIE, 10132, 1013219 (2017) http://dx.doi.org/10.1117/12.2254429
2. X. Ji, Y. Ge, R. Zhang, K. Li, G.-H. Chen, " Weighted singular value decomposition (wSVD) to improve the radiation dose efficiency of grating-based x-ray phase contrast imaging with a photon counting detector." Proc. SPIE, 10132, 101325I (2017) http://dx.doi.org/10.1117/12.2255014
3. X. Ji, Y. Ge, R. Zhang, G.-H. Chen, K. Li, " Signal and noise characteristics of a CdTe-based photon counting detector: cascaded systems analysis and experimental studies." Proc. SPIE, 10132, 1013219 (2017) http://dx.doi.org/10.1117/10.1117/12.2255063

Conference presentations

1. Y. Ge, J. Garrett, R. Zhang, X. Ji, J. P. Cruz Bastida, G.-H. Chen, K. Li., "Initial Experimental Results from the First X-Ray Dark Field Breast Tomosynthesis Prototype System." Radiological Society of North America 2017 Scientific Assembly and Annual Meeting, Chicago, IL, 2017 (RSNA Student Travel Stipend Award)

2. Y. Ge , X. Ji, R. Zhang , K. Li , G.-H. Chen. "Energy Calibration of Photon Counting Detectors Based On Measurement of X-Ray Attenuation Curve of K-Edge Materials." AAPM 2017 Annual Meeting, Denver, CO, 2017

3. K. Li, Y. Ge, J. Garrett, R. Zhang, X. Ji, J. P. Cruz Bastida, G.-H. Chen. "X-Ray Dark Field Tomosynthesis Imaging." The 2017 International Conference on Fully Three-Dimensional Image Reconstruction in Radiology and Nuclear Medicine, Xi'an, China, 2017

4. K. Li, Y. Ge, J. Garrett, R. Zhang, X. Ji, J. P. Cruz-Bastida, G.-H. Chen. "First results from an x-ray dark field breast tomosynthesis prototype system." The 4th International Conference on X-ray and Neutron Phase Imaging with Gratings, Zurich, Switzerland, 2017

5. X. Ji, Y. Ge, R. Zhang, K. Li, G.-H. Chen. "Is High Sensitivity Always Good for a Grating-based Differential Phase Contrast Imaging System?" The 4th International Conference on X-ray and Neutron Phase Imaging with Gratings, Zurich, Switzerland, 2017

6. R. Zhang, K. Li, G.-H. Chen. "Optimization of Grating Interferometer Parameters for a General Three-Grating Interferometer." The 4th International Conference on X-ray and Neutron Phase Imaging with Gratings, Zurich, Switzerland, 2017

7. R. Zhang, K. Li, G.-H. Chen. "How many gratings are needed for a high sensitivity differential phase contrast imaging system?" The 4th International Conference on X-ray and Neutron Phase Imaging with Gratings, Zurich, Switzerland, 2017

- **Website(s) or other Internet site(s)**
  List the URL for any Internet site(s) that disseminates the results of the research activities. A short description of each site should be provided. It is not necessary to include the publications already specified above in this section.

Nothing to Report.

- **Technologies or techniques**
  Identify technologies or techniques that resulted from the research activities. In addition to a description of the technologies or techniques, describe how they will be shared.

Nothing to Report.

- **Inventions, patent applications, and/or licenses**
  Identify inventions, patent applications with date, and/or licenses that have resulted from the research. State whether an application is provisional or non-provisional and indicate the application number. Submission of this information as part of an interim research performance progress report is not a substitute for any other invention reporting required under the terms and conditions of an award.

Nothing to Report.

- **Other Products**
  Identify any other reportable outcomes that were developed under this project. Reportable outcomes are defined as a research result that is or relates to a product,

scientific advance, or research tool that makes a meaningful contribution toward the understanding, prevention, diagnosis, prognosis, treatment, and/or rehabilitation of a disease, injury or condition, or to improve the quality of life. Examples include:

- *data or databases;*
- *biospecimen collections;*
- *audio or video products;*
- *software;*
- *models;*
- *educational aids or curricula;*
- *instruments or equipment;*
- *research material (e.g., Germplasm; cell lines, DNA probes, animal models);*
- *clinical interventions;*
- *new business creation; and*
- *other.*

- Video recording of a SAM Imaging Symposium talk delivered at 2017 AAPM Annual Meeting:

  Link: http://www.aapm.org/education/vl/vl.asp?id=12253
  Title: Phase-Contrast Imaging of the Breast with Photon-Counting Detectors

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

Provide the following information for: (1) PDs/PIs; and (2) each person who has worked at least one person month per year on the project during the reporting period, regardless of the source of compensation (a person month equals approximately 160 hours of effort). If information is unchanged from a previous submission, provide the name only and indicate "no change."

Example:

Name:	*Mary Smith*
Project Role:	*Graduate Student*
Researcher Identifier (e.g. ORCID ID):	*1234567*
Nearest person month worked:	*5*
Contribution to Project:	*Ms. Smith has performed work in the area of combined error-control and constrained coding.*

Funding Support: *The Ford Foundation (Complete only if the funding support is provided from other than this award).*

Name: *Ke Li*
Project Role: *PI*
Nearest person month worked: *3*
Contribution to Project: *Dr. Li has been overseeing all aspects of this project.*

Name: *Guang-Hong Chen*
Project Role: *Co-Investigator*
Nearest person month worked: *2*
Contribution to Project: *Dr. Chen has performed work in the optimization of the trimodal x-ray imaging system, image acquisition protocol, and postprocessing method.*

Name: *John Garrett*
Project Role: *Assistant Scientist*
Nearest person month worked: *12*
Contribution to Project: *Dr. Garrett has performed work in the construction, characterization, and optimization of the trimodal mammography imaging system.*

Name: *Amy Fowler*
Project Role: *Co-Investigator*
Nearest person month worked: *1*
Contribution to Project: *Dr. Fowler has provided guidance on the development and optimization of the prototype system from the perspective of a clinical breast radiologist.*
Funding Support: *UW-Madison ICTR KL2 Scholars Program*

Name: *Frederick Kelcz*
Project Role: *Co-Investigator*
Nearest person month worked: *1*
Contribution to Project: *Dr. Kelcz has provided guidance on the development and optimization of the prototype system from the perspective of a clinical breast radiologist.*

Name: *Andreas Friedl*
Project Role: *Co-Investigator*
Nearest person month worked: *1*
Contribution to Project: *Dr. Friedl has performed work in the designing of multi-contrast imaging workflow.*

Name: *Kelley Salem*
Project Role: *Post-doc*
Nearest person month worked: *1*
Contribution to Project: *Dr. Salem has performed work in designing and streamlining the multi-contrast imaging workflow.*

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

If the active support has changed for the PD/PI(s) or senior/key personnel, then describe what the change has been. Changes may occur, for example, if a previously active grant has closed and/or if a previously pending grant is now active. Annotate this information so it is clear what has changed from the previous submission. Submission of other support information is not necessary for pending changes or for changes in the level of effort for active support reported previously. The awarding agency may require prior written approval if a change in active other support significantly impacts the effort on the project that is the subject of the project report.

Li, Ke

ACTIVE

U01 EB021183 (Chen, GH)
Project title: One Stop Shop Imaging for Acute Ischemic Stroke Treatment
Funding agency: NIH/NIBIB
Project goal: Develop and validate revolutionary imaging technologies that will result in the availability of a new image guided workflow for the diagnosis, triage, and endovascular treatment of patients presenting with an acute ischemic stroke due to a large artery occlusion.
Start and end date: 9/30/2015-6/30/2019
Role: Co-investigator
Level of effort: 3.6 calendar months
Point of contact at the funding agency: SASTRE, ANTONIO SASTREA@MAIL.NIH.GOV

R01 EB020521-01 (Chen, GH and Li, K)
Project title: Multi-Contrast X-Ray Breast Imaging
Funding agency: NIH/NIBIB
Project goal: Develop a phase contrast digital breast tomosynthesis system and evaluate its potential utility in improving the sensitivity and specificity of breast cancer diagnosis through pilot human subject studies.
Start and end date: 01/01/2016-12/31/2019
Role: co-PI
Level of effort: 5.4 calendar months
Point of contact at the funding agency: SHABESTARI, BEHROUZ
SHABESTB@MAIL.NIH.GOV

Chen, Guang-Hong

COMPLETED

R01 CA169331-02 (Chen, GH and Pickhardt, P)
Project title: Ultra-Low Radiation Dose Body CT Imaging
Funding agency: NIH/NCI
Project goal: The overarching objective of the proposal is to develop, optimize, and evaluate an iterative image reconstruction algorithm that holds a promise to reduce radiation dose level by 70%-90% without compromising diagnostic accuracy.
Start and end date: 08/08/2012-05/31/2017
Level of effort: 2.88 calendar months
Point of contact at the funding agency: HENDERSON, LORI A. hendersonlori@mail.nih.gov

ACTIVE

U01 EB021183 (Chen, GH)
Project title: One Stop Shop Imaging for Acute Ischemic Stroke Treatment
Funding agency: NIH/NIBIB
Project goal: Develop and validate revolutionary imaging technologies that will result in the availability of a new image guided workflow for the diagnosis, triage, and endovascular treatment of patients presenting with an acute ischemic stroke due to a large artery occlusion.
Start and end date: 9/30/2015-6/30/2019
Role: PI
Level of effort: 3.84 calendar months
Point of contact at the funding agency: SASTRE, ANTONIO SASTREA@MAIL.NIH.GOV

R01 EB020521-01 (Chen, GH and Li, K)
Project title: Multi-Contrast X-Ray Breast Imaging
Funding agency: NIH/NIBIB
Project goal: Develop a phase contrast digital breast tomosynthesis system and evaluate its potential utility in improving the sensitivity and specificity of breast cancer diagnosis through pilot human subject studies.
Start and end date: 01/01/2016-12/31/2019
Role: co-PI
Level of effort: 2.88 calendar months
Point of contact at the funding agency: SHABESTARI, BEHROUZ SHABESTB@MAIL.NIH.GOV

Kelcz, Frederick

COMPLETED

R43CA165407 (Harter, R)
Project title: Interactive MR image guided intervention (IMR-IGI) for breast applications
Funding agency: NIH
Project goal: The proposed technology uses MRI compatible robotics and real-time MR imaging to enable interventional procedures to be done inside the MRI scanner with interactive remote control of the procedure. The digital nature of the visualization and control technology offers the further potential benefit of long-distance remote control of iMR-IGI procedures, thereby broadening the reach of scarce specialized clinical skills to remote and/or underserved populations.
Start and end date: 09/19/12-11/30/17
Role: Co-Investigator
Level of effort: 1.8 calendar months
Point of contact at the funding agency: EVANS, GREGORY evansgl@mail.nih.gov

ACTIVE

R01 EB020521-01 (Chen, GH and Li, K)
Project title: Multi-Contrast X-Ray Breast Imaging
Funding agency: NIH/NIBIB
Project goal: Develop a phase contrast digital breast tomosynthesis system and evaluate its potential utility in improving the sensitivity and specificity of breast cancer diagnosis through pilot human subject studies.
Start and end date: 01/01/2016-12/31/2019
Role: Co-investigator
Level of effort: 1.2 calendar months
Point of contact at the funding agency: SHABESTARI, BEHROUZ SHABESTB@MAIL.NIH.GOV

Fowler, Amy

COMPLETED

Research Seed Grant RSD1420 (PI: Fowler)
Project Title: Impact of Endocrine-resistant Estrogen Receptor-α Variants on [18F]Fluoroestradiol Imaging of Breast Cancer
Funding agency: RSNA
Project goal: The long term goal is to develop a better understanding of ERalpha-dependent factors influencing FES imaging of patients with advanced/metastatic breast cancer in situations of endocrine resistance and yield molecular evidence regarding the mechanisms of FES as a predictive imaging biomarker
Role: PI
Start and end date: 7/1/2014-6/30/2017
Level of effort: (1% no salary support)
Point of contact at the funding agency: WALTER, SCOTT A. SWALTER@RSNA.ORG

ACTIVE

KL2TR000428 (PI: Drezner)
Project Title: [18F]FFNP-PET Imaging of Progesterone Receptor as a Biomarker of Endocrine Sensitivity in Patients with Breast Cancer
Funding agency: NIH/NCATS-Institutional Clinical and Translational Science (ICTR)
Project goal: Goal is to test 1) the precision and accuracy of quantitative FFNP-PET imaging and 2) whether it can distinguish endocrine-sensitive from endocrine-resistant ERα+PR+ breast cancers.
Role: KL2 Scholar
Start and end date: 01/01/2016-present
Level of effort: 9 calendar months
Point of contact at the funding agency: PEGGY HATFIELD pmhatfie@wisc.edu

NOTE: In this DOD Breakthrough Award, Dr. Amy Fowler was listed as a co-investigator with an effort of 1.2 calendar months per year from Years 2 to 3. However, Dr. Fowler was selected to become one of the KL2 awardees at our institution (listed above). This award requires a 75% commitment of research time, and the goal of this award is to establish Dr. Fowler as a clinician-scientist, enabling the clinical translation of new technologies, such as that which will be developed in our project. Due to the scientific overlap between Dr. Folwer's proposed work on the DOD award and the career development goals defined in her KL2 award, her contribution to Dr. Li's DOD award is synergistic with her ICTR KL2 research project. Both investigators are studying novel imaging methods for improved detection and characterization of breast cancer. Furthermore, one of Dr. Fowler's career goals is to move breast imaging to both a more molecular and quantitative level.

Friedl, Andreas

COMPLETED

VA Merit Review Program I01BX000137-07 (Friedl)
Project Title: Glypican-1 in Gliomagenesis
Funding agency: Department of Veterans Affairs
Project goal: This project focuses on studying the role of the heparin sulfate proteoglycan glypican-I in regulating the cell cycle in gliomas. The work is based on our observation that glypican-1 is overexpressed in the vast majority of glioma tumors and that overexpression of glypican-1 in glioma cells in vitro induces G1-S transition, DNA re- replication and DNA damage. We believe that glypican-1 overexpression in gliomas contributes to loss of growth control and genetic instability.
Start and end date: 04/01/2009-03/31/2017
Role: PI
Level of effort: 1.8 calendar months
Point of contact at the funding agency: Smith, Samantha Samantha.Smith10@va.gov

W81XWH-14-1-0274 (Friedl)
Project Title: Syndecan-1 and Metastasis Dormancy
Funding agency: DOD/Army
Project goal: This project aims at understanding the role of the heparan sulfate proteoglycan syndecan-1 in the escape of disseminated breast carcinoma cells from dormancy. Specifically, the goals are to 1) Determine the role of stromal syndecan-1 in escape of disseminated breast carcinoma cells from dormancy in vivo; 2) Determine the mechanism of disseminated breast carcinoma cell dormancy and metastatic outgrowth; and 3) Determine the cell type responsible for syndecan-1-dependent escape from dormancy
Start and end date: 08/01/2014-07/31/2017
Role: PI
Level of effort: 1.8 calendar months
Point of contact at the funding agency: Wendy A. Baker, grants officer wendy.a.baker.civ@mail.mil

ACTIVE

UM1 CA186716-02 (Dipaola & Liu)
Project Title: Wisconsin and New Jersey Alliance in Precision Experimental Therapeutics
Funding agency: RBHS -CANCER INSTITUTE OF NEW JERSEY
Project goal: To merge two strong prior Phase I (U0l) sites to create the Wisconsin and New Jersey Alliance in Precision Experimental Therapeutics (WIN-Alliance). This group, as a synergistic, multidisciplinary and multi-institutional model, will develop and evaluate innovative, early phase experimental therapeutic clinical trials to improve clinical outcomes
Start and end date: 03/19/2014-02/28/2019
Role: Co-investigator
Level of effort: 0.36 calendar months
Point of contact at the funding agency: Ivy, S. Percy ivyp@ctep.nci.nih.gov

U01 CA189283-01A1 (Seewaldt)
Project Title: Combined breast MRI/biomarker Strategies to Identify Aggressive Biology
Funding agency: NIH/NCI
Project goal: The goal of this research is to test from the bench to the clinic the hypothesis that loss of the tumor suppressor WWOX 1) in preclinical models mechanistically activates of glycolysis in metastatic TNBC via transcriptional activation HIF1α and 2) in primary and metastatic TNBC activates metabolism as measured by Fluorescence Lifetime Imaging (FLIM).
start and end date: 8/1/2015-7/31/2020
Role: Co-investigator
Level of effort: 0.3 calendar months
Point of contact at the funding agency: MAZURCHUK, RICHARD V mazurchukrv@mail.nih.gov

R01 EB020521-01 (Chen, GH and Li, K)
Project title: Multi-Contrast X-Ray Breast Imaging
Funding agency: NIH/NIBIB
Project goal: Develop a phase contrast digital breast tomosynthesis system and evaluate its potential utility in improving the sensitivity and specificity of breast cancer diagnosis through pilot human subject studies.
Start and end date: 01/01/2016-12/31/2019
Role: Co-investigator
Level of effort: 0.6 calendar months
Point of contact at the funding agency: SHABESTARI, BEHROUZ SHABESTB@MAIL.NIH.GOV

What other organizations were involved as partners?
If there is nothing significant to report during this reporting period, state "Nothing to Report."

Describe partner organizations – academic institutions, other nonprofits, industrial or commercial firms, state or local governments, schools or school systems, or other organizations (foreign or domestic) – that were involved with the project. Partner organizations may have provided financial or in-kind support, supplied facilities or equipment, collaborated in the research, exchanged personnel, or otherwise contributed.
Provide the following information for each partnership:
Organization Name:
Location of Organization: (if foreign location list country)
Partner's contribution to the project (identify one or more)

- *Financial support;*
- *In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff);*
- *Facilities (e.g., project staff use the partner's facilities for project activities);*
- *Collaboration (e.g., partner's staff work with project staff on the project);*
- *Personnel exchanges (e.g., project staff and/or partner's staff use each other's facilities, work at each other's site); and*
- *Other.*

Nothing to Report.

8. SPECIAL REPORTING REQUIREMENTS

COLLABORATIVE AWARDS: N/A

QUAD CHARTS: N/A

9. APPENDICES: N/A