INTRODUCTION:
(See ProjectDescription.pdf)

ADMINISTRATIVE INFORMATION:
Information regarding contacts, budgets, facilities, resources, regulatory or legal considerations, proprietary or specialized components, technologies or intellectual property associated with the project.

- Project Name (tentative): Depth-resolved optical molecular imaging of the human hand
- Project Number: P09052
- Project Track: *Assistive Devices & Biotechnology*
- Project Family: *Basic science research and development*
- Start Term: 20082 (Winter)
- End Term: 20083 (Spring)
- Faculty Guide *(project mentor)*: D. Phillips

- Faculty Consultants *(disciplinary subject matter experts)*: M. Helguera, R. Doolittle
- Customer organization and primary contact (name, phone, e-mail):

  Carestream Health, Inc.: Gilbert Feke, Senior Optical Engineer, 203-786-5638, gilbert.feke@carestreamhealth.com

  Qioptiq: Linda Antos, Senior Electrical Engineer/Project Manager, 585-223-2370 x148, Linda.Antos@ny.qioptiq.com

- Principle sponsor or sponsoring organization: (*provider of financial support)*

  Carestream Health, Inc.: Gilbert Feke, Senior Optical Engineer, 203-786-5638, gilbert.feke@carestreamhealth.com

  Qioptiq: Bob Zinter, Director of Technology & Business Development, 585-223-2370 x150, Bob.Zinter@ny.qioptiq.com

  RIT: CEIS Grant, M. Helguera, Principle Investigator

- Project Overview (*1-2 paragrapsh that provide a general description of the project: background, motivation(s), customer(s), and overall objective(s).*): Carestream Health, Inc., has a need for a research prototype of a clinical system capable of performing depth-resolved optical molecular imaging of a stationary human hand, specifically fluorescence imaging; therefore Carestream Health, Inc., is the “customer”.

  Carestream Health, Inc., and Qioptiq have a desire to explore the application of Qioptiq’s “structured illumination” solution for depth-resolution (commercially vended under the name Optigrid) to the problem, as well as the integration of structured illumination technology into Carestream Health, Inc.’s molecular imaging system platform (commercially vended under the name KODAK In Vivo Imaging System F); therefore, both Carestream Health, Inc., and Qioptiq are the “sponsors”.

- Staffing Requirements: (Staffing Requirements link on EDGE)

DETAILED PROJECT DESCRIPTION:

- Customer needs: Carestream Health, Inc., has a need for a research prototype of a clinical system capable of performing depth-resolved optical molecular imaging of a stationary human hand, specifically fluorescence imaging. The system needs to be based on Carestream Health, Inc.'s existing imaging platform, the likely choice being the technology used in the commercial product KODAK In Vivo Imaging System F. Carestream Health, Inc.'s existing imaging platform is currently not capable of single-wavelength depth-resolved optical molecular imaging of stationary subjects. Approaches involving structured illumination have been demonstrated by others to solve the problem (for example, see US Patent Appl. No. 2006/0184043 by Tromberg *et al.*, applied to a mouse), so the application of structured illumination to the problem is what Carestream Health, Inc., needs to research. The initial demonstration of the working research prototype needs to include depth discrimination between fluorescence signals originating from the front of the hand vs. the back of the hand, with special attention paid to the knuckles, whereby the fluorescence signals have the same wavelength (i.e., so that discrimination by color is not available). Such a demonstration would likely involve application of small pieces of commercially available fluorescent plastic sheets to volunteer hands. If possible, a follow-up demonstration should include depth discrimination of the interior of a fluorescently-labeled knuckle of a phantom (i.e., model) hand, whereby the phantom hand shall be developed by RIT.

- Customer deliverables (*Customer requested milestones, progress reports, and expected product*):

Milestones:

1. Detailed plan for integration of "structured illumination" technology into existing imaging platform.

2. Initial demonstration of prototype working research prototype needs to include depth discrimination between fluorescence signals originating from the front of the hand vs. the back of the hand, with special attention paid to the knuckles, whereby the fluorescence signals have the same wavelength (i.e., so that discrimination by color is not available).

3. If possible, a follow-up demonstration should include depth discrimination of the interior of a fluorescently-labeled knuckle of a phantom (i.e., model) hand, whereby the phantom hand shall be developed by RIT.

Progress reports:

1. Technical issues regarding integration of "structured illumination" technology into existing imaging platform (prior to demonstration).

2. Technical issues regarding initial demonstration showing two-sides of hand.

3. Technical issues regarding demonstration showing knuckle interior.

Expected product:

A research prototype of a clinical system capable of performing depth-resolved optical molecular imaging of a stationary human hand, specifically fluorescence imaging, to be delivered to Carestream Health, Inc.

- Customer and Sponsor Involvement (*Describe role of customer and sponsor in the project, planned participation in design and project reviews, etc.*):

As sponsors, both Carestream Health, Inc., and Qioptiq will participate in at most 1-2 hrs biweekly design and project reviews. Qioptiq shall provide advice for implementation of structured illumination technology, as well as materials including a standard grid as used for defining the structured illumination pattern, a paddle for interfacing the grid to the actuation mechanism, the actuation mechanism, and the control electronics. Carestream Health, Inc., shall provide advice for integration of structured illumination technology into Carestream Health, Inc.'s existing imaging platform and procedures to achieve the demonstrations, as well as materials including the critical components of the existing imaging platform, additional materials necessary to integrate the materials provided by Qioptiq into the existing imaging platform (where available), and funds for purchase and manufacture of parts (when necessary).

- Regulatory requirements (*i.e. UL, IEEE, FDA, FCC, RIT*):

Since this is only a research prototype, there are no regulatory requirements.

- Project Budget and Special Procurement Processes (*Provide all budget details and processes associated with expenditures*):

Funded by a grant from the Center for Electronic Imaging Systems, M. Helguera, Principle Investigator

- Intellectual property (IP) considerations (*Describe any IP concerns or limitations associated with the project*):

Since this activity is only for research, there are no IP concerns. Note should be made of US Patent No. 6,958,815 and US Patent Appl. No. 2006/0184043.

- Other (*Describe potential benefits and liabilities, known project risks, etc.*):

Benefits: If the integration of Qioptiq's structured illumination technology into Carestream Health, Inc.'s existing imaging platform is successfully achieved, then Carestream Health, Inc., will be enabled to evaluate the research prototype for possible future commercialization.

Liability: If the integration of Qioptiq's structured illumination technology into Carestream Health, Inc.'s existing imaging platform is not successfully achieved, then Carestream Health, Inc., will not be enabled to evaluate the research prototype for possible future commercialization.

Known project risks:

1. A detailed plan for integration of structured illumination technology into Carestream Health, Inc.'s existing imaging platform has not yet been achieved, so the project may be ill-conceived.

2. The application of structured illumination technology to the problem may be prone to image artifacts.

3. The algorithms needed to reconstruct depth information may be more complicated to implement than initially hoped.

4. The known structured illumination techniques that have the potential for solving this type of problem may not for whatever reason be capable of solving this particular problem.

5. Both Carestream Health, Inc., and Qioptiq may need to delay delivery of some materials and funds until January, 2009, due to budget limitations.

6. Many components are fragile.

7. Remote location of Carestream Health, Inc., contact Gilbert Feke (New Haven, CT) may impede progress.

8. If for any reason the main sponsor contact personnel cannot fulfill their obligation, replacement contact personnel may not be available.

DETAILED COURSE DELIVERABLES:

From the Course Deliverables document, extract general and discipline specific deliverables that are appropriate to the project. This should provide clear guidance to the students on what it expected.

(See ProjectDescription.pdf)

PRELIMINARY WORK BREAKDOWN:

Describe the anticipated distribution of general tasks to be accomplished by project participants based on perceived skill set requirements. This should justify the requested skills and number of students from each discipline.

(Too be determined, see ProjectDescription.pdf)

GRADING AND ASSESSMENT SCHEME:

Describe how the grading rubric relates to expectations and deliverables. The impact of project enhancements and improvements from baseline should be clearly articulated.

(To be determined)

THREE WEEK SDI SCHEDULE:

List expected activities in the first three weeks. Highlight any project specific activities that may not be part of the generic course syllabus (e.g. customer visits). (To be determined by students)

Category	Source	Description	Resource Available (*mark with X*)
Faculty	M. Helguera	Imaging Science, PI	X
	R. Doolittle	Medical Sciences	X
	D. Phillips	Electrical Engineering	X
Environment	CIS U/S Lab	Secure lab in Center for Imaging Science	X
Equipment	Kodak F-system	Imaging System to be modified	X
	Qioptiq	Structured Illumination system	X
Materials	Hand phantom	TBD	
Other			