

Imaging Workshop Summary

The second research strategic planning session, held August 18th and 19th at UA's Biosphere2 focused on Imaging. Participants were identified for their expertise and diversity across the imaging continuum, from nanometer to kilometer scales and for biological and non-biological applications, and came from colleges across the University. The Imaging reception included welcome remarks by Dr. Kimberly Andrews Espy and a presentation on "Advanced Optics for Ophthalmology" by Dr. Jim Schwiegerling, Professor of Optical Sciences and Ophthalmology. Breakout discussions consisted of the following topics:

- 1) Computational Imaging / Machine-Industrial Imaging;
- 2) New Contrast Mechanisms;
- 3) Multi-dimensional Imaging;
- 4) Extracting Quantitative Information; Quantifying Information Extraction.

Each breakout session was held twice, and was moderated by an expert in the field. Session leads reported back to the full group on the opportunities for exploiting UA's strengths to develop new and strategic capabilities – to identify the "big ideas" along with assessment of required resources and program risks to take these next steps.

The following represent the primary recommendations identified during the full-group discussion:

1. **Develop approaches to leverage personnel and infrastructure for further imaging advances in UA's strength areas.** Among the investigators within the Colleges of Medicine, Optical Sciences Agriculture and Life Sciences, Science, and Engineering, opportunities were identified to: **A)** capitalize upon UA's astronomy and computer science expertise to share imaging technologies that have the potential to bridge imaging challenges across scales; and **B)** tackle projects extending UA's strengths in informatics, big data, and analytics to address complex imaging challenges (i.e., diagnostics, functional genomics). Although it was noted that long standing collaboration does exist across the medical and main campuses, the need to further integrate biomedical and non-biomedical imaging efforts to leverage existing strengths into new application areas was recognized. A broad, possibly virtual, seminar series with themes such as "extraordinary images" or "pain point/failures" could help bring investigators together.
2. **Leverage UA's imaging expertise into a holistic "imaging systems engineering" approach.** Participants identified that a unique part of UA's strength is our ability to take an end-to-end approach for imaging, relating task/need to the imaging system hardware as well as image acquisition, visualization, analysis, and interpretation.
 - a. Session participants recognized the potential for UA to capitalize on its preeminent units including Optical Sciences, Astronomy, iPlant, Center for Gamma Ray Imaging, as well as strengths in chemistry, materials and advanced nanofabrication, computer sciences and mathematics to create this imaging systems engineering approach. Planning for an NSF Engineering Research Center (ERC) proposal submission for 2018 could be started now. There is a good potential to populate all thrust levels of an ERC with UA PI's, in addition to select PI's from other institutions.
 - b. Consider implementing "one-stop" biomedical imaging in the new Biosciences Research Labs building including state of the art core and multi-user imaging instrumentation and

fabrication capabilities in the basement, together with biomedical imaging faculty and imaging informatics faculty and capabilities.

3. Promote advances in imaging technology to keep UA in the lead

- a. Consider support (or assistance in obtaining external support) for making more mature versions of developmental imaging systems. There are several examples of imaging instruments for non-biological, cell, tissue, and pre-clinical samples which could be developed into multi-user or core instrumentation, and potentially licensed to industry.
- b. Build upon UA's success in imaging and materials technology. Participants recognized opportunities to develop cross-campus collaborations to develop new contrast agents and novel imaging technology would address current limitations such as to increase resolution and/or to reduce imaging damage.
- c. Seek out partners who can recognize the value of our leading-edge imaging capabilities, potentially Janelia Farms, industry.
- a. Capitalize further on opportunities to collaborate with and access Banner resources, including potential to pair big data image processing with results from natural language processing of clinical narratives (radiology reports, billing & discharge summaries) to find new image characteristics that suggest disease. This effort would require HIPAA compliant computation infrastructure.

4. Provide investment in critical imaging systems infrastructure. Participants expressed overlapping needs for statistical-, analytics-, data management-capable personnel, and not just new physical infrastructure on campus, and suggested that further centralization of core resources (personnel, software support, and equipment) was desired. Interest in central support for developing unique capabilities included:

- a. Continue to offer TRIF Graduate Imaging Fellowships, but with expanded focus on collaboration across disciplines and "sharing" of graduate fellows between units.
- b. Offer pilot funding (\$50K) for imaging collaborations by ORD that is not focused only on junior faculty.
- c. Provide infrastructure support of image analysis that comprises expertise in simulation and visualization, multimodal analysis, imaging informatics, quantitative data extraction from images, as well as data archiving, handling, and storage.
- d. Continue to provide support to faculty for proposal coordination / development for equipment grant submissions (i.e., NSF Major Research Instrumentation Program; NIH Shared Instrumentation/High-End Instrumentation Grants).
- e. In addition, selected participants suggested that the new imaging cluster-hire process may be an opportunity to add new resources which are linked to the strategic initiatives that evolve from the imaging workshop.
- f. Interact with imaging industry to find potential partners for our evolving imaging centers.

For additional information on the upcoming follow-up activities, please contact Jennifer Barton at barton@email.arizona.edu or Neal Armstrong at nra@email.arizona.edu. For information on the breakout session groups, including how to participate in follow-on meetings, please contact the group lead:

☐ Computational Imaging / Machine-Industrial Imaging, contact Ali Bilgin, Biomedical Engineering, Electrical & Computer Engineering, bilgin@email.arizona.edu, or Michael Lesser, Astronomy and Steward Observatory, mlesser@email.arizona.edu.

☐ New Contrast Mechanisms, contact Bob Norwood, rnorwood@optics.arizona.edu.

☐ Multi-dimensional Imaging, contact Leilei Peng, Optical Sciences, pengl@email.arizona.edu.

☐ Extracting Quantitative Information; Quantifying Information Extraction, contact Daniela Zarnescu, Molecular and Cellular Biology, Neuroscience, zarnescu@email.arizona.edu, or Harry Barrett, Optical Sciences, Medical Imaging, barrett@radiology.arizona.edu.