SUMMARY:

- BU Presentation – Institute for Manufacturing Innovation
  - Focus on: areas where US has a lead or can quickly establish a lead, areas that will benefit from industry/government/non-profit collaboration and investment, areas with dual defense and commercial applications
  - Focus Areas: Biophotonic materials and instruments, adaptive optics and imaging, high power fiber lasers
- Breakdown of each areas (slides 5-8)
  - BU Strengths: Biosensing and imaging, neurophotonics, adaptive optics, fiber lasers
Institutes for Manufacturing Innovation

- **Focus on:**
  - Areas where the US has a lead or can quickly establish a lead.
  - Areas that will benefit from joint industry/government/non-profit collaboration and investment.
  - Areas with dual defense and commercial applications.

- **Competitive in strategic areas:**
  - Eg, Brain Research through Advancing Innovative Neurotechnologies (BRAIN) initiative
Focus Areas:

- Biophotonic Materials and Instruments
- Adaptive optics and imaging
- High power fiber lasers

Strengths @ BU:
- Biosensing and Imaging
- Neurophotonics
- Adaptive Optics
- Fiber Lasers
Manufacturing – some thoughts

- Innovation driven technology
- Manufacturing vs. rapid prototyping
  - Large corporation vs start-ups
- Foundry for optical microsystems
- Modular components – optical lego
  - Spindler&Hoyer -> ThorLabs
- Optical fiber sources with a catalog of parameters
- Beam shaping
- Sensors
- Quality control for nanophotonics
**Enables embryonic field of Neuro photonics / Optogenetics**

**Toolkit for:**
- Light induced activation of neuronal signals
- Light induced silencing of nerves
- Indicators for light-based sensing of neuronal signals

**Applications/Potential**
- Vision restoration
- Treatment of neurological disorders/ injuries (strokes, addiction, epilepsy, TBI, Parkinson’s, Alzheimer’s, etc.)
- Biomimetic memory elements in all optical processing

**US Position vs. ROW**
- Leader in optogenetic research and biophotonic protein development

**Issues to be addressed**
- Production techniques for manufacturing families of proteins activated/inactivated at different wavelengths
- Processes to deliver optogenetic actuation/sensing proteins to specific neural pathways and circuits
- Develop proteins for “rewritable” and “non-rewritable” applications and techniques to synthesize in volume
- Characterization tools

**Existing Equipment/Design Tools**
- At universities that have taken research lead (i.e. Stanford, MIT, Boston Univ.)

**Current Foundries:**
- None
Enables Biosensors

Technology development / prototyping
- Advanced technology innovation at the cross-section of nanotechnology and photonics
- Pipeline for rapid prototyping and business development

Applications/Potential
- Infectious diseases
- Cancer
- Biomarker discovery

US Position vs. ROW
- Leader in diagnostic technology
- Stiff competition from Europe and China with varying regulatory hurdles

Issues to be addressed
- Idea to benchtop to clinic
- Partnering with medical research
- NSF-NIH boundaries
- UC Davis STC
Several uniquely defense applications that involve adaptive optics in wave-front sensing and control, but also cross-over commercial applications

Defense Applications
- Earth based tracking of satellites
- Imaging or communication through fog, smoke or distances
- Stand-off sensing for chemical or biological pathogens
- High energy laser weapon systems
- Control of optical elements for beam steering (anti-missile defense)

Commercial Applications
- Healthcare:
  - Imaging deep in tissue
  - Ophthalmic retinal imaging systems
- Control of industrial lasers in applications like precision lithography systems
- Improving cameras and other commercial applications
- IC failure analysis

US Position vs. ROW
- Innovation lead, but lack optical MEMS foundry capability
- MEMS foundries have succeeded, but not in the more complex domain of optical microsystems

Issues to be addressed
- Production facilities need to be capable of volume manufacturing but also allow customization and fast prototyping.
- Flexible manufacturing line with library of processes for customization
- Design tools compatible with manufacturing processes
- Wafer level testing of custom devices
- Partnering with UC Santa Cruz STC

Existing Equipment/Design Tools
- Builds on standard semiconductor equipment

Current Foundries:
- Two European companies for optical MEMS (one w/ foundry in NC)
Commercial sector leads the way due to the strength of the optical amplifiers for the telecom sector

Advantages
- Compact
- Rugged
- Strong manufacturing infrastructure

Applications/Potential
- Stand-off systems for biological/chemical defense
- High energy laser weapons systems
- Industrial in fabrication, cutting, welding, machining
- Multiphoton imaging systems

US Position vs. ROW
- Leadership in manufacturing
- Unsure about position in lasers for defense applications

Issues to be addressed
- Investigate non-conventional fiber modes (Bessel-like fiber modes) and other techniques that will optimize for wide tunability and high power
- Sourcing of gain dopant materials
- Standardization of control systems

Existing Equipment/Design Tools
- Existing infrastructure that supports high volume fiber amplifier production used in communications applications
- Unsure if necessary to leverage government funds

Current Foundries:
- Capacity in the telecom industry
Thank you