Welcome.
## Agenda

<table>
<thead>
<tr>
<th>All participants</th>
<th>Social (30 mins.)</th>
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</thead>
<tbody>
<tr>
<td>Roop Mahajan</td>
<td>Opening remarks (15 minutes)</td>
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<tr>
<td>All scholars</td>
<td>Scholars introduce themselves, their advisor, department head, and dean if present. (2 min. ea.)</td>
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<tr>
<td>Roop Mahajan</td>
<td>Closing remarks (2 minutes)</td>
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Innovation Concepts

Human Spark

- Neanderthals and modern humans evolved from the same ancestors.
- Neanderthals left Africa and spread to Europe where they lived for about 200,000 years before they became extinct.
- Those left behind successfully evolved to modern humans and occupied the planet.

DO YOU KNOW WHY?
Innovation

“Just as energy is the basis of life itself, and ideas the source of innovation, so is innovation the vital spark of all human change, improvement and progress.”

Ted Levitt; Marketing Guru, Harvard Business School
1. Invention vs. Innovation
Invention vs. Innovation

**INVENTION**

- an idea made manifest
- the creation/embodiment of something new
- the first occurrence of an idea for a new product or process
- *is the conversion of cash into ideas*
Invention vs. Innovation

INNOVATION

- an idea applied successfully in practice
- is the conversion of ideas into cash

(Etymological origin of word INNOVATION – creation of something new)
**Invention vs. Innovation**

- **Innovators** produce, market and profit from their innovations.
- **Inventors** may or may not profit from their inventions.
“My team has created a very innovative solution, but we’re still looking for a problem to go with it.”
“I never perfected an invention that I did not think about in terms of the service it might give others... I find out what the world needs, then I proceed to invent.”

— Thomas Edison
2. Sources of Innovation
Sources of Innovation

- Inventor(s) – driven
  - Recent research suggests that the most successful innovation occurs at the boundaries/interfaces

- End-User – Driven
  - Need-based
  - Increasingly assuming more importance
3. Linear vs. disruptive Innovation
3. Linear vs. Disruptive Innovation

- **Linear**
  - Incremental
    - Ex: Cost reduction
  - **Barrel reactor silicon epitaxy**
CVD: Barrel Reactor
3. Linear vs. Disruptive Innovation

- Disruptive
  - Game-changer
  - EX: Digital vs analog watches

- Condensation Soldering vs IR soldering
Condensation and IR Reflow Soldering
Disruptive Innovation and a Black Swan

A Black Swan is an event that has three characteristics;
- it is an outlier
- it carries an extreme impact
- it has retrospective predictability.
  "The Black Swan", by Nassim Nicholas Taleb

- Our world is dominated by Black Swans.
  - the internet
  - the computer
  - the laser

All three were unplanned, unpredicted, and unappreciated upon their discovery, and remained unappreciated well after initial use.
Disruptive Innovation

A powerful exercise for disruptive innovation

WHAT WILL MAKE YOUR CURRENT WORK IRRELEVANT IN 7 YEARS?

OR

WHAT NEW EXTERNAL EVENT WILL FUNDAMENTALLY CHANGE WHAT YOU DO NOW?
Innovation Concepts

4. Promoting innovation
4. Promoting Innovation

- promoting interdisciplinary research

  Buds of creativity bloom at intersections

- encourage risk-taking

  - Celebrate successes and failures

- constantly examine existing paradigms

  - Look for the next Black Swan
4. Promoting Innovation

Additional ingredients for success

• Technical competency

• Resources

• Recognition
Innovation Concepts

1. Invention vs. Innovation
2. Sources of Innovation
3. Linear vs. disruptive innovation
4. Promoting innovation
   • ICTAS as an agent of Innovation
VISION

To be among the top-ranked global institutes in transformative technologies for a sustainable future
**Mission**

**RESEARCH**
To stimulate, catalyze and promote interdisciplinary / trans-disciplinary research at the intersection of science, engineering, biology and social sciences.

**EDUCATION**
Enhance educational experience of students in cutting-edge technologies

**OUTREACH**
Develop innovative and elegant sustainable solutions to promote economic development and enhance quality of life locally, nationally, and globally.
**NBIC Tetrahedron: Defining Research Thrusts**

ICTAS research is at the NBIC interfaces with a focus on a SUSTAINABLE FUTURE

“The most incomprehensible thing about the world is that it is at all comprehensible.”

Albert Einstein
ICTAS Thrust Areas

- Nanoscale Science and Engineering
- Sustainable Water
- Nano-Bio Interface
- Cognition & Communication
- Sustainable Energy
- Emerging Research
- Renewable Materials
- National Security
**Thrust Areas Populated**

<table>
<thead>
<tr>
<th>Nanoscale Science and Engineering</th>
<th>Environmental Nanoscience and Technology</th>
<th>Nanomaterials including carbonaceous materials</th>
<th>Nanosensors</th>
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<tr>
<td>Nano-Bio Interface</td>
<td>Targeted Delivery of Nano-medicine</td>
<td>Cellular Engineering Microsystems</td>
<td>Non-invasive Sensing and Diagnosis</td>
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<td>Inflammation</td>
<td>Bio-Imaging</td>
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<td>Sustainable Energy</td>
<td>Fuel Cells</td>
<td>Organic Photovoltaics</td>
<td>Biologically Derived Fuels</td>
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<td>Energy Harvesting</td>
<td>Clean Coal Energy</td>
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<td>Renewable Materials</td>
<td>Bio-based Materials: Design and Processing</td>
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<tr>
<td>Sustainable Water</td>
<td>Water Infrastructure Management</td>
<td>Sustainable Ecosystems and Urban Infrastructure</td>
<td>Water &amp; Health</td>
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<tr>
<td>Cognition and Communication</td>
<td>Cognitive Radio Networks</td>
<td>Autonomous Secure Communications</td>
<td>Human Computer Interface</td>
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<td>Homeland Security</td>
<td>Naval Surface Warfare Center Dahlgren Division (NSWCDD)</td>
<td>DARPA, NASA</td>
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<td>Emerging Research</td>
<td>Complex Network Systems</td>
<td>Accelerating Scientific Discovery through Data Mining</td>
<td>Personal Health Informatics</td>
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<td>Humanoid Hospital</td>
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ICTAS Center

ICTAS Targeted Investment

External funding

Seed monies

Competitive Reviews

ICTAS RFP
Laboratories and Collaborative Space

Bill Reynolds, NCFL Director
ICTAS A
Nanoscale Characterization and Fabrication Laboratory (9/2007). 31,496 sq. ft. that currently has 18 industrial collaborators and state of the art analytical equipment.

ICTAS HQ
Laboratories and Infrastructure: Collaborative Research Space

ICTAS- LSC
Due to open 1/2011 with 42,190 sq. ft. of research space to promote extended collaborations within Sustainable Water and Nano-bio Interface research.

ICTAS – NCR
ICTAS will be expanding into the National Capital Region facility in the Ballston, Virginia area. The seven-floor, 144,000 square foot building, designed by Cooper Carry to meet the Silver U. S. Green Building Council's LEED™ Building Rating Systems, will be located on the 800-900 block of North Glebe Road. ICTAS is committed to approximately 6,000 square feet in this facility. The anticipated construction completion date is 2011.
Nanoscale Fabrication: NT/Sphere Device
(B) Mechanical Testing

Direction of application of force
ICTAS – An agent of Innovation

- Interdisciplinary research
  - Recall “Buds of creativity bloom at intersections”
- Identify/ Recognize need
  - NBIC for sustainable growth
  - Thrust areas
- Match need with technical expertise
  - Interdisciplinary teams; 227 faculty
- Provide resources
  - NCFL, Collaborative space, financial resources
- Promote transformative thinking
  - The Black Swan Seminar Series

Results have far exceeded our expectations
Students and Faculty

- ICTAS Doctoral Scholars
- New Faculty Hires
- ICTAS Faculty Fellows
ICTAS Doctoral Program
ICTAS Doctoral Scholars Program Profile

- The ICTAS Doctoral Scholars Program was established in 2007.
- The program honors exceptional Ph.D. applicants through award of full financial support for the Ph.D. qualifying period (maximum of four years).
- Successful candidates of the highest caliber are selected for this honor.
ICTAS Doctoral Scholars Program Profile

- This program led and managed by ICTAS is a cooperative effort among participating departments, colleges, the Graduate School and ICTAS.
- The initial goal for the program is to establish a steady state of 40 ICTAS fellows by 2011 ad infinitum.
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<th>Year</th>
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<td>2010</td>
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<td>35</td>
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Jeremy Archuleta
Computer Science

Awards:

• Participant in Virginia Tech Synergy Lab team, named winner of the Storage Challenge award for "ParaMEDIC: Parallel Metadata Environment for Distributed I/O and Computing"

• Best undergraduate poster in the ACM Student Research Competition during the Supercomputing Conference 2009
S. Carter Fox
Wood Science and Forest Products

Awards:

M. Amin Karami
Engineering Science and Mechanics

Conferences and Workshops

• Presentation during Annual AIAA Structures and Structural Dynamics Conference 2009, May 3-8-2009, Palm Springs, CA

• Presentation during Power MEMS 2009, December 1-4, 2009, Silver Spring, MD

• Presentation during IMAC-XXVIII, February 1-4-2010, Jacksonville, FLA
Tila Khan
Biomedical Sciences and Pathobiology

Conferences and Workshops:

• Poster presentation during VMRCVM Research Symposium, November 20, 2009
Justin Lemkul
Biochemistry

Awards:

• 2009 - First place poster (student biomedical category), VCOM 6th Annual Research Recognition Day

• 2008 - Bruce M. Anderson award, outstanding first-year graduate student in Biochemistry
Qingqing Li
Wood Science and Forest Products

Publications:

• Layer-by-layer Nanoscale Bondlines for Macroscale Adhesion. Submitted to Bioresources, under revision for publication.

• Molecularly thin nanoparticles from cellulose: isolation of sub-microfibrillar structures. Cellulose, 16 (6): 1025-2032.
Marcel Remillieux
Mechanical Engineering

Awards:

• 2nd place at the Acoustical Society of America Student Poster competition, Raleigh, NC, March 30, 2007.

• 3rd place at the 2006 Young Engineer Paper contest organized by the ASME Fluids Division, Chicago, IL, November 5-10, 2006.
Jon Weekley
Horticulture
Matthew Williams
Statistics

Presentations:


Sihui Zhang
Biological Sciences

Awards:

1st place in poster award competition during 17th International C. elegans Meeting 2009, in the category of Morphogenesis for poster entitled "Isolation and Culture of Motile C. elegans Sex Myoblast Cells for High-resolution Microscopy"
Adam Bowman
Mathematics
Mehdi Ghommem
Engineering Science and Mechanics

Presentations:

• “Modeling Gust in Model Reduction Framework,” 62nd Annual Meeting of the APS Division of Fluid Dynamics, Minneapolis, Minnesota, 22-24 November

Matthew Steele-Macinnis
Geosciences

Presentations:

• Presentation during European Current Research on Fluid Inclusions 2009, September 20-October 1, 2009 in Granada, Spain

• Presentation during American Geophysical Union 2009 Joint Assembly, May 22-28, 2009, Toronto, CANADA
Syed Mazahir
Chemical Engineering

Publications:

• “Effect of Sparse Long-Chain Branching on the Step-Strain Behavior of a Series of Well-Defined Polyethylenes.” Polymer Engineering Science

• “Evaluation of the use of a Semi-Hyperbolic Die for Measuring Elongational Viscosity of Polymer Melts Donald G. Baird,”
Suwan Myung
Biological Systems Engineering

Publications:

• Myung S, Wang Y, and Zhang YHP. 2010, "Fructose-1,6-bisphosphatase from a hyper-thermophilic bacterium Thermotoga maritima: Characterization, metabolite stability, and its implications" (submitted/ revised)
Karthik Pillai
Wood Science and Forest Products
Thomas Rogers-Cotrone
Biomedicine and Veterinary Science
Noppadon Sathitsuksanoh
Biological Systems Engineering

Conferences:

• AIChE 2009 Annual Meeting. “Bamboo Saccharification by Cellulose Solvent- and Organic Solvent-Based Lignocellulose Fractionation Followed by Ultra Low Enzyme Concentration”.

Xiaoyue (Selina) Zhang
Industrial Systems Engineering

Conferences:

• Presentation during the HFES 53rd Annual Meeting, October 18-23, 2009, San Antonio, TX

• Presentation during the 17th Congress of the International Ergonomics Society, August 8-15, 2009, Beijing, China

• Presentation during the 21st Annual Conference of the International Society for Occupational Ergonomics and Safety, June 2009, Dallas, TX
Gregory James
Chemical Engineering
Jeong-ah Lee
Physics
Taylor Mach
Chemistry
Zhe Bao
Biological Sciences
Jung Ki Hong
Wood Science and Forest Products
Nathan Jones
Biological Systems Engineering
Konstantinos Krommydas
Computer Science
Sarah Phoebe Williams
Plant Physiology
Daniel Youngstrom
Biomedical and Veterinary Sciences
Concluding remarks
ICTAS is about satisfying our thirst for curiosity.

“The important thing is not to stop questioning. Curiosity has its own reason for existing.”

“The most incomprehensible thing about the world is that it is comprehensible.”
Dreams can *transform*.

- ICTAS is about creating and fulfilling dreams
  - a creative home for our faculty, staff, and students; a place where individuals can dream big and actually transform dreams to realize goals

- “Proceed in the direction of your dreams and you come across unprecedented happiness.”
  --Emerson
“We can't solve problems by using the same kind of thinking we used when we created them.”

-- Einstein

- Be creative
- Don’t be discouraged by the enormity of the task at hand
- Rome was not built in a day
- Build a chain- one link at a time or a bridge- one brick one at a time