Access to Space with Hypersonic Airbreathing Propulsion

Erik L. Axdahl, Ph.D.
Research Aerospace Engineer
NASA Langley Research Center

Greater Efficiency • Reusable Hardware • Launch from Runway
Instant environment perception from a mobile platform with a new generation geospatial database background

Csaba Benedek, Balázs Nagy and Zsolt Jankó
Institute for Computer Science and Control, Hungarian Academy of Sciences (MTA SZTAKI)
Supported by NKFI Grant #K-120233, #KH-125681

- 3D urban point cloud models for autonomous driving assistance
- HD map of the cities obtained by laser scanning
- Moving object detection in dynamic scenes
- Semantic HD map generation by segmentation of 3D point clouds

Riegl Mobile data collection system

Moving car, parking car, tram, pedestrian, tree crown, pole
Design of flexible composite materials for space applications
Alex Brinkmeyer

- Launching payload into space is expensive – more than $20,000/kg placed in orbit
- OSS are developing a range of deployable structures that are lighter, less complex, and more reliable than those in commercial demand
- A joint OSS - University of Bristol project aimed to develop understanding of flexible composites – OSS core technology for deployable structures
- Created a mathematical ‘toolkit’ to predict the performance of flexible composites and reduce product design lead time
- This supported the launch of OSS’ first deployable boom into space last year – setting a world record for the industry
Elena Chitanu

Materials Research for Photovoltaic Applications

General Information

National Institute for Research and Development in Electrical Engineering ICPE-CA, Bucharest, Romania

Research in the field of materials, including materials (ZnO, AZO, ITO) and technological aspects regarding the deposition (PVD, chemical) of thin films and surface functionalization (wet chemical etching, nanoparticles growth) for manufacturing organic and inorganic PV.

Material Advanced Department

The research areas of the department: achieving and characterization of materials and components for energy, components for electrical engineering, development of interdisciplinary research in surface functionalization and study of the interface properties, development of research on structural changes in massive materials and thin films and characterization of metallic, ceramic, magnetic, carbonic and polymeric materials.

http://www.icpe-ca.ro/
Nanoscale Materials Engineering

- ‘Bio-active’ photonic nanomaterials
- Solar energy harvesting
- Optical metamaterials
- Anti-counterfeiting
- Self-assembly
- Biosensors

DNA origami as self-assembly engineering platforms

Naked-eye protein binding detection

Molecularly assembled nanophotonics

Metasurfaces

Dual-color nano-pixels for ultra-high-res image encoding

awclarkresearch.com

@AWClarkResearch
Research Group:
Image analysis and computer graphics

Research areas:
- Computer vision – industry applications
- Image analysis – materials microstructure
- Medical image analysis – computer-aided diagnosis
- Remote sensing
- Computer graphics – rendering and geometric modeling

Materials science

Stereo vision

Biomedical imaging

Natural heritage
Lucia-Andreea EL-LEATHEY*

Experiments and Simulation Research Leading to Smart Use of Solar Power for Self Consumption

General Information

*National Institute for Research and Development in Electrical Engineering ICPE-CA, Bucharest, Romania

Department of Efficiency in Energy Conversion and Consumption
Laboratory of Renewable Energy Sources and Energy Efficiency

Research activities in the following fields: power engineering, renewable energy sources (photovoltaic systems, wind turbines), Smart Grid, energy efficiency, power quality in electrical systems, distributed grid-connected PV integration.

http://www.icpe-ca.ro/eng/index-eng.htm
SciosView™ leverages a comprehensive suite of capabilities providing customers with an affordable and effective sustainment solution across domains and weapon systems.

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- 30M+ Monthly Transactions Performed

**Christopher Geiger**

Engineering Director

Enterprise Sustainment Solutions

Lockheed Martin
Goal: Understand light propagation in disorder

(1) Improve optics with computing

(2) Improve computing with optics

Extract in-depth complex optical information

Zebrafish Brain (Betzig Lab)

High Performance Machine Learning
Hillhouse Research Group
at the nexus of nanomaterials and energy conversion

Printed Low Bandgap Chalcogenide Solar Cells

Printed High Bandgap Hybrid Perovskite Solar Cells

Combinatorial Methods & Optoelectronic Characterization

Printable Tandem Solar Cells

High Bandgap Top Cell

NIR

Low Bandgap Bottom Cell

UV

Energy (eV)

External Quantum Efficiency (%)
Infusion of Vision Systems into Planetary Landers

Andrew E. Johnson, Principal, Jet Propulsion Laboratory
MULTI-SCALE MANUFACTURING AND MODELING OF MATERIALS AND DEVICES

Leila Ladani
Professor, Mechanical and Aerospace Engineering
University of Texas at Arlington

MAnufacturing Innovation and Catalysis (MAGIC)
Advancing manufacturing at multiple scales
• Additive Manufacturing
• Nano-manufacturing

OUR VISION
• Impact the community through science and innovation

OUR MISSION
• To develop techniques for advanced multi-scale manufacturing of materials and devices
• To innovate methods, devices and techniques for advancement of humanity
Interaction Between Radiofrequency Fields and Biological Tissue in Magnetic Resonance: Challenges and Opportunities
Ultra-High Field Magnetic Resonance Imaging (≥ 7 Tesla)

Coil and model

EM field interactions

Distorted EM field

Challenges

Inhomogeneous image contrast

Inhomogeneous RF power deposition

Opportunities

Electrical properties ($\sigma$, $\varepsilon$)

$$\frac{\nabla^2 B_i^+}{B_i^+} \approx -i\omega \mu (\sigma - i\omega \varepsilon)$$

Riccardo Lattanzi

EU-US FOE

16-18 November, 2017
Solution based photovoltaics
Impact of atmospheric parameters on Multi-Junction Solar Cells
Spectral, Electrical and Thermal

Characterisation of Photovoltaic Power Generators

\[ I = I_{ph} - \frac{V + IR_s}{R_{sh}} - I_0 \left[ e^{\frac{V + IR_s}{nV_t}} - 1 \right] \]

Create a system of five non-linear equations to solve using exp. data

Integrated volumetric \( T_{int} \) vs. \( h_{conv} \) at AM 1.5D with different PW and AOD.
Mimicking Animal Vision with Computational Imaging

David Phillips
Affordable Space Technology for Sustainable Space

http://spacecraft.aalto.fi/
Intelligent Health Systems

- Parisa Rashidi, Assistant Professor, University of Florida
- Director of the Intelligent Health Lab (iHeal)
- Technical Area: Artificial Intelligence, Machine Learning
- Application Domain: Perioperative, ICU, Recovery
- Projects: Smart ICU, Intelligent Operating Room, Intraoperative Monitoring, Outpatient Monitoring
Single-Junction Perovskite Solar Cell

**Experiment**
- LM foil created by UV NIL
- 5% increase in $J_{SC}$ and PCE

**Optical simulations**
- Good matching with optical simulations (CROWM$^1$)
- 10% improvement with LM foil for large area devices

**Results**
- 11% increase in $J_{SC}$ and PCE
- Wider bandgap (1.73 eV) needed

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Meredith Sellers, Ph.D., P.E.
Managing Engineer, Materials & Corrosion Engineering

Investigating and understanding materials issues over a diverse range of industries:

- Oil and gas
- Microelectronics and integrated circuit fabrication
- Solar and wind energy
- Transportation and infrastructure

Assisting domestic and international clients in the litigation-support and product development arenas.

Providing clients with objective solutions for their important science, engineering, and business problems.
We engineer living, synthetic, ex vivo immune organoids to:

1. Model immune response to infectious threats and identify vaccine candidates
2. Understand complex immune cell processes (epigenetics)
3. Develop new immune-therapeutics
4. Treat malignant lymphomas, which are spawned from aberrantly mutated immune cells.
Photovoltaics

Modeling and simulation of SC and PV modules

Characterisation of SC and PV modules

Monitoring and analysis of PV modules and systems

Materials and Technologies
How to synthesize and use 2-dimensional porous nanosheets

Nature 543, 690-694 (2017)
Science 336, 1684-1687 (2012)
Science 334, 72-75 (2011)
Jean Vettel, PhD
jean.m.vettel.civ@mail.mil

Vision for 2040 & Beyond

Design systems that can dynamically adapt to individuals and improve performance
Computational Microscopy
Joint design of optical hardware and computer software for new imaging capabilities

1) Modify hardware

2) Crunch data

\[ \arg \min_{x,s} \| b - Ax \|^2 + f(x) \]

Nonlinear optimization algorithms for multi-dimensional inverse problems

3) Reconstruct images

Phase retrieval - visualizes shape/density of transparent samples

LED array illuminator

Gigapixel super-resolution

Phase amplitude

3D phase

amplitude

HeLa cancer cells

3D imaging

Laura Waller
UC Berkeley
Microbial Community Engineering
for Clean Water, Energy Generation, and Resource Recovery

George Wells
Northwestern University, Dept. of Civil & Environmental Engineering

Microbial Ecology

Sustainable Environmental and Public Health Protection and Resource Recovery from Urban Waste Streams

Website: wells.northwestern.edu
Additive Fabrication of Electronic Devices and Systems

Gregory Whiting
University of Colorado Boulder
Mechanical Engineering

Application areas include: health care, structural/environmental monitoring, energy generation/storage, robotics, waste reduction, and data security
Milos Zelezny  
senior researcher, associate professor, vice dean  
Pilsen, Czech Republic  

**MULTI-MODAL HUMAN-COMPUTER INTERACTION**  
Mainly audio-visual speech and sign language processing  

**INDUSTRIAL IMAGING**  
Applications: traffic sign recognition, visual feedback for a manipulator, logotype detection  

**MEDICAL IMAGING**  
Semi-automatic liver volumetry from CT data, shoulder range of movements analysis of patients against healthy subjects.